Longitudinal change in quality of life following hospitalisation for acute exacerbations of COPD

John Steer,1 G John Gibson,2 Stephen C Bourke1,2

ABSTRACT

Background: Current guidelines for management of patients hospitalised with acute exacerbations of chronic obstructive pulmonary disease (COPD) recommend that clinical decisions, including escalation to assisted ventilation, be informed by an estimate of the patients’ likely postdischarge quality of life. There is little evidence to inform predictions of outcome in terms of quality of life, psychological well-being and functional status. Undue nihilism might lead to denial of potentially life-saving therapy, while undue optimism might prolong suffering when alternative palliation would be more appropriate. This study aimed to detail longitudinal changes in quality of life following hospitalisation for acute exacerbations of COPD.

Methods: We prospectively recruited two cohorts (exacerbations requiring assisted ventilation during admission and exacerbations not ventilated). Admission clinical data, and mortality and readmission details were collected. Quality of life, psychological well-being and functional status were formally assessed over the subsequent 12 months. Time-adjusted mean change in quality of life was examined.

Results: 183 patients (82 ventilated; 101 not ventilated) were recruited. On average, overall quality of life improved by a clinically important amount in those not ventilated and did not decline in ventilated patients. Both groups showed clinically important improvements in respiratory symptoms and an individual’s sense of control over their condition, despite the tendency for functional status to decline.

Conclusions: On average, postdischarge quality of life improved in non-ventilated and did not decline in ventilated patients. Certain quality of life domains (ie, symptoms and mastery) improved significantly. Better understanding of longitudinal change in postdischarge quality of life should help to inform decision-making.

KEY MESSAGES

▸ Predictions of subsequent quality of life influence important treatment decisions. This is the first study to describe, in detail, longitudinal changes in quality of life following hospitalisation for COPD exacerbations and demonstrates that, in the majority of patients, quality of life either improves or does not significantly decline.

▸ Following hospital discharge, most quality of life domains took 3 months to recover to baseline levels. Individuals’ activity levels tended to decline following discharge but the reduction was not clinically significant.

▸ Quality of life was recorded using multiple validated tools to ensure that all aspects of an individual’s quality of life and functional status were assessed.

▸ Previous studies have shown prognostic nihilism is common and non-invasive ventilation is underused in this population. These results should help to inform both clinicians and patients when making important clinical decisions about the appropriateness or otherwise of escalating treatment when the patient’s condition potentially warrants it.

BACKGROUND

Acute exacerbations of chronic obstructive pulmonary disease (AECOPD) are often accompanied by a decline in an individual’s quality of life (QoL). ▸ While recovery following AECOPD managed without hospital admission may be unpredictable and prolonged, the time course of recovery following hospitalisation for AECOPD has been infrequently studied and requires clarification.

Clinical guidelines recommend that patients whose QoL is “unlikely to recover to an acceptable level” should not receive assisted ventilation when otherwise indicated. Implicit in this statement is an assumption that both clinicians and patients can make a reasonable estimate of what an individual’s QoL and functional status will be if they survive the acute admission. However, evidence on this point is sparse, with only a single longitudinal study, which suggested that QoL measurements may continue to recover for up to 9 months following hospital discharge.

Despite the prognostic uncertainty, some patients do not receive assisted ventilation because either they or their clinicians expect
their QoL and/or functional status to be unacceptably poor following hospital discharge. Nava et al6 surveyed end-of-life decision-making in respiratory critical care units across Europe and rated the reasons for withholding or withdrawing treatment on a scale of 1 (most important) to 10 (least important). They showed that predictions of a poor QoL following discharge (specifically, a poor predicted functional status or assumption by the patient that their QoL postdischarge would be unacceptable) were between the second and fourth most common reasons for limiting treatment. As recommended, therefore, important treatment decisions are being made on the basis of clinicians’ and patients’ predictions of post-discharge QoL and functional status with very little evidence that such predictions are accurate.

