Does hospitalization impact survival after lower respiratory infection in nursing home residents


Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The initial treatment of nursing home residents with a lower respiratory infection (LRI) in hospital versus the nursing home. Initial treatment in hospital was defined as hospitalisation within 24 hours of evaluation, plus no treatment with antibiotics in the nursing home in the 2 days before evaluation. Initial nursing home treatment was defined as no hospitalisation within 24 hours of evaluation, or treatment with antibiotics in the nursing home 1 or 2 days before evaluation.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised nursing home residents with an LRI. Patients were diagnosed as having an LRI if they had at least 3 of the following signs and symptoms:

- new or increased cough;
- new or increased sputum production;
- fever of 38 degrees C (100.4 degrees F) or higher;
- pleuritic chest pain;
- at least one indication of a change in status or breathing difficulty (new or increased shortness of breath, respiratory rate \( \geq 26 \) minutes, worsening mental or functional status); and
- new or increased physical findings on lung examination (wheezes, crackles, rhonchi, bronchial breathing).

Residents were also included in the study if they had at least two of the above signs and symptoms, along with a chest X-ray interpreted as probable for pneumonia. To avoid misclassification of an exacerbation of congestive heart failure or chronic obstructive pulmonary disease as an LRI, residents with these diagnoses were required to have a probable infiltrate on chest X-ray or fever to be included in the analysis. Patients were excluded if they were on antibiotics for acute illness for 3 or more days before LRI symptoms.

Setting
The setting of the study was the hospital versus the nursing home. The economic study was conducted in Missouri, USA.
Dates to which data relate
The effectiveness evidence was derived from data collected from 1995 to 1998. Resource use referred to years 1997 and 1998. Although not explicitly stated, 1997 to 1998 prices were probably used.

Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
The costing was carried out, probably prospectively, on a sub-sample of patients participating in the effectiveness study. Patients enrolled after March 1997 were eligible for the economic analysis, whereas those enrolled earlier had incomplete economic data and were therefore excluded. Of the 1,409 episodes examined in the clinical study, 1,119 were eligible for the economic analysis. Eighty-seven of these were subsequently excluded because of missing or non-comparable cost data. This left 1,032 episodes for the cost analysis, 117 (11.3%) initially treated in the hospital and 915 (88.7%) initially treated in the nursing home.

Study sample
No power calculations were performed. The study sample was selected from nursing home residents with symptoms compatible with LRI from August 1995 to September 1998. Out of 2,592 episodes with potential LRI, 1,409 met the inclusion criteria. For 3 episodes in which residents were enrolled twice within 30 days and subsequently died, only the first episode was counted. Of the remaining 1,406 episodes, 198 (14.1%) were initially treated in the hospital and 1,208 (85.9%) were initially treated in the nursing home. The initial study sample was probably appropriate for the clinical study question, but there was no evidence in support of this.

Study design
This was a prospective cohort study that was conducted in 36 nursing homes in Missouri, USA. The follow-up period lasted 30 days after evaluation, or less if the patients died. No loss to follow-up was reported. The study was part of a larger study of nursing home residents with an LRI, the Missouri Lower Respiratory Infection Project (Missouri LRI Project). The methods used in this project have been described in detail in two studies by Mehr et al. (see 'Other Publications of Related Interest' below for bibliographic details).

Analysis of effectiveness
In an attempt to mirror an intention to treat analysis of randomised trials, costs and outcomes were attributed to the initial treatment setting. The primary health outcome used in the analysis was the 30-day mortality from LRI. The groups were not comparable at baseline. In particular residents initially hospitalised were more likely to be male, black, younger, sicker, have more co-morbidities, have been recently hospitalised, have a physician with a higher than average hospital census, or be located in an urban facility. However, a propensity score was estimated in order to take pre-treatment differences between groups into consideration. The propensity score eliminated most of the differences between patients treated in the two locations. Further details of the method used to estimate the propensity score are given in the 'Modelling' section.

Effectiveness results
Mortality was 24.7% for episodes initially treated in the hospital, and 13.1% for episodes initially treated in the nursing home.

Before controlling for other factors, patients initially treated in the hospital appear to have been twice as likely to die within 30 days of evaluation as residents treated in the nursing home (odds ratio, OR=2.19, 95% confidence interval, C): 1.52 - 3.14).

