Costing Hospitalisations:
Issues with Scottish Hospital Episode Statistics

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ABSTRACT

Background: To estimate the economic burden of disease using Hospital Episode Statistics requires a decision about the most appropriate costing method. In the past in Scotland different approaches have been employed, including both Scottish per day/episode costs and English Healthcare Resource Group (HRG) based costs. Both methods are considerably different, in terms of data collection and costing methodology.

Objective: To outline the main issues surrounding different costing methods; and using an empirical example to assess the magnitude at which results differ.

Methods: We use a MIDSPAN dataset which includes baseline survey data linked to subsequent hospital admissions for a period of 27 years. We generate different cost estimates and compare results. The first cost variable is derived using English reference unit costs based on HRGs (method 1). The second cost variable utilises costs per diem derived from the Scottish Cost Book (method 2). Our next method (also based on the Cost Book) is novel in that it distinguishes between variable and fixed costs per episode and incorporates individual length of stay (LOS) information (method 3). Our final cost approach uses per episode costs based on national average LOS (method 4).

Results: We find mean costs using HRG costing (method 1) to be the lowest, £ 2,325 (SD 2,920). Mean costs using per diem costing (method 2) are highest at £3,365 (SD 6,173). Mean costs based on method 3 are £3,028 (SD 4,328) and mean costs resulting from method 4 are £2,616 (SD 1,585).

Discussion: Several issues arise for which we welcome discussion and suggestions. What are the implications for modelling health care expenditure when we have a range of cost estimates we can potentially choose from? For historic hospital episodes, where LOS is longer on average, would we underestimate costs if we applied a method that does not account for individual LOS? What are the implications for the selection of a regression model?

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INTRODUCTION

The estimation of the economic burden of disease using Scottish hospital episode statistics (Scottish Morbidity Records) requires a decision about which costs or costing method would be the most appropriate to use. A review of economic burden of disease studies and economic evaluation undertaken in Scotland in recent years shows that when applying costs to hospital admissions, per diem costs as reported in the Scottish Health Services Costs Book, multiplied with the number of bed days, that is length of stay (LOS), are frequently used (see Appendix). Per diem costs include all direct costs from an NHS perspective, including medical, pharmaceutical, staff, supply and lab costs. An alternative costing method that is used employs English HRG based unit costs, which are specific to either a disease classification (ICD10) or a procedure performed (OPCS4) but (as yet) are not available for Scottish hospital episodes. Assessing how results differ when applying different costing methods using a common sample of hospital admissions is of special importance if we are interested in absolute costs to estimate the economic burden of disease but also for any inference we make from econometric modelling of costs where we assess the marginal effect of explanatory variables.

Another issue arises when costing historic or longitudinal data: inpatient stays were longer on average in the past than they are now. This raises the issue of how to adequately account for this without over- or under estimating recent or historic costs, respectively?

In this paper we outline the main issues arising from using different costing methods. Using an empirical example, we assess the magnitude at which results differ. We consider how important – at an aggregate level - it is to distinguish between different costing methods when analysing Scottish hospital episode statistics. Special emphasis is given to issues arising from costing historic hospital episodes and the implications of this for longitudinal survey data when linked to hospital admissions.

REVIEW OF COSTING METHODS

HRG based costing (method 1)

Healthcare Resource Groups (HRGs) were first developed in England in the 1980s, but it was not until the mid 1990s that they were routinely used to cost hospital activities (Street and Dawson, 2002). HRGs are a measure of case mix and present standard groupings for clinically similar treatments, which consume a common set of health care resources (The Health and Social Care Information Centre, 2009) and are based on the Körner hospital episode statistics.

Data collection is initiated every time a patient is admitted to hospital and a patient record is created. Based on information from the patient records (procedure, diagnosis, length of stay, complications, co-morbidity, discharge method, age and gender) each single record is grouped in an HRG and reflects one finished consultant episode (FCE) (Street and Dawson, 2002). The most recent HRG (HRG4) provides over 1,400 different groupings, reflecting variations in severity of diseases etc. Since 1998 English NHS hospitals are required to submit their annual costs per HRG (Reference Costs) to the NHS Executive (Street and Dawson, 2002). Here, a top-down costing approach is used, starting off with the hospital's annual financial returns data and then cascading down costs to treatment services, then specialties and finally HRGs (Street et al, 2007). Compared to a bottom-up approach, which might be more preferable, this approach circumvents the issue of underestimating costs as it is more likely to cover all key input variables to care (Mugford et al, 1998).

The estimated cost and associated data are then reported as a national schedule of reference costs and in a second step aggregated by hospital to provide the reference cost index (=weighted average of all HRG costs in each hospital relative to the national average) (Street and Dawson, 2002).