In order to clarify the long-term effects on QoL of hospitalisation for AECOPD, we have performed sequential assessments of surviving patients, both those who required and did not require assisted ventilation, over 12 months following discharge.

‘Quality of life’ is a broad multidimensional concept which includes evaluation of both positive and negative aspects of life.9 Psychological well-being, functional status, general health-related QoL (HRQoL) and respiratory-specific HRQoL are all domains of overall QoL. The definitions of these domains vary in the literature and there is terminological confusion. The assessment tools used in this study aim to evaluate each of these domains individually but they will also be influenced by general changes in individuals’ lives (eg, bereavement, unemployment, medical conditions). Consequently, due to terminological uncertainty and the lack of specificity of the individual tools, we have chosen to use the general term ‘quality of life’ to describe the changes in HRQoL, psychological well-being and functional status that participants experienced.

**METHODS**

Patients admitted to two neighbouring hospitals between December 2008 and September 2010 with an acute exacerbation of COPD, and who survived to discharge, were eligible. Participants were approached prior to hospital discharge and written consent obtained. We aimed prospectively to recruit approximately equal numbers of patients with AECOPD who (A) required assisted ventilation for acidaemic respiratory failure (at any point during hospital stay) and (B) did not need ventilation. To ensure that the recruitment rates of the two groups followed comparable timeframes, over each 2-week period all admissions since the last assessment (including whether assisted ventilation was required) and the length of hospital stay for each admission. At each visit, the St George’s Respiratory Questionnaire (SGRQ),13 Chronic Respiratory Disease Questionnaire (CRQ),14 Nottingham Extended Activities of Daily Living Scale (NEADL)15 and Hospital Anxiety and Depression Scale (HADS)16 were administered. The period of recall for each questionnaire was 1 month. A summary of these tools, and the accepted minimum clinically important differences (MCIDs), is shown in table 1. Any significant medical developments since the previous assessment were also documented. If a patient had died in the interim: date of death; place of death and cause of death were collected.

Variable distribution was assessed by visual inspection of the histogram. Descriptive statistics were used to characterise the patient sample, using proportions, means with SDs or medians with IQRs, where appropriate.
Bivariate comparisons were performed using Fisher’s exact test, Student t test and Mann-Whitney U test as appropriate. Mortality data were examined using Kaplan-Meier survival analysis, with groups compared by the log-rank test. Methods used to handle missing QoL data are described below. Missing admission clinical data were uncommon: five patients in the non-ventilated group had no ABG recorded. Where necessary, data were imputed using the expectation-maximisation algorithm based on our larger (n=920) cohort.

The peak (ie, best) QoL score during follow-up was chosen to represent the time at which QoL had recovered from its baseline level. The mean time between baseline and ‘best’ QoL described the average recovery time following hospital discharge. In order to obtain a global assessment of QoL change over time, we calculated the time-weighted mean changes (Δ) during the follow-up period (see online supplementary figure E1). These were compared to the MCID for the relevant questionnaire (table 1) to estimate whether, on average, an individual’s QoL changed by a clinically significant amount.

We have assumed that the change in QoL between assessments was related to time in rectilinear fashion. If a participant failed to attend a follow-up appointment but their QoL was recorded at the next scheduled visit, a time-adjusted average was imputed for the missing value by assuming a linear change between the two data points either side of the missing assessment. If no follow-up visits were attended, the individual was excluded from analyses of longitudinal QoL data. Similar to previous studies, for each questionnaire (except HADS), death was equated to the score representing the worst QoL, and if a patient died during follow-up, a linear decrease in QoL was assumed from the value at the last assessment to the time of death.

**RESULTS**

Of the 183 patients recruited, 82 received assisted ventilation. During the period of the study, only 6.6% of patients with COPD exacerbations who developed respiratory acidemia and did not improve with standard management either refused or were judged unsuitable for assisted ventilation. Compared with non-ventilated patients, ventilated patients had more severe background COPD and a more severe exacerbation (ventilated patients were more likely to: have previously received assisted ventilation; have lower mean FEV1; % predicted; have worse stable-state dyspnoea and have been prescribed long-term oxygen therapy); and were more likely to be female (table 2).

