Quality adjustment of public service health output: current method

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Introduction

When measuring health productivity in the Healthcare Productivity articles ONS explicitly adjusts the measures of the quantity of health care produced to take account of quality. These quality adjustments are not included in the healthcare estimates in the National Accounts. The basic activity measure, common to productivity articles and National Accounts, consists of cost-weighted aggregates of procedures performed (disaggregated into several thousand Health Resource Groups (HRGs)), primary care consultations given and primary care prescriptions of drugs paid for by the UK governments. The quality-adjustment ONS applies in productivity articles takes account of some of the aspects of quality not already captured by the simple activity measures.

Some aspects of quality are captured directly by the activity measure. For example, if the NHS can and does perform more useful procedures than used to be possible, this will be picked up directly in more activity. And a shift to more expensive but more beneficial procedures automatically raises output because more expensive procedures have a higher cost weight. Activities where cheaper but equally effective treatments become possible, e.g. day case treatment for cataract surgery instead of overnight stay are handled by treating the two treatments as a single procedure for measurement purposes.

But for goods provided outside the market these adjustments do not exhaust all possibilities because there is no price that consumers pay at the margin which reflects what they think the procedure is worth. So ONS has introduced an explicit quality adjustment to take account of changes in healthcare delivery that are not simply captured in costs or quantity of procedures.

The quality-adjustment was introduced following work done by the Centre for Health Economics at the University of York and the National Institute of Economic and Social Research. The adjustment was designed to meet the Atkinson Report ideal that a quality adjustment should reflect the improvement in (health) outcomes that could be directly attributed to public (healthcare) service activity. Improvements in health outcomes that arise from changes in lifestyles or other factors that have nothing directly to do with NHS activity are therefore excluded. It was modified after 2007, following consultation, to include patient experience.

The health quality adjustment has three components. The first two are related to achieving outcomes, and the third relates to meeting user needs:
• one for health gain in those procedures categorised into HRGs, most of hospital output;
• one for the degree to which GPs are following best practice in the treatment of certain ongoing conditions; and
• one for the quality of the patient experience.

Figure 1 provides a diagram of these adjustments. The rest of the article describes each of these three components in turn and how they are aggregated together.

Annex A provides more technical information on the construction of each of the components of quality adjustment, using algebraic notation from the York University/NIESR study.

**Figure 1  Components of Healthcare quality adjustment**

Source: Office for National Statistics
The HRG adjustment

The HRG adjustment is applied to all HRGs; the primary care adjustment to primary care output; and the user experience measure is applied across all activity.

The one that has the greatest quantitative effect is that applied to the procedures categorised by HRG. It is an approximation to the increase in quality adjusted life years (QALYs) that patients derive from the procedures performed. QALYs are a widely used measure of health status. The ONS measure works by adjusting the cost-weighted activity index by post-operative survival rates and a measure of the difference in health status before the procedure and after recovery from the procedure.

In practice there are few regularly collected data on health status. The NHS is starting to collect systematic data for some common procedures on Patient Reported Outcome Measures (PROMs). For those procedures for which regular data are unavailable, ONS uses an average estimate based on data from clinical trials and non-NHS procedures. As PROMs measures become available they will be used for the appropriate procedures instead of the average measure.

Two further adjustments are used. Waiting times are incorporated by including an estimate of the reduction in health gain that arises from postponing a procedure. And there is also an allowance for the change in the age (if any) of people who undergo a particular procedure – because older people have less time left to experience health gain. Details are given in the Technical Annex.

The care management quality adjustment

The care management quality adjustment relates to patients on a GP list who have been diagnosed with hypertension, coronary heart disease, strokes and chronic kidney disease. ONS measures the proportion of patients with these diagnoses whose blood pressure is maintained within a desired clinical target range and for stroke and coronary heart disease patients those whose cholesterol levels are within the desired clinical target range.

As implemented the measure accounts for the proportion of patients on lists with the specified conditions as well as the fact that maintaining patients within target ranges is only part of good management. This adjustment has had a substantial effect on output in the past, but its effect is diminishing as the proportion of patients being within these target ranges approaches the natural upper limit of 100 per cent.