Per diem costing using the Scottish Cost Book (method 2)

This method is frequently used in Scottish studies (see Appendix). As for HRGs, it is also based on a top down method of allocating costs to different specialties. The information provided in the Cost Book is mainly derived from financial and statistical data compiled by Scottish Health Boards. Costs are available at either hospital or health board level. Total costs incurred by a specific service or specialty and the number of patients treated (bed days) are used to assign a daily cost to a specialty level. Researchers can then multiply the per diem cost with individual LOS to derive costs per episode.

Using a per diem costing approach is likely to lead to an overestimation of costs as it places a relatively high weight on LOS. The method assumes that the cost for the first day in hospital is equal to the cost of every subsequent day, thus neglects the split between so called 'hotelling costs' and 'medical costs'.

Per episode costing - individual LOS using the Scottish Cost Book (method 3)

The approach of per episode costing is a method that has been developed by researchers from the Information Services Division Scotland (ISD) for the latest review of the resource allocation formula in Scotland, but has not previously been applied in costing exercises (Bishop et al, 2006). The novelty of the approach is that it makes a distinction between fixed and variable costs, based on the assumption that a proportion of costs (fixed costs) is the same for all patients treated in a specialty, regardless of LOS (medical costs, lab costs etc.). Variable costs, however, are assumed to vary proportionally with LOS. Variable costs are assigned to each bed day and fixed costs are assigned to each episode (Bishop et al, 2006). Compared to the more simplistic approach of applying a cost per diem, this alternative method generates a cost per episode based on individual LOS but will result in lower costs per episode on average and so circumvent overestimation of costs.

To derive a percentage split between fixed and variable costs, national average specialty per episode costs are taken from the Cost Book and split into a fixed and variable component. The percentage split is derived from regression analysis first undertaken by researchers in ISD using 1997-1998 cost data. The regression analysis has subsequently been updated using 2004-2005 cost data. The analysis was undertaken for five main specialties and the results were used to calculate figures for the percentage split for the remaining specialties. Average LOS for each specialty is regressed on 'Total gross cost per episode'. The value of the resulting constant term is used as the fixed cost component and the value of the coefficient as the variable cost component. The regression analysis is done at the hospital level and very small hospitals are excluded, Weighted Least Squares regression is used (weighted by the number of discharges).

Per episode costing- national average LOS using the Scottish Cost Book (method 4)

This final costing method also uses costs per episode, but does not distinguish between fixed and variable costs. It also doesn't include any individual LOS information. National average costs per episode are again taken from the Scottish Cost Book. If we were using a representative sample of hospitalisations for the Scottish population, these national averages should produce similar results to those from the procedure described above, using individual LOS. This assumption may not hold for a couple of reasons: our sample is not representative of the Scottish population and/or using historic hospital episodes with longer stays in previous decades and costs that are for more recent periods will not give us comparable results.

METHODS

Data

The Renfrew/Paisley study, as one of the MIDSPAN studies, covers a total period of 35 years, and includes baseline survey data linked to subsequent hospital admissions (SMR01). The initial survey took place from 1972-1976 and includes men and women from the burghs of Renfrew and Paisley, who were aged between 45 and 64 years at the time of study entry. Participants were asked to complete a questionnaire and invited to attend for screening examination at clinics. Computer linkage was established for Scottish Medical Records hospital discharge data from 1981 onwards, and study members have been either followed up until death or to the end of the study period in December 2007 (Hart et al, 2005). This provides a rich data set of hospitalisations for a wide range of causes.

SMR01 has episode-based patient records that relate to all inpatient and day cases. Care episodes that are excluded from SMR01 are obstetric and psychiatric specialties as well as geriatric long stay. A record is generated when a patient completes an episode of inpatient or day case care. Completion of an episode includes discharge home, transfer to another consultant in either, the same or a different hospital, a change of specialty under either the same or a different consultant, or death. The data that is collected to describe each episode include demographic information, episode management details and general clinical information. Diagnoses are recorded using ICD-10 codes and procedures performed are recorded using OPCS-4 codes (ISD Data Dictionary, 2009).

Although cost data for our different cost variables are provided either on an episode level or a per diem level, we argue that costing up hospital episode statistics needs to take account of multiple episodes within a patient's stay in hospital. We will therefore use a patient's continuous inpatient stay (CIS) as the common denominator for our four cost variables. A CIS lasts from admission to hospital until discharge or death.

We use an observational period of 27 years (1980-2007). Over this period we observe a total of 37,112 continuous inpatient stays for 9,893 individuals. We use the same denominator for all four cost variables, which is a CIS.