At the time of hospital discharge, ventilated patients reported that, prior to hospitalisation, they had less severe respiratory symptoms (lower SGRQ symptom domain, p=0.021), but their respiratory symptoms had a greater impact on their emotional function (lower CRQ emotional function domain, p=0.061) and they reported lower levels of activity (lower NEADL, p<0.001). There were, however, no other differences in QoL (measured using either SGRQ or CRQ) or symptoms of anxiety or depression between the two patient groups.

Most patients (n=130, 71%) were rehospitalised during the 12-month follow-up period (median (IQR) readmissions=1 (0–3), range 0–15). In total, 157 (86%) patients reported at least one episode of AECOPD during follow-up (median (IQR) AECOPD=3 (1–6), range 0–15). Ventilated patients were more likely to be readmitted and spent more days in hospital during the 12 months following discharge (table 3). Thirty-five (19%) patients died during follow-up: mortality was non-significantly higher in ventilated compared with non-ventilated patients (23.2% vs 15.8%; log-rank p=0.20; figure 1).

For the whole population (n=183), at the time of hospital discharge, lower self-reported functional status was associated with higher 12-month mortality (mean (SD) SGRQ activity=77.9 (16.3) in survivors vs 85 (12.8) in non-survivors, p=0.021; and median (IQR) NEADL=38 (28–45) vs 28 (14–37), p<0.001). Mortality was also non-significantly higher in patients with higher scores in the SGRQ impacts and HADS depression domains (p=0.071 and 0.082, respectively; see online supplementary table E1). Lower self-reported functional status (SGRQ activity and NEADL) was significantly associated with higher rates of hospital readmission (p=0.012 and p<0.001, respectively; see online supplementary table E2).

Of 732 potential outpatient follow-up assessments, 67 (9%) visits were not attended: complete follow-up of longitudinal QoL data was available on 152 patients patients.
Online supplementary figure E2 shows details of follow-up attendance during the study. Seven patients did not attend any follow-up appointments following hospital discharge and were therefore excluded from longitudinal QoL analysis.

Most QoL measures peaked at 3 months following discharge, with the exception of activity levels (measured using NEADL and SGRQ activity) which peaked after 6 weeks. For all measures of QoL, except those measuring patient activity (SGRQ activity domain and NEADL), a quarter of patients took 6 months or longer to fully recover (ie, reach their peak QoL). The time course of QoL recovery was statistically similar between ventilated and non-ventilated patients.

In non-ventilated patients, compared with their reported status at discharge, most patients experienced: improved overall QoL (ΔSGRQ total=−4.55 (MCID=±0.5)); improved respiratory symptoms during the year of follow-up (ΔSGRQ symptoms=−11.8 (MCID=±4)); less impact of their disease on their QoL (ΔSGRQ impacts=−5.36 (MCID=±0.5)); improved sense of control over their condition (ΔCRQ mastery=0.87 (MCID=±0.5)); and less anxiety (ΔHADS anxiety=−1.70 (MCID=±1.5)). Non-ventilated patients’ activity levels worsened during the 12-month follow-up (ΔSGRQ activity=0.60 and ΔNEADL=−2.69) although these changes were not clinically significant (table 4). On average, for ventilated patients, overall QoL did not decline following discharge (ΔSGRQ total=0.05) and their respiratory symptoms (ΔSGRQ symptoms=−4.80) and sense of control over their condition (ΔCRQ mastery=0.66) improved by a clinically important amount.