After controlling for treatment site, illness severity and propensity of being hospitalised, mortality was not significantly
related to initial treatment in the hospital (OR 0.89, 95% CI: 0.52 - 1.52).

Similar results were obtained from the stratified analysis. After controlling for mortality risk and initial hospitalisation risk across strata, there was no association between 30-day mortality and initial treatment setting (OR 1.0, 95% CI: 0.64 - 1.57).

The mortality rates were comparable between those initially treated in the nursing home and in the hospital within each quintile of hospitalisation risk. Both increased as the risk of hospitalisation increased.

Clinical conclusions
After controlling for illness severity and propensity to be hospitalised, the site of initial treatment (i.e. the hospital versus the nursing home) had no significant effect on the risk of mortality in a nursing home population with LRI.

Modelling
A propensity model was used to account for systematic biases and confounders likely to have arisen because of the lack of patient randomisation. A propensity score was estimated from a logistic regression model of initial hospitalisation. The authors considered the relationship of initial hospitalisation with a wide range of potential predictor variables (demographic factors, vital signs, co-morbid conditions, cognitive status, nutrition indicators, and facility and physician characteristics). The final hospitalisation model included 19 variables, such as various acute illness indicators, recent hospitalisation, the physician's average hospital census and younger resident age. The model coefficients were used to calculate a propensity score for each episode, representing the probability of initial hospital treatment.

To examine both mortality and cost, the authors used a 30-day mortality model to control for illness severity. This contained eight variables. Further details of the model were provided in Mehr et al. 2001 (A) (see ‘Other Publications of Related Interest’ below for bibliographic details). The way in which initial hospitalisation affected mortality was examined using two different methods. First, the authors estimated a logistic regression that included a dichotomous variable representing initial hospitalisation, a variable representing the risk of hospitalisation (propensity score), and the eight variables from the mortality model. This method allowed the testing of whether hospitalisation was significantly related to mortality after controlling for variables associated with illness severity and for the probability of initial hospitalisation. Second, the authors performed a stratified analysis to determine whether the effects of hospitalisation were uniform over the range of mortality risk. Episodes were separated into strata (quintiles) based on their propensity score. The mortality rates between initially hospitalised and non-hospitalised patients within strata were then compared.

Measure of benefits used in the economic analysis
The results of the clinical study showed no difference in effectiveness between the two interventions assessed. Therefore, the economic analysis was based on cost-differences only (i.e. cost-minimisation analysis).

Direct costs
The direct costs comprised medical costs only. Costs incurred during the 30-day period following the diagnosis of an LRI (or until the patient's death, when a patient died within this period) were estimated. The costs included the following categories of services:

- room and board, in all settings;
- hospital and associated transportation costs;
- laboratory and radiology services;
- physician and nurse practitioner visits;
- medications likely related to treating pneumonia or its complications;
intravenous fluid therapy;

oxygen therapy;

physical, occupational and speech therapy.

The costs and the quantities were not analysed separately. Estimates of resource use were derived from actual data obtained in 1997 and 1998, from a sub-sample of patients participating in the cohort study. The unit costs were based on Medicare and Medicaid rates, as well as national published sources. To estimate the hospital costs, billed charges were multiplied by the appropriate cost-to-charge ratio.

It was stated that in order to examine cost-differences between the interventions, a model was used to control for illness severity, but no further details were provided. The costs were presented as the mean costs per patient. Discounting was not necessary, as the costs referred to a 30-day period, and was not undertaken. Although not explicitly stated, 1997 to 1998 prices were probably used.

**Statistical analysis of costs**

No statistical analysis of the costs was undertaken.

**Indirect Costs**

The indirect costs were not included in the analysis.

**Currency**

US dollars ($).

**Sensitivity analysis**

No sensitivity analysis was undertaken.

**Estimated benefits used in the economic analysis**

See the 'Effectiveness Results' section.

**Cost results**

The average episode cost was $10,408 per patient for initial treatment in the hospital and $3,789 per patient for initial treatment in the nursing home.

The daily cost per patient was also estimated because not all patients survived to 30 days. This was $419.75 for patients initially hospitalised and $138.24 for patients initially treated in the nursing home.

No results of any statistical analysis of the costs were provided.