Assigning HRG based costs (method 1)

The data provides both an OPCS and ICD code (Operating Procedure Code and International Disease Classification), which form the basis for costing on an HRG level. We use the ICD10

code to assign HRG codes as not all hospitalisations involve a procedure. Historic admissions will have ICD9 codes, which we convert into ICD10 codes using a look-up file. A second look-up file derived from the HRG4 grouper assigns an HRG code to every ICD10 code. An ICD code can have several HRGs and we have taken a pragmatic approach and chosen the first HRG code per ICD code chronologically. The 'National Schedule of Reference Costs' (Department of Health) is then used to assign an HRG code and a unit cost to each hospital episode. If the episode's LOS exceeds a certain trimpoint we assign an extra cost per day (hotelling cost) multiplied with the number of days that were beyond the trimpoint. Adding these to the unit cost for the episode we get the total cost for that episode. This method has previously been employed in a research paper by Laudicella et al (2009). If a patient's stay in hospital only involves one episode this forms the total cost for the CIS. Different methods to derive a cost per CIS when multiple episodes are involved have been suggested by Dawson et al (2005). We use, however, an alternative method to give weight to variable and fixed costs. If the stay consisted of multiple episodes, this was taken into account by selecting the most expensive episode within that CIS and adding the extra per day cost multiplied by LOS of any additional episode to the total cost of the most expensive episode within the CIS. If several episodes had the same cost, we use a chronological approach, selecting the first episode that forms the CIS. Figure 1 shows how HRG based costs per CIS build up.

Assigning costs using per diem approach- individual LOS (method 2)

For the following three costing methods, costs are assigned to episodes using hospital and specialty codes. Hospital codes that have ceased to exist are either replaced with the code of the hospital they now belong to or are discarded from hospital/specialty specific cost merging.

Per diem costs as provided in the Scottish Cost Book, are multiplied with individual LOS to derive a cost per episode. As there is no information on trimpoints and related additional costs per day, in order to form a CIS, costs for each episode are added up over the entire CIS. Figure 2 shows how a cost per CIS is derived for this costing method.

Assigning costs using per episode approach – individual LOS (method 3)

Again, we match on specialty and hospital code and calculate a cost per CIS using costs per episode, incorporating individual LOS information as well as a percentage split between fixed and variable costs. Similar to HRG costing we pick the most expensive episode if the CIS consists of more than one episode and to avoid double counting of fixed costs we add the variable cost component of the remaining (less expensive) episodes to the total cost of the most

expensive episode. The flow chart in figure 3 provides details on how costs per CIS build up using hospital and specialty specific costs including individual LOS information and a split between fixed and variable costs.

Assigning costs using per episode approach – national average LOS (method 4)
Using the same matching procedure as above, we assign a cost per episode to each hospital episode based on national average LOS, neglecting individual LOS and add up costs for each episode belonging to a CIS (figure 4).

GLM Regressions
We run a series of Generalised Linear Models to assess whether the choice of cost variable impacts on any other choices we may need to make when it comes to running a regression model of health care expenditure. We initially run an OLS model for all four cost variables. We then choose Gamma as the most commonly used distribution for analysing health care expenditure data, which offers means for accounting for heteroskedasticity, but places less weight on high costs and investigate the use of this distributional family with a log link for our four different cost variables. We test the choice of the family using the modified Park test that recommends a family, given a link function. A coefficient that equals two indicates that the model is best specified with a Gamma distribution. We further test the specification for the link function given the distributional family using the Hosmer Lemeshow test. If the F statistics from that test are not significant we fail to reject our hypotheses that there is no difference between observed and predicted values, implying that the model estimates fit the data well.

To illustrate how the choice of different cost variables impact on results we run a regression of age at admission, sex, deprivation category and year of admission on costs and cluster on patient identifier.

RESULTS

Results for the entire observational period in table 1 show that costs that are mainly driven by LOS through the application of a per diem costing approach (method 2) are higher on average than costs derived using our three alternative methods that place less weight on LOS. Their variance is also higher than for other cost variables, suggesting substantial variation in individual LOS. Costs that are calculated using HRGs are lowest, followed by costs using average LOS

information. Both of these also show less variation as we would expect. Looking at subcategories in the years observed we find that costs based on individual LOS were higher on average in earlier years than in more recent years. This is due to a decrease in LOS on average over time. This time trend can not be observed to the same extent for costs that do not rely on individual LOS information (method 4, method 1). Due to the decreasing importance of LOS in more recent years, differences between costs are more pronounced in earlier years (1980-1985) than in later years (2001-2007). Costs for the most recent period vary between £2,485 (method 1) and £3,171 (method 2) per CIS.