### Table 2: Comparison of characteristics, admission findings and baseline QoL of ventilated and non-ventilated patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Ventilated (n=82)</th>
<th>Non-ventilated (n=101)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>69.3 (9.2)</td>
<td>68.7 (8.8)</td>
<td>0.63</td>
</tr>
<tr>
<td>Female (%)</td>
<td>67.1</td>
<td>51.5</td>
<td>0.036</td>
</tr>
<tr>
<td>Hospitalisations in previous year (median, IQR)</td>
<td>0 (0 to 2)</td>
<td>0 (0 to 1)</td>
<td>0.52</td>
</tr>
<tr>
<td>Previously received assisted ventilation (%)</td>
<td>41.5</td>
<td>9.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Previous pulmonary rehabilitation (%)</td>
<td>14.6</td>
<td>18.8</td>
<td>0.55</td>
</tr>
<tr>
<td>FEV₁% predicted</td>
<td>36.8 (18.3)</td>
<td>42.9 (16.1)</td>
<td>0.018</td>
</tr>
<tr>
<td>eMRCD (median, IQR)</td>
<td>4 (4 to 5a)</td>
<td>4 (3 to 4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cor pulmonale (%)</td>
<td>18.3</td>
<td>6.9</td>
<td>0.023</td>
</tr>
<tr>
<td>LTOT (%)</td>
<td>30.5</td>
<td>5.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Charlson Comorbidity Index (median, IQR)</td>
<td>1 (1 to 2)</td>
<td>2 (1 to 2)</td>
<td>0.14</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.4 (7.2)</td>
<td>25.9 (6.8)</td>
<td>0.62</td>
</tr>
<tr>
<td>CXR consolidation (%)</td>
<td>28.0</td>
<td>28.7</td>
<td>1</td>
</tr>
<tr>
<td>pH (median, IQR)</td>
<td>7.29 (7.24 to 7.34)</td>
<td>7.43 (7.39 to 7.47)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>pO₂, kPa (median, IQR)</td>
<td>8.4 (6.6 to 12.2)</td>
<td>8.3 (7.2 to 10.0)</td>
<td>0.98</td>
</tr>
<tr>
<td>pCO₂, kPa (median, IQR)</td>
<td>9.3 (7.6 to 11.6)</td>
<td>5.3 (4.9 to 6.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>10 (7 to 15)</td>
<td>7 (4 to 11)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DECAF (median, IQR)</td>
<td>2 (1 to 2)</td>
<td>1 (0 to 2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Discharge QoL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SGRQ*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>65.2 (49.3 to 80.9)</td>
<td>71.5 (60.7 to 83.0)</td>
<td>0.026</td>
</tr>
<tr>
<td>Activity</td>
<td>82.9 (72.7 to 92.5)</td>
<td>85.8 (66.8 to 92.5)</td>
<td>0.97</td>
</tr>
<tr>
<td>Impacts</td>
<td>50.3 (38.1 to 68.8)</td>
<td>51.1 (36.0 to 62.9)</td>
<td>0.64</td>
</tr>
<tr>
<td>Total</td>
<td>62.5 (51.9 to 73.6)</td>
<td>63.1 (52.3 to 73.5)</td>
<td>0.94</td>
</tr>
<tr>
<td>CRQ†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>2.8 (2.2 to 3.8)</td>
<td>2.8 (2 to 4)</td>
<td>0.57</td>
</tr>
<tr>
<td>Emotional function</td>
<td>2 (1.3 to 3)</td>
<td>3.7 (2.7 to 4.8)</td>
<td>0.061</td>
</tr>
<tr>
<td>Fatigue</td>
<td>3.3 (2.1 to 4.9)</td>
<td>2.5 (1.8 to 3.2)</td>
<td>0.17</td>
</tr>
<tr>
<td>Mastery</td>
<td>2.8 (2 to 4.1)</td>
<td>3.3 (2.3 to 4.5)</td>
<td>0.14</td>
</tr>
<tr>
<td>HADS*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>8.5 (4 to 14)</td>
<td>8 (4.5 to 12.5)</td>
<td>0.35</td>
</tr>
<tr>
<td>Depression</td>
<td>6 (3 to 10)</td>
<td>6 (3 to 8)</td>
<td>0.50</td>
</tr>
<tr>
<td>NEADL†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>31 (19 to 41)</td>
<td>38 (32 to 47.5)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Values quoted are mean (SD) unless otherwise stated.

*Lower scores indicate better QoL.
†Higher scores indicate better QoL.

