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Clinical and economic choices in the treatment of respiratory infections in cystic fibrosis: Comparing hospital and home care

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Abstract

Background: A cost-effectiveness evaluation comparing home-based and hospital-based treatment with intravenous antibiotics for respiratory exacerbations in adults with cystic fibrosis (CF) has not been previously undertaken.
Methods: The study was conducted in a UK adult CF centre from a health service perspective. Clinical outcome and resource use data were obtained from a retrospective one-year study and combined with unit cost data in an incremental economic analysis. The primary outcome measure was percentage change in FEV_1; "effectiveness" was defined as maintenance of baseline average FEV_1 over the one-year study period.
Results: 116 patients received 454 courses of intravenous antibiotics. At the end of 1 year, there had been a mean percentage decline in FEV_1 compared with baseline average for home-treated patients but an improvement for hospital-treated patients (Tukey's HSD mean difference 10.1%, 95% CI 2.9 to 17.2, $p=0.003$). Treatment was deemed "effective" in more hospital (58.8%) than home (42.6%) patients. The cost of hospital treatment was higher than home treatment (mean difference £9005, 95% CI 3507 to 14,700, $p<0.001$). The mean ICER was £46,098 (2.5th and 97.5th percentiles −374,044 and 362,472).
Conclusions: Hospital treatment was more effective but more expensive than home treatment. Potential methods to improve outcome at home should be considered but these may have resource implications.

Keywords: Cost-effectiveness; Respiratory infection; Home therapy; Cystic fibrosis

1. Introduction

In the United Kingdom, 28 million working days are lost because of respiratory illness every year and the respiratory death rate is twice the European average, at 105 per 100,000 people [1]. Data from 196 patients attending the Manchester CF Unit showed that in 2003, 113 patients were attending work or school but 1799 days were lost because of sickness. Despite this, respiratory disease is not prioritised like heart disease or cancer and has no National Service Framework. Effective management of chronic lung disease would reduce the huge burden it places on the National Health Service and patients, but needs to be evidence-based, better resourced and supported by Government policy. The resultant lack of standardised approaches to care or policy-driven initiatives mean that resources are not directed strategically to respiratory programmes and not all patients are treated optimally. This is apparent in treatment of infective episodes in adults with cystic fibrosis (CF) where patient outcome is influenced by the approach to, and site of, care [2].

Adults with CF experience repeated infective respiratory exacerbations leading to continued decline in lung function [3]. Eventually, death results from respiratory failure [4]. Standard treatment for exacerbations is intravenous antibiotics, which may be administered in hospital or at home. Home treatment is well established in the UK [5], because of both the lack of inpatient beds and patient preference. The

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cited advantages of home treatment are: reduced risk of cross-infection, less time off work or school, improved quality of life, and reduced costs for the healthcare provider [6].

We have examined the clinical outcome of patients receiving intravenous antibiotics [7]. There were greater improvements in lung function and nutrition among hospital-treated patients compared with home-treated patients; these differences in outcome were apparent after one course of intravenous antibiotics and were maintained after one year of treatment. However, it could be expected that treatment in hospital would result in higher costs to the health service because of, for example, the cost of hospital accommodation. Would the improved outcome after hospital treatment justify the increased costs that are required compared with home treatment? Therefore, the aim of this study was to compare the cost-effectiveness of home and hospital treatment with intravenous antibiotics over both one course and one year of treatment in adults with CF.

2. Patients and methods

2.1. Study design

The retrospective, observational, one-year pragmatic study was conducted in the Manchester Adult CF Centre, a specialist centre which treats approximately 220 adults with CF per year. Ethics approval was obtained and patients were informed of the study. The study recruited all adult patients ($\geq$16 years) with confirmed CF who experienced at least one respiratory exacerbation (defined as an increase in lower respiratory tract symptoms requiring treatment with intravenous antibiotics) during the one-year study. Patients were excluded if they received intravenous antibiotics for conditions other than respiratory infections or if they received treatment at other hospitals (shared care).

2.2. Allocation to treatment groups

The study was analysed on an intention-to-treat basis. The site of home or hospital treatment for each individual course of treatment had been decided prospectively after discussion between the treating physician (AKW) and the patient. This was based on the severity of the presenting clinical symptoms and the competency of the patient to administer intravenous antibiotics but was ultimately the choice of the patient. In the study, courses of intravenous antibiotics were categorised retrospectively by an independent investigator (JT) according to where treatment had been started (regardless of any changes partway through the course). Thus, courses where treatment had been started at home were defined as home courses and courses where treatment started in hospital were defined as hospital courses. Patients were then allocated retrospectively to treatment groups according to where they received most treatment over one year. Although some patients had received all their treatment either at home or in hospital, other patients received almost equal amounts of home and hospital treatment over the one-year study period. Therefore, a pragmatic method of categorisation was used: "home" patients were those in whom the intention had been to treat at home in >60% of courses and who, therefore, had received most of their treatment at home; "hospital" patients were those in whom the intention had been to treat in hospital in >60% of courses and who, therefore, had received most of their treatment in hospital; and "both" patients were those in whom the intention had been to treat in hospital or at home in 40–60% of courses and thus who had received almost equal amounts of home and hospital treatment.

2.3. Outcome

The primary clinical outcome variable was forced expiratory volume in 1 s (FEV_1). For home treatment, spirometric testing was performed at the start and end of each course of intravenous antibiotics. In hospital, spirometric testing was performed at admission, twice weekly, and at discharge. Two baseline FEV_1 values were established in each patient for the one-year baseline period which preceded the one-year study period. The "best" FEV_1 was the highest FEV_1 during the baseline year and the "average" FEV_1 was the mean of all FEV_1 values recorded during that period. The percentage of predicted FEV_1 for a healthy subject of the same age, height and sex was calculated for both values [8].

2.3.1. Clinical effectiveness of treatment courses

FEV_1 was recorded for the start and end of each course of antibiotics. The outcome after a single course of treatment was a comparison with baseline "best" FEV_1 and, for each course, the percentage change from baseline "best" to the end of the course was calculated. For the economic evaluation, a definition of effectiveness of treatment was needed. In practice, the main aim of treatment with antibiotics is to achieve and maintain the patient's best lung function. Therefore, a course of treatment was defined as "effective" if lung function was maintained at baseline "best", that is, the percentage decline in FEV_1 was $\leq$0%.

2.3.2. Clinical effectiveness over one-year study period

For the one-year study period, the final FEV_1 was recorded as the last value of the last course at the end of this period. Over time, however, the mean baseline value may more accurately represent the patient's everyday condition. Therefore, the outcome after 1 year was a comparison with baseline "average" FEV_1 (percentage change in FEV_1 from baseline "average" to final). For the economic evaluation, treatment over the study period was defined as "effective" if lung function was maintained at baseline "average", that is, the percentage decline in FEV_1 was $\leq$0%. However, because the natural history of CF is characterised by a continued decline in lung function, this requirement for no decline from baseline lung function over 1 year may be unrealistic [3].