Table 1: Mean costs per CIS in £ for different cost variables

Cost variable	All years (1980-2007) Mean (SD) [95% CI] SE	1979-1985 Mean (SD) [95% CI] SE	1986-1992 Mean (SD) [95% CI] SE	1993-2000 Mean (SD) [95% CI] SE	2001-2007 Mean (SD) [95% CI] SE
Method 1	2325 (2920) [2295 to 2354] 15	2389 (2463) [2294 to 2484] 48	2253 (2864) [2187 to 2319] 33	2217 (2558) [2176 to 2258] 20	2485 (3412) [2425 to 2546] 30
Method 2	3365 (6173) [3302 to 3428] 32	4565 (6008) [4333 to 4797] 118	4010 (6376) [3863 to 4158] 75	3008 (5597) [2919 to 3098] 45	3171 (6682) [3053 to 3289] 60
Method 3	3028 (4328) [2984 to 3071] 22	3782 (4421) [3612 to 3953] 87	3229 (4168) [3133 to 3325] 49	2837 (3902) [2775 to 2900] 31	2987 (4848) [2901 to 3073] 43
Method 4	2616 (1585) [2600 to 2632] 8	2739 (1791) [2670 to 2808] 35	2371 (1454) [2337 to 2404] 17	2601 (1610) [2576 to 2627] 13	2752 (1564) [2725 to 2780] 14

Method 1: Costs per CIS, based on HRGs
Method 2: Costs per CIS, based on specialty and hospital specific per diem costs, individual LOS
Method 3: Costs per CIS, based on specialty and hospital specific episode costs, individual LOS
Method 4: Costs per CIS, based on specialty and hospital specific episode costs, national average LOS

Table 2: Descriptive Statistics

Independent Variable	Mean (SD) or Frequency (%)
Age at admission	75.25 (7.6)
Sex	Male 15,908 (42.9) Female 21,204 (57.1)
Deprivation Category 1*	2,412 (6.5)
Deprivation Category 2	0 (0)
Deprivation Category 3	5,168 (13.9)
Deprivation Category 4	8,359 (22.5)
Deprivation Category 5	13,650 (36.8)
Deprivation Category 6	6,117 (16.5)
Deprivation Category 7	1,313 (3.5)
Deprivation Category- missing	93 (0.3)

- * Most affluent area
- Results for year of admission not shown

Regression results for coefficients, standard errors and corresponding p-values using a Generalised Linear Model with (a) a Gamma distribution and a log link and (b) a Gaussian distribution and an identity link (OLS) are presented in table 3, column 2 and 3. We also show results for the alternative distributional family and link function where the modified Park test recommended a different distribution and results for the Hosmer Lemeshow test did not confirm the log link to be the best fit (table 3, column 4). A Gamma distribution with a log link may not be the correct specification for all four cost variables. This is especially true for the cost variable derived using HRGs. Compared to the alternative three cost variables, HRG based costing leads to a different effect of deprivation category on costs, where a higher level of deprivation seems to lead to significantly more being spent on patients, whereas the other three (Scottish) cost variables indicate that as the level of deprivation increases, less is spent on patients. This negative effect of deprivation categories on expenditure using Scottish costs however is only significant for the two most deprived areas (depcat6 and depcat7) using episode based costing and average LOS (method 4).

We analysed whether these differences in terms of the effect of deprivation category persist when we hold the specialty constant and re-run the OLS regression for the most frequently occurring specialty in our data- 'General Medicine'. This is done for method 1 and method 4 only as these are the two cost variables that did show an effect of deprivation category on costs (table 3, column 6). We found that the negative effect that deprivation category had on costs derived using national average LOS (method 4) becomes insignificant, whereas we observe a persisting positive and significant effect for deprivation category on HRG based costs (method 1). This leaves us to assume that specifying costs using disease classification may pick up an underlying association between the actual disease (ICD) and deprivation category rather than an association between the specialty the patient was admitted to and deprivation category.

Age at admission and sex seem to have a consistent influence on costs across cost variables with the size of the effect being greater for the two variables that give most weight to individual length of stay. The intercept for all four regression models is also not influenced by the choice of the cost variable. The year of admission has an increasingly significant negative impact on costs as time progresses (results not shown) for cost variables that account for some element of individual LOS (methods 1, 2 and 3). Year of admission using average LOS information (method 4) however has an insignificant positive effect on costs throughout the years.