BMI, body mass index; CRQ, Chronic Respiratory Disease Questionnaire; DECAF, Dyspnoea, eosinopenia, consolidation, acidosis, atrial fibrillation prognostic score; FEV₁, forced expiratory volume in 1 s; HADS, Hospital Anxiety and Depression Scale; NEADL, Nottingham Extended Activity of Daily Living Scale; SGRQ, St George’s Respiratory Questionnaire; QoL, quality of life.
Non-ventilated patients had a statistically significantly greater improvement in overall QoL (SGRQ total, p=0.019) and respiratory symptoms (SGRQ symptoms, p=0.017) than those ventilated. Furthermore, the impact of their respiratory disease (SGRQ impacts) improved significantly more in non-ventilated patients (p=0.024; table 4). There were no differences in ΔCRQ, ΔHADS or ΔNEADL between the two groups, although non-ventilated patients showed a trend towards greater improvement in activity-specific breathlessness (CRQ Dyspnoea, p=0.11).

In approximately 70% of those ventilated, symptoms and overall QoL improved or remained static following discharge. In non-ventilated patients, overall QoL clinically improved in the majority and only 24% experienced a clinically significant decline following discharge (table 5).

Within the whole population (n=176), compared with those who were not readmitted during follow-up, readmitted patients had significantly less improvement in QoL for all measures except those assessing depressive symptoms (mean change in HADS depression, p=0.50). There were no significant relationships between self-reported exacerbation frequency during follow-up and mean change in QoL (see online supplementary table E3).

**DISCUSSION**

Most patients admitted to hospital with AECOPD did not experience an overall decline in QoL during follow-up, and in certain domains (disease-specific symptoms, mastery of their condition and anxiety levels), QoL improved by a clinically important amount (table 4). In addition, QoL of patients treated with assisted ventilation was, on average, stable or improved during follow-up. The QoL of patients readmitted within 12 months of discharge was significantly poorer than that of those who were not readmitted, but even among readmitted patients, QoL did not decline on average. QoL recovers slowly following discharge with, on average, most QoL domains taking 3 months to recover. Therefore, despite a poor outcome in some individuals, the majority of patients did not experience declining QoL and hence our results suggest that treatment decisions should not be influenced by an assumption that following discharge, a decline in QoL is inevitable.

This is the largest study to date investigating QoL following hospital admission for AECOPD and is the only one to report longitudinal changes over 12 months following discharge. Although COPD is a chronic condition...
with a typically progressive course, there are fluctuations in symptom burden and QoL, often related to exacerbations. Previous studies investigating QoL change between only two time points, or widely spaced intervals, will not have adequately reflected this variation and the repeated measurements in our study will better take account of such subtleties. However, the accuracy of our assessment of mean change in QoL could have been improved with even more frequent assessments, but this would have been impractical. We opted to analyse patient death in a similar way to that used in the measurement of preference-based QoL (ie, utility), whereby the lowest possible score on the measurement scale is assigned to indicate patient death.20 Although this methodology is not common in QoL studies in stable COPD, it is important to include death in the assessment, because if ignored, the gradual decline in QoL which threatens illness has on individuals’ QoL is uncertain.

We are not aware of any publications comparing change in QoL between ventilated and non-ventilated patients. To provide context for our longitudinal QoL data, we have compared the results in the two groups. There are, however, important baseline differences between the two populations (table 2) and therefore the clinical implications of statistically significant differences are unclear. We have highlighted where statistically significant differences were found but would emphasise that the clinically relevant comparison of mean change in longitudinal QoL for each group is with the MCID for that instrument.

