
FINAL REPORT

International comparison of costs: An exploration of within- and between-country variations for ten healthcare services in nine EU member states *

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** Findings presented here are based on analyses of data available at 26/02/07 and should be treated as highly provisional*

Executive Summary

Objectives

The objectives of this study for Work Package 10 (WP10) were to:

- identify and develop a methodology for cost comparison
- assess whether prices are a good estimate of costs of individual services
- explore the reasons underlying variations in the costs of individual services

Methods

This synthesis report is based on the following evidence:

- Data on resource use, costs and prices of a set of 10 standardised health services (vignettes) were available from nine EC countries (Work Package 9)
- Data were collected and costs were calculated according to a pre-specified methodology (described in Work Package 8)

Using this evidence, this report:

- Describes how researchers applied the methodology of WP8 to collect data and calculate costs of the vignettes in each country
- Assesses the structural and administrative obstacles in each country to applying a common methodology
- Calculates the correlation between prices and costs for each vignette
- Analyses and compares the proportions of direct costs and overheads in total costs for each vignette in each country
- Undertakes Analysis of Variance (ANOVA) for each vignette to identify mean differences in costs between countries
- Undertakes an exploratory regression analysis to identify factors at provider-level that might explain differences in costs

Results

Key issues identified in this report include:

- Countries, and providers within countries, differed in their ability to provide data according to the required methodology.
- Structural differences between countries were identified as:
 - Hospital providers in some countries do not own their assets, or international accounting standards regarding the cost of capital have not been fully implemented

- Exchange rates for some countries were volatile against the Euro over the period of analysis and may not reflect purchasing power parity
- Administrative differences between countries included:
 - Legal barriers to accessing patient data
 - Variation in the willingness to disclose data
 - Variation in the quality of information systems between countries and providers
 - Variation in the number of providers contributing data to each vignette in each country and the numbers of patients sampled by each provider
 - Differences in the accounting rules used to allocate indirect and overhead costs to services
- Where patient-level data could not be obtained, researchers used expert opinion, published surveys, national and local databases and imputation to estimate resource use and/or unit costs. In these cases the sample may not correspond with the characteristics of patients specified by the vignette.
- The exploratory analysis of the correlation between prices (reimbursement) and costs showed that:
 - in delivery, stroke and colonoscopy, prices and costs match fairly well on average, though there are outliers.
 - In appendectomy, hip replacement, cataract and AMI, prices are on average greater than costs.
 - in tooth filling prices seem on average to be less than costs.
 - There were insufficient data to allow a comparison of costs and prices for cough and physiotherapy
- The comparison of cost components by vignette found that:
 - For most vignettes, the total cost of care in Hungary, Poland and Spain was below average
 - Differences in personnel costs appeared to explain international variations for the cough and filling vignettes, with differences in treatment setting appearing important for colonoscopy and possibly stroke
 - Overheads as a proportion of total cost varied widely both between countries and between vignettes
 - The proportion of overheads in Denmark was generally high, comprising at least 70% of total costs in five of the vignettes

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- In Spain, overheads as a proportion of total costs ranged from 7% to 21%

- The ANOVA showed
 - that there were significant differences in mean cost between countries at the 5% level for all vignettes.
- A visual inspection of the 95% confidence intervals for each country showed that for the inpatient vignettes:
 - Denmark, England France and Germany and Italy were consistently either at or above the mean
 - Hungary, Poland and Spain were consistently at or below the mean.
- Length of inpatient stay was a significant factor associated with differences in cost between hospitals only in the stroke vignette

Further work is underway to provide a detailed examination of resource use and costs for each vignette.

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1 Objectives

A key purpose of the HealthBASKET project is to identify and develop a methodology for cost comparison that allows the identification of cost variations within and between countries, enables the reasons for these variations to be explored and identifies what approaches and data are needed for reliable international comparisons to be made:

“The primary aim of this project is to develop a methodology which allows comparisons of the costs of individual health services between Member States and which allows the reasons underlying variations in the costs of individual services to be explored.”¹

This report undertakes international comparisons of costs and prices among nine European countries to explore whether variations reflect variations in the types and quantities of services provided or actual differences in the costs per service. It also seeks to assess whether prices charged for typical conditions linked with standard services (i.e. charges / bills invoiced to payers) represent a good estimate of costs of individual services, as they would be assessed following an academic approach.

In doing this, the current potential for and limitations to comparison are to be documented, and recommendations regarding the minimum data required to inform meaningful international comparison in the future are to be made. In addition, the relationship between costs and prices (reimbursement) is to be documented.

2 Methods

2.1 Methods for WP9: calculating costs

The precise methods to be used in Work Package 9 (WP9) for calculating costs of the ten vignettes were specified in WP8 (this is reproduced in the Appendix, section 6.1). The ten vignettes are described in Box 1.

To collect relevant data, each project partner identified a sample of at least five representative health care providers in their own country for each setting relevant to the case-vignettes (i.e. at least 5 hospitals, 5 GPs etc.). Regarding case-vignettes for inpatient settings, atypical providers, with cost structures that would be expected to differ from those normally providing the service (e.g. tertiary care hospitals if the

¹ SIXTH FRAMEWORK PROGRAMME PRIORITY [8.2.1]: Proposal no. 501588 – HealthBASKET, April 2004

service is provided mainly in general hospitals), were to be excluded from the sample. Partners were advised to use 'general acute hospitals' with around 200 to 400 beds, unless this did not reflect existing service organisation.

Box 1: Overview of the ten vignettes costed in WP9

Vignette 1	appendectomy; male aged 14-25; inpatient; emergency
Vignette 2	normal delivery; female aged 25-34; inpatient; elective
Vignette 3	hip replacement; female aged 65-75; inpatient; elective
Vignette 4	cataract; male aged 70-75; outpatient; elective
Vignette 5	stroke; female aged 60-70; inpatient; emergency
Vignette 6	acute myocardial infarction; male aged 50-60; inpatient; emergency
Vignette 7	cough; male aged ~2; outpatient; emergency
Vignette 8	colonoscopy; male aged 55-70; outpatient; elective
Vignette 9	tooth filling; child aged ~12; outpatient; emergency
Vignette 10	physiotherapy; male