Table 3: GLM Regression Results

Cost Variable	β (SE) OLS	β (SE) Gamma, log link	β (SE) after Modified Park test	Hosmer-Lemeshow Test	β (SE) OLS (General Medicine)
Method 1			**Inv. Gaussian (identity)**	**Rejects log link**	
Age	55.60*** (3.71)	.022*** (.0014)	48.65*** (3.04)		30.41*** (4.55)
Sex	-210.61*** (33.69)	-.082*** (.0143)	-155.23*** (31.96)		-8.74 (45.13)
Depcat3	106.85* (61.49)	.039 (.0263)	82.90 (54.15)		67.80 (91.50)
Depcat4	185.53*** (58.70)	.077*** (.0250)	173.17*** (52.69)		226.59** (90.86)
Depcat5	167.66*** (52.56)	.070*** (.0226)	162.81*** (47.69)		168.45* (87.04)
Depcat6	211.23*** (66.62)	.086*** (.0271)	196.68*** (56.52)		196.11** (92.45)
Depcat7	287.03*** (93.11)	.124*** (.0383)	294.70*** (86.75)		395.12*** (137.10)
Constant	5800.00 (6249.07)	7.56 (.6410)	5720.41 (6228.28)		298.39 (662.02)
AIC/ BIC	18.78/ 3.11e+11	17.48/ -373476.5	24.43/ -388978.7		18.24/ 5.88e+10
Method 2			**Poisson (log)**	**Confirms log link**	
Age	88.26*** (8.49)	.024*** (.0024)	.025*** (.0024)		
Sex	-705.54*** (79.81)	-.214*** (.0253)	-.215*** (.0244)		
Depcat3	-193.00 (175.43)	-.064 (.0526)	-.056 (.0516)		
Depcat4	-13.85 (176.20)	-.004 (.0525)	-.001 (.0510)		
Depcat5	-131.70 (163.13)	-.033 (.0489)	-.037 (.0476)		
Depcat6	-70.26 (180.39)	-.004 (.0536)	-.019 (.0520)		
Depcat7	-87.12 (248.65)	-.036 (.0705)	-.026 (.0731)		
Constant	4154.47 (3419.81)	7.63 (.3461)	7.60 (.3767)		
AIC/ BIC	20.27/ 1.39e+12	18.18/ -338777.7	4775.43/ 1.76e+08		
Method 3			**Gamma**	**Confirms log link**	
Age	58.78*** (5.96)	.018*** (.0018)			
Sex	-466.29*** (55.29)	-.152*** (.0188)			
Depcat3	-70.72 (119.38)	-.029 (.0393)			
Depcat4	26.95 (118.62)	.006 (.0390)			
Depcat5	-46.85 (109.11)	-.015 (.0360)			
Depcat6	-14.24 (123.32)	-.003 (.0400)			
Depcat7	-100.86 (161.16)	-.045 (.0521)			
Constant	4681.49 (3517.84)	7.86 (.4066)			
AIC/ BIC	19.57/ 6.84e+11	18.00/ -361565			
Method 4			**Gamma**	**Confirms log link**	
Age	7.26** (2.96)	.002** (.0011)			5.83*** (1.64)
Sex	-52.85* (31.17)	-.018 (.0119)			-1.43 (17.34)
Depcat3	25.58 (62.60)	.005 (.0235)			70.35 (45.92)
Depcat4	-61.68 (60.35)	-.028 (.0227)			5.21 (40.48)
Depcat5	-54.74 (56.45)	-.025 (.0212)			11.96 (39.40)
Depcat6	-118.67** (59.82)	-.051** (.0226)			-6.55 (40.79)
Depcat7	-157.77** (80.45)	-.069** (.0311)			-56.18 (49.95)
Constant	1705.76 (508.57)	7.50 (.2388)			1173.72 (115.27)
AIC/ BIC	17.55/ 9.13e+10	17.73/ -379262.4			16.39/ 9.16e+09

*** p<0.01; **p<0.05; Deprivation category 1 (most affluent) serves as the reference category

Discussion

Our results show that those cost estimates that include individual LOS in their estimation are higher on average with a greater variance, but decrease over time. Part of the explanation is LOS, which decreases over time. The issue arising from our data that looks at LOS and costs over time within a cohort, which ages over time, is that we may have two effects that could cancel each other out:

(1) LOS decreases over time
(2) LOS increases with age

Coming back to our initial research question of how important it is to distinguish between different methods we can see that the importance seems to decrease over time. When comparing a per diem costing method and the method of using a percentage split for fixed and variable costs we found that this second procedure produces lower mean costs for all periods studied. Our initial hypothesis suggested that using a per diem approach assumes that every day in hospital incurs the same cost and may therefore over-estimate costs seems to be confirmed. A per diem approach doesn't take into account that, especially if the inpatient stay consists of more than one episode, some medical or lab costs might be double counted.