Table 5
Clinically important QoL change following hospital discharge

<table>
<thead>
<tr>
<th>SGRQ</th>
<th>Improved by more than MCID*, n (%)</th>
<th>Neither improved nor declined†, n (%)</th>
<th>Declined by more than MCID‡, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilated, n=80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>38 (47.5)</td>
<td>19 (23.8)</td>
<td>23 (28.8)</td>
</tr>
<tr>
<td>Activity</td>
<td>17 (21.3)</td>
<td>28 (35.0)</td>
<td>35 (43.8)</td>
</tr>
<tr>
<td>Impacts</td>
<td>34 (42.0)</td>
<td>21 (26.3)</td>
<td>25 (31.3)</td>
</tr>
<tr>
<td>Total</td>
<td>31 (38.3)</td>
<td>25 (31.3)</td>
<td>24 (30.0)</td>
</tr>
<tr>
<td>Non-ventilated, n=96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>66 (68.8)</td>
<td>11 (11.5)</td>
<td>19 (19.8)</td>
</tr>
<tr>
<td>Activity</td>
<td>26 (27.1)</td>
<td>38 (39.6)</td>
<td>32 (33.3)</td>
</tr>
<tr>
<td>Impacts</td>
<td>47 (49.0)</td>
<td>25 (26.0)</td>
<td>24 (25.0)</td>
</tr>
<tr>
<td>Total</td>
<td>50 (52.1)</td>
<td>23 (24.0)</td>
<td>24 (24.0)</td>
</tr>
</tbody>
</table>

*3SGRQ≤−4. †−4<3SGRQ<4. ‡3SGRQ≥4.

MCID, minimum clinically important difference; SGRQ, St George’s Respiratory Questionnaire; QoL, quality of life.
patients showed an overall improvement in all SGRQ domains except activity. Wildman et al.\(^7\) showed that 73% of patients surviving intensive care following an exacerbation of COPD or asthma reported that their QoL was better than or equivalent to before admission, and Connors et al.\(^8\) reported that 51% of patients hospitalised with a severe AECOPD claimed to have good, very good or excellent QoL 6 months after discharge. It is not possible to compare our findings quantitatively with these studies, but the suggestion that patients hospitalised with a severe exacerbation of COPD do not inevitably experience a decline in QoL following discharge is consistent. In our study, improvement in QoL was significantly less in patients who required rehospitalisation within 12 months following discharge than in those not readmitted. There were, however, no differences between those with more or less frequent exacerbations (see online supplementary table E3). It is not possible to state whether it is exacerbation severity or the location of care which impacts on QoL, but this is a finding which merits further study.

Following hospital discharge, in spite of frequent adverse outcomes, the overall QoL of the majority of individuals does not deteriorate from the level experienced during the few weeks prior to hospital discharge, and in many patients, it may improve (table 5). In keeping with national recommendations,\(^6\) decisions regarding the appropriate ceiling of care are often made on the basis of patients’ and clinicians’ predictions of subsequent QoL. Incorrect estimates of postdischarge QoL may lead to either: patients being denied potentially beneficial escalation of care; or a prolongation of suffering when palliative approaches may be preferable. These results provide long-term data on expected QoL following hospitalisation for AECOPD and we recommend that poor or declining QoL postdischarge should not be assumed when discussing and making decisions about the appropriateness of escalating treatment when the patient’s condition potentially warrants it.

Acknowledgements The authors acknowledge the following for their help with the study: Dr Nick Steen, biostatistician, Newcastle University; the respiratory and acute care physicians at North Tyneside General Hospital and Wansbeck General Hospital; Dr Gbenga Afolabi, Respiratory Physician; Ms Elizabeth Norman and the Respiratory Specialist Nursing Team, North Tyneside General Hospital; the North Tyneside General Hospital Teaching and Research Fellow programme; Breathe North; and the National Institute of Health Research, through the Comprehensive Local Research Network.

Contributors SCB designed and obtained funding for the study. JS performed the literature search and collected the data. JS performed data analysis and interpretation and SCB and GJG supervised it. JS drafted the manuscript. SCB and GJG helped with its revision.

Funding The Breathe North Appeal and Northumbria Healthcare NHS Foundation Trust Teaching and Research Fellow Programme.

Competing interests None.

Ethics approval County Durham & Tees Valley 1 Research Ethics Committee.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

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BMJ Open Resp Res 2015 2:
doi: 10.1136/bmjresp-2014-000069

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