Patient Experience

The patient experience component of the measure is based on surveys commissioned by the Care Quality Commission. Survey questions are grouped into five equally important domains, including, for example, ‘better information, more choice’ and ‘safe, coordinated high quality care’. Surveys measure different areas of the NHS, including hospital inpatients, outpatients, mental health, primary care and emergency services.

The measure is based on the average ratings of patients across each domain and a growth factor adjustment is made to the appropriate activity. This measure also has a natural upper limit of 100
per cent. In practice the patient scores have not moved very much, so limiting the quantitative effect of this component on growth.

**Combining the components**

The patient experience measure is applied across all the domains for which survey evidence is available. The HRG adjustment is applied across all HRGs. The care management adjustment is applied to primary care. This means that some areas have two quality adjustments applied.

For each component ONS calculates an overall growth factor to be applied to the basic activity index. For those areas where two adjustments apply the two growth factors are multiplied together.

**References**

Technical Annex

Quality in hospital procedures: HRGs

The basic index of health output for hospitals without quality adjustment is simply the sum of cost weighted procedures by Healthcare Resource Group (HRG) in period t+1 divided by the sum of cost weighted procedures by HRG in period t:

\[ \frac{\sum_{j} x_{jt+1} c_{jt}}{\sum_{j} x_{jt} c_{jt}} \]  

where \( x_{jt} \) is the number of procedures in HRG\( j \) in period t and \( c_{jt} \) is the unit cost of HRG\( j \) in period t.

The cost weights for both periods are the same – those of period t. So this is a Laspeyres index. The fact that the weights are the same ensures that the same activity receives the same weight whether it was performed this year or last year, top and bottom are fully comparable.

Accounting for Quality: Approximating QALYs

The concept of a “quality adjusted life year” (QALY) is widely used in the health field. For example, it is used by the National Institute for Heath and Clinical Excellence (NICE) in their studies of drug effectiveness. It is a standard and internationally recognised measure. A QALY gives an idea of how many extra months or years of life of a reasonable quality a person might gain as a result of treatment. The quality of life rating can range from negative values below 0 (worst possible health) to 1 (the best possible health). So a year in perfect health is one QALY.

A natural way to measure the change in quality of a procedure is to estimate how the QALYs attributable to a procedure change over time. And, since the procedure can be viewed as an investment (pain now for improved quality of life later), standard practice would be to count benefits in the further future rather less than benefits in the immediate future by the use of a time discount factor.

The change in discounted QALYs for procedure \( j \) at time \( t \), \( q_{jt} \), for non-life threatening conditions is

\[ q_{jt} = a_{jt} q_{jt}^* - q_{jt}^0 \]  

where

\( a_{jt} \) is the post-operative survival rate for procedure \( j \) at time \( t \)

\( q_{jt}^* \) is the discounted stream of QALYs if you survive treatment

\( q_{jt}^0 \) is the discounted stream of QALYs without treatment
Note that the first term on the Right Hand Side of the equation only counts health benefit for those who survive the procedure.

The proportionate change between two periods in the increase in discounted QALYs from a procedure is given by

\[ \frac{\text{q}_{jt+1}}{\text{q}_{jt}} \]  

which equals

\[ \frac{\text{a}_{jt+1} q^*_j q_{jt+1} - \text{a}_j q^*_j q_{jt+1}}{\text{a}_{jt} q^*_j - q^*_j} \]  

(4)

However this equation cannot be made operational with current routinely collected data.

Data are available for the number of patients who survive 30 days after an operation. These can be used as an approximation to \( a_j \). There is no systematic routine data collection of post operative health state over the rest of a patient’s life. However there are data from clinical trials and from a limited number of studies of particular procedures.

The NHS in England is now routinely collecting Patient Reported Outcome Measures (PROMs) for a subset of HRGs. Therefore it is possible to approximate \( q^*_j / q^*_j \) by taking the “snapshot” of health gain provided from these studies (which are based on the same sorts of instruments that underlie the QALY studies) and assuming that health status after treatment is constant over the rest of the patient’s life. I.e. we can assume that the without treatment health profile stays constant and that the gain from treatment does not change over time.