**Synthesis of costs and benefits**

Not applicable. Since the two interventions assessed were demonstrated to be equally effective, the study was a cost-minimisation analysis.

**Authors' conclusions**

After controlling for illness severity and probability of hospitalisation, the initial location for the treatment of nursing home residents with a lower respiratory infection (LRI) did not appear to be related to risk of mortality. For residents with a low or medium risk of mortality, nursing home treatment was likely to be safe and less costly.
CRD COMMENTARY - Selection of comparators

Although no explicit justification for the selection of the comparator was given, it seems that initial treatment in hospital represented standard care in many settings. Initial treatment in the nursing home was an alternative practice, which was likely to reduce the cost as well as risk of complications associated with the hospitalisation of nursing home residents diagnosed with a LRI. You should consider whether any of these interventions reflect standard practice in your own setting.

Validity of estimate of measure of effectiveness

The analysis was based on a prospective cohort study. The authors acknowledged that this study design was likely to introduce bias in the estimated treatment effects. For this reason they used a propensity score to control for pre-treatment differences between the groups that might confound the results of the analysis. The study sample was likely to be representative of the patient population. The patient groups were not comparable at baseline, although the calculated propensity score eliminated most of the differences between the groups. The authors acknowledged, as a major limitation of the analysis, the remaining potential for unmeasured confounding because of a lack of randomisation. Another limitation of the effectiveness analysis was that no power calculations were reported. Hence, the study might have had insufficient power to detect differences in outcomes between the two groups.

Validity of estimate of measure of benefit

The analysis of benefits was based upon the therapeutic equivalence of the treatment alternatives. The economic analysis therefore included only costs.

Validity of estimate of costs

Although not explicitly stated, it was likely that a health service perspective was adopted. All the categories of cost relevant to this perspective were included in the analysis. The costs and the quantities were not reported separately, and this may hinder the reproducibility of the results. It was stated that in order to examine cost-differences between the interventions, a model was used to control for illness severity. However, no further details of this model were provided. The costs were presented as the mean cost per patient. No further statistical analysis of the costs was undertaken.

The costs were estimated for a sub-sample of the patient population for whom data were available, and this might have introduced systematic bias into the analysis. In addition, it was reported that the exclusion of 87 episodes from the cost analysis might have made the cost estimates less precise. Since all the costs were incurred over 30 days, discounting was unnecessary and was not applied. In cases where billed charges were used, these were multiplied by the appropriate cost-to-charge ratio in order to estimate the health service costs. The date to which the prices referred was not explicitly reported, but it can be inferred from the data provided. This improves the generalisability of the results.

Other issues

The authors made appropriate comparisons of their findings with those from other studies. The issue of generalisability to other settings was not addressed. The authors did not use sensitivity analyses to investigate the robustness of their results. The results of the analysis were adequately reported. The authors’ conclusions reflected the scope of the analysis. The authors reported several limitations to their study, which have been highlighted already.

Implications of the study

The authors suggested that nursing home residents with an LRI and at moderately high risk of hospitalisation could be treated in the nursing home without increased mortality risk. However, it was acknowledged that, should the reduction of hospitalisation rates for LRI be a goal, some nursing homes might require better physician availability, higher staff-to-resident ratios, and more staff with advanced training to address this issue. The authors recommended that the treatment of ill nursing home residents starts with a well-defined care plan, with the treatment goal (e.g. cure, palliation) clearly outlined. The decision on hospitalisation should then be based upon whether aggressive therapy is compatible with the treatment goals and the availability of appropriate care. In some cases, it was recommended that attention be...
shifted from curative to comfort care. Finally, the authors highlighted the need for more research on approaches to improve care for acute illnesses in nursing home residents who are close to the end of their life.

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**Other publications of related interest**


**Indexing Status**
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Aged; Aged, 80 and over; Cohort Studies; Confidence Intervals; Female; Geriatric Assessment; Homes for the Aged /economics /statistics & numerical data; Humans; Length of Stay /economics; Logistic Models; Male; Middle Aged; Missouri /epidemiology; Nursing Homes /economics /statistics & numerical data; Odds Ratio; Outcome Assessment (Health Care); Pneumonia, Bacterial /economics /mortality /therapy; Prospective Studies; Risk Assessment; Severity of Illness Index; Survival Analysis; Time Factors

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