Running a simple regression model, including age at admission, sex, deprivation category and year of admission presents further issues concerning the modelling, i.e. for a GLM the choice of the distributional family and link function. Looking at regression results, even more important however, is the choice of the actual costing method. Changing link function and distributional family does not change the direction or significance of the effect our independent variables have on costs. Changing the cost variable, however seems to have a substantial influence on results, especially for deprivation category.

We have used costs that are based on a CIS. This however, is not the level costs are provided at. The methods we have used to nevertheless, derive a CIS based cost may not be appropriate and we welcome suggestions on how to improve this.

Scottish National Tariff

We have discussed four different costing methods that can be applied in costing exercises. One option we have not employed empirically is the use of the Scottish National Tariff (SNT). In Scotland, costs for inpatient hospital episodes are not collected on an HRG level, but on a specialty level only. HRG based SNTs have recently been developed for cross boundary flows between different health boards. To derive costs per HRG and to develop the SNT, English reference costs were used. Relative cost weights have been applied to English costs, assuming that the resource differential between any two procedures is the same in Scotland than it is in England (ISD, 2010). After costs have been calculated these can be converted into a tariff using adjustments for pay and price factors. The so derived SNT does not provide information on extra daily costs if an episode exceeds a certain trimpoint. It will therefore give less weight to individual length of stay (LOS) information. In their report to the National Resource Allocation Committee (NRAC) researchers from ISD and the Scottish Executive Health Department compare costs using the current costing method with using the SNT and find that results are similar for most ages apart from older age groups, where the tariff method produces lower costs on average than the current method as it does not give enough weight to individual LOS information. As long as the SNT is still under development using it is not recommended as it does not fulfil all of the NRAC core criteria (Bishop et al, 2006).

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Appendix

Table 4: Scottish studies involving costing hospital episodes:

Author	Study title	Costing Method
Anandan et al, (2009)	Epidemiology and disease burden from allergic disease in Scotland: analyses of national databases	1. English Reference Costs 2. PSSRU
Christensen and Munro (2008)	Ischemic stroke and intracerebral hemorrhage: the latest evidence on mortality, readmissions and hospital costs from Scotland.	Per diem specialty costs (ISD, Cost Book)
Gray et al (2001)	An economic evaluation of atenolol vs. captopril in patients with Type 2 diabetes (UKPDS 54)	Per diem specialty costs multiplied with length of stay (ISD, Cost Book)
Maheshwari et al (2009)	Direct health services costs of providing assisted reproduction services in older women	1. English Reference Costs, 2. Average cost of gynaecology day case in NHS Grampian, 3. Average daily cost of inpatient stay (ISD, Cost Book)
Miller et al (2009)	Economic burden of intracranial vascular malformations in adults: Prospective population- based study	Per diem specialty costs (ISD, Cost Book)
Walker et al (2003)	Cost effectiveness and cost utility model of public place defibrillators in improving survival after prehospital cardiopulmonary arrest	Per diem specialty costs (ISD, Cost Book)

Figure 1: Deriving a cost per CIS using HRGs (method 1)