For many procedures \( k_{jt} \) has to be approximated by the average health gain across a subset of procedures for which there is evidence from clinical trials etc, i.e \( k_{jt} \) does not vary across procedures. And there is no information about how this value changes over time. So we can write \( k_{jt} = k_j = 0.8 \) (i.e. on average, before the procedure peoples’ health is 80% of what it is after the procedure and recuperation). But where there are time varying procedure-specific data these are applied to the relevant procedure. The increasing availability of PROMS data will increase the proportion of areas that use procedure-specific health gain measures.

With these simplifications the previous expression for health gain reduces to

\[ \frac{\text{a}_{jt+1} - k_j}{\text{a}_{jt} - k_j} \]  

(5)

Where \( k_j = \frac{\text{q}^*_j}{\text{q}_{jt}} \)
(Note that even when $k_j$ is a constant it still makes a difference to the quality adjustment factor because subtracting a constant from the top and bottom of a fraction changes the value.)

The use of an average can lead to problems when $k$ is close to $a_{jt}$ or $a_{jt+1}$. This means that the terms $(a_{jt+1} - k_j)$ and $(a_{jt} - k_j)$ may be zero or negative, or so small as to be unduly sensitive to small changes in post-operative survival. The apparent implication of these terms being negative is that the procedure has no social value – the health gain is insufficient to outweigh the risks of the procedure. This may be incorrect for at least two reasons.

The first is for terminal care, where all treatments end in death. But this does not mean that that care is valueless. It means instead that the post-operative survival does not depend on the procedure. The appropriate health gain is then the extent to which the patient is better off for the time that he or she survives.

The second reason is that using an average $k$ underestimates the health gains from some procedures, so that even though post-operative survival is not that high the procedure is still worth performing (for example to treat a disease that, left untreated, would lead to death or severe disability in the relatively near future – though beyond the 30 day horizon).

A third possibility is that the risks of the procedure do indeed outweigh the benefits. It is assumed that no such procedures are carried out.

To deal with these cases, if the terms $(a_{jt+1} - k_j)$ and $(a_{jt} - k_j)$ are negative, or if the implied growth rate exceeds 10 per cent, only the simple survival adjustment is used.

In the simplified form the health quality adjustment can either be thought of as an approximation to the extra QALYs from procedures, or alternatively simply as a survival and average heath gain adjustment.

Applying the quality adjustment to the cost weighted activity index – with the implicit assumption that the cost weights represent the correct "valuation" that should be put on each activity - the overall index becomes:

$$
\frac{\sum_j x_{jt+1} c_{jt+1} \frac{a_{jt+1} - k_j}{a_{jt} - k_j}}{\sum_j x_{jt} c_{jt}}
$$

(6)

**Life Expectancy**

In the form given so far the adjustment assumes no change in the life expectancy of people who survive treatment with a given procedure. It can be argued that if treatment is being given to people who live longer the extra years of life in good health ought to be counted as part of health output. The main reason why life expectancy may change is because the age of the treated people in a particular HRG may change. Assuming that health status with and without treatment is constant over the remaining life of patients, the discounted expected gain from treatment $j$ in period $t$ is just
(7) \[(a_j, h_j^x - h_j^0) \left(1 - \frac{e^{-rL_{jt+1}}}{r}\right)\]

The first term is the difference in health states before and after treatment, and the second the discount factor applied over the remaining life of those treated, \(L_{jt}\). \(r\) is the appropriate time rate of discount. In practice the main driver of the discount factor as a whole is the age of those treated.

So the quality factor adjustment between two adjacent periods is

\[
\frac{q_{jt+1}}{q_{jt}} = \frac{(a_j, h_j^x - h_j^0) \left(1 - \frac{e^{-rL_{jt+1}}}{r}\right)}{(a_j, h_j^x - h_j^0) \left(1 - \frac{e^{-rL_{jt}}}{r}\right)}
\]

(8)

Note that if \(L_{jt+1} = L_{jt}\), i.e. the remaining life of patients experiencing a particular treatment does not change between time periods, then this expression is the same as the basic health gain one.

The overall cost-weighted and quality adjusted index becomes:

\[
\frac{\sum_j x_{jt+1} c_j \left(\frac{(a_j, h_j^x - h_j^0) \left(1 - \frac{e^{-rL_{jt+1}}}{r}\right)}{(a_j, h_j^x - h_j^0) \left(1 - \frac{e^{-rL_{jt}}}{r}\right)}\right)}{\sum_j x_{jt} c_j}
\]

(9)

This index will change if the average life expectancy of those treated in a particular HRG changes between years. If there are no changes by HRG then the index is identical to the cost-weighted health gain adjusted index. This is true even if treatments shift towards procedures in HRGs with older than average patients. Any differences in the value of such a shift are assumed to be entirely captured by the cost weights. Output will go up if the shift is to activities with higher cost weights.

**Waiting Times**

The final adjustment ONS make to the basic HRG activity measure is for waiting times. There are various possible ways of treating waiting times, for example as a directly undesirable aspect of treatment. But the most practicable way of using existing information is to concentrate on the loss in health gain from delaying treatment. This loss, keeping all the previous assumptions, is just the value of the health gain that would have occurred if the procedure were carried out immediately (note this assumes, for example, that the condition does not worsen during the wait) accumulated (the opposite of discounted) over the period of the wait. That is

\[
\left(\frac{e^{\frac{rw_{jt}}{r}} - 1}{r}\right)
\]

(10)

where \(w_{jt}\) is the length of the wait and the accumulation factor is \(\frac{e^{\frac{rL_{jt}}{r}} - 1}{r}\).
Subtracting this cost from the “standard” health gain means that the total health gain is

\[
(a_j h_j^* - h_j^0) \left( \frac{2 - e^{-rL_{jt}} - e^{rW_{jt}}}{r} \right)
\]

(11)

And the associated index is

\[
\sum_j x_{jt+1} c_{jt} \frac{(a_j c_{jt+1} h_j^* - h_j^0) \left( 2 - e^{rW_{jt+1}} - e^{-rL_{jt+1}} \right)}{(a_j h_j^* - h_j^0) \left( 2 - e^{rW_{jt}} - e^{-rL_{jt}} \right)}
\]

(12)

A full discussion of these measures and why they are practicable and others, such as allowing for re-admissions or hospital infections can be found in “Developing New Approaches to Measuring NHS Outputs and Activity” CHE Research Paper 6 produced by the Centre for Health Economics University of York and the National Institute of Economic and Social Research.

**Care Management Quality Measure**

Appropriate management in primary care is treated differently. The primary care measure adjusts the simple activity measure for patients on GPs’ lists with certain conditions who are being managed following current best practice. These conditions are coronary heart disease, strokes, chronic kidney disease and high blood pressure.

For all of these conditions ONS measures the proportion of relevant patients whose blood pressure falls within the target clinical range. For stroke and coronary heart disease patients ONS measures the proportion of relevant patients whose cholesterol levels are within the desired clinical target range. ONS uses one third of the growth rate in the proportion of patients whose measured levels are within target as the quality index for this group of patients. One third is used to reflect the fact that there are other factors in managing conditions apart from target blood pressure and cholesterol levels. There is no quality adjustment for other patients on the GPs’ lists.

The measure has a natural upper bound because the proportion can never exceed 100% and the rate of growth of quality thus measured has dropped sharply as the proportions have increased towards 100 per cent.

**Patient Experience Overall Quality Measure**

The patient experience measure uses the survey commissioned by the Care Quality Commission. Five aspects are used by ONS. These are
- access and waiting
- safe, high quality, coordinated care
- better information, more choice
- building closer relationships
- clean friendly place to be.

Scores on these aspects are used across five domains: inpatient, outpatient, emergency, mental health and primary care.

All aspects are used for inpatients, outpatients and primary care. The emergency measure excludes ‘access and waiting’. The mental health excludes ‘clean, friendly comfortable place to be’. There is a maximum score possible for each aspect, so the measure has a natural upper limit of 100 per cent satisfaction. ONS calculates the (equally-weighted) average of the growth in the relevant scores by aspect for each domain. This gives a multiplier (one plus a growth factor) to apply for each domain.

**Combining the components**

Some of the components apply to more than one of the underlying activities. For example, a knee replacement categorised into a particular HRG will be affected both by the relevant HRG adjustment and also by the patient experience score for the inpatient domain. These elements are combined multiplicatively.

Each component leads to the calculation of a multiplier (one plus a growth factor) and these factors are multiplied together and applied to the basic cost weighted activity measure to derive a quality-adjusted measure for that activity, which are then aggregated.