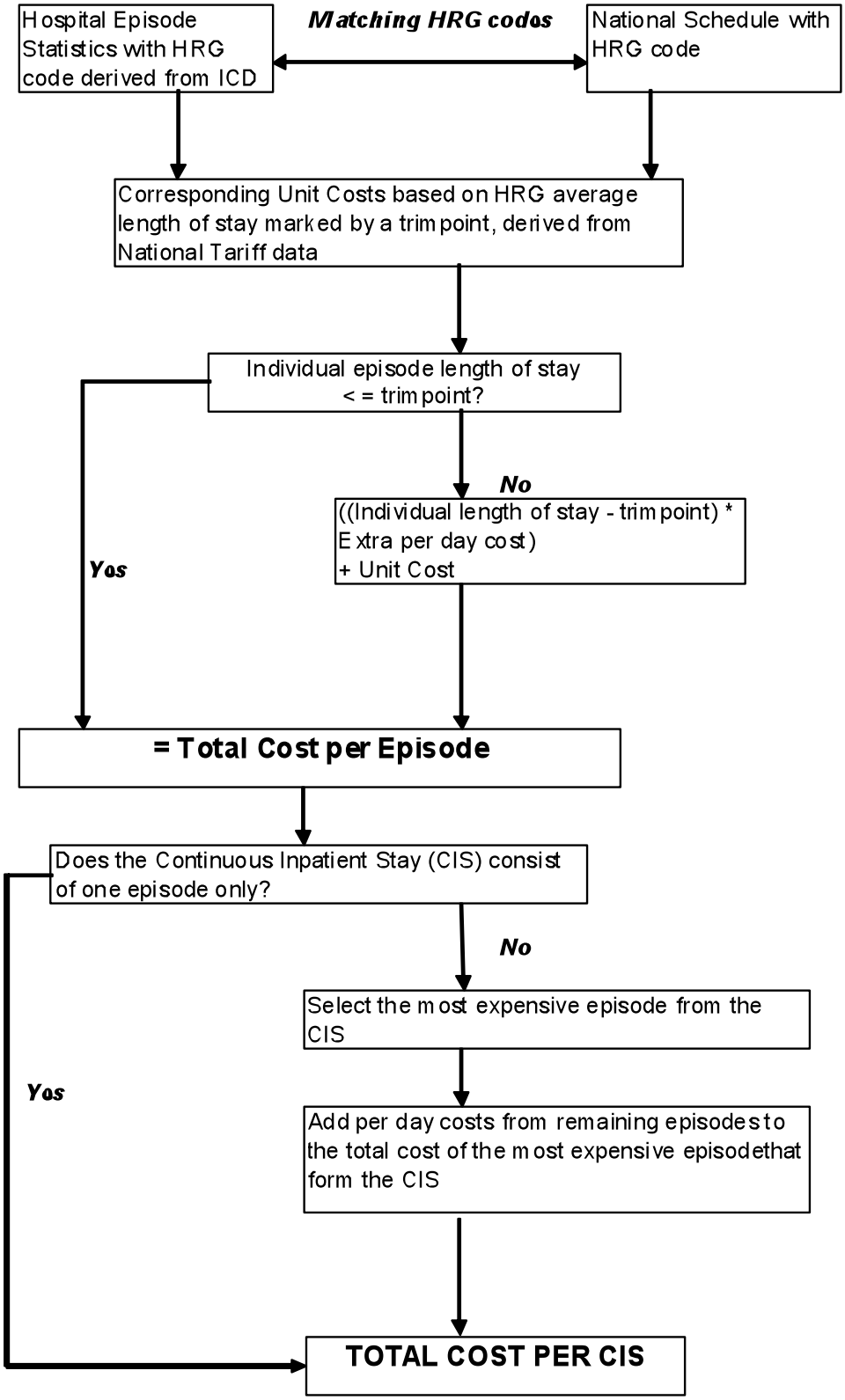

Figure 2: Deriving a cost per CIS using per diem costing (method 2)

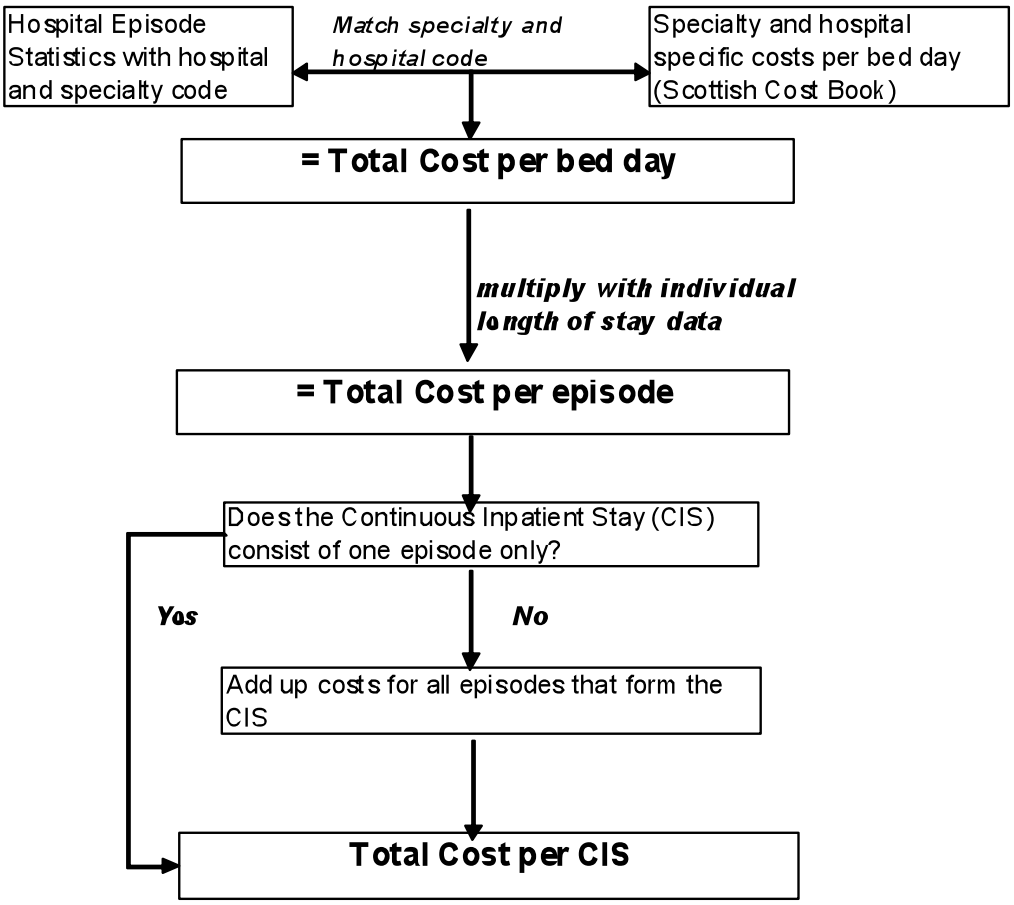

Figure 3: Deriving a cost per CIS using per episode costing – individual LOS and a variable and fixed cost split (method 3)

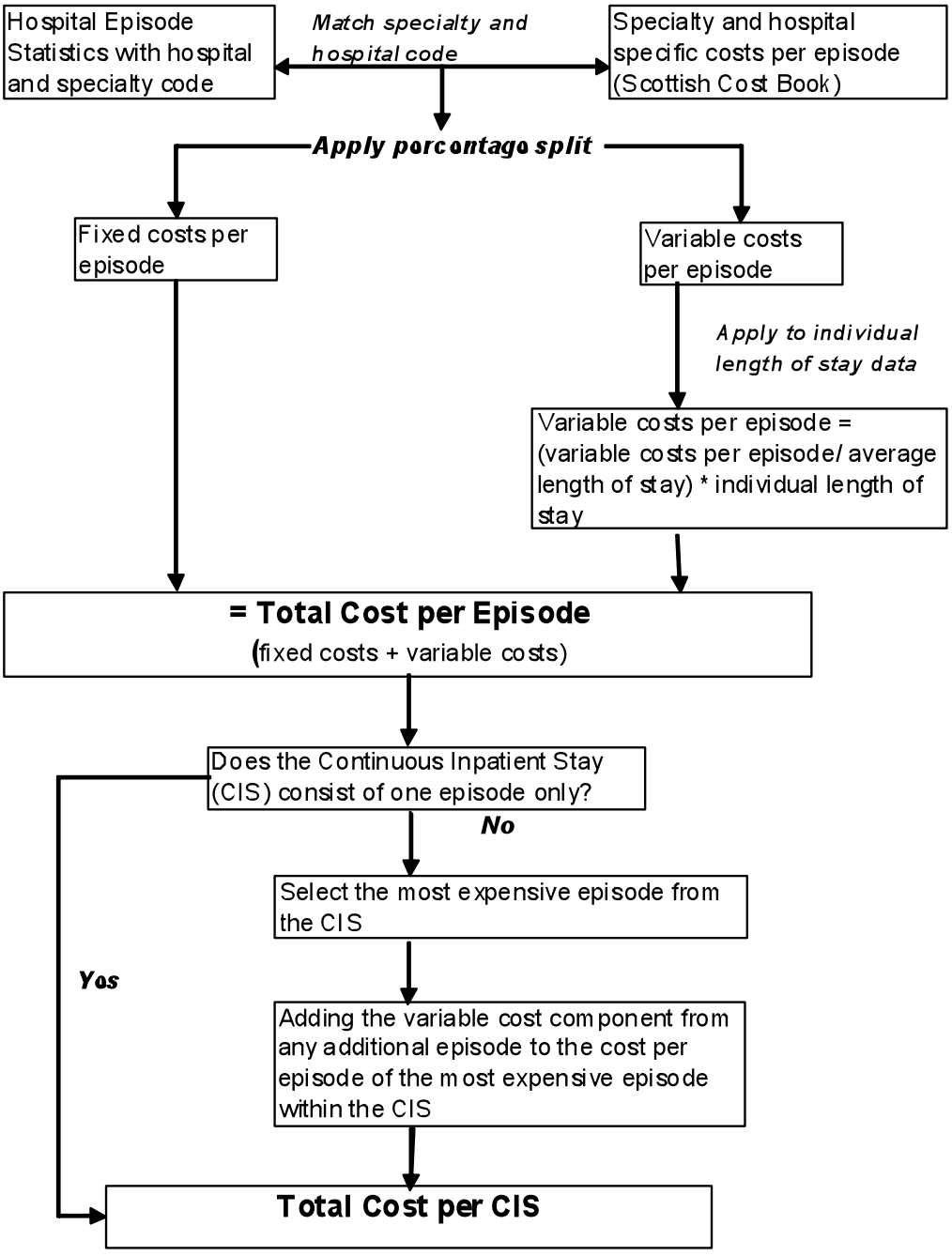

Figure 4: Deriving a cost per CIS using per episode costing- average LOS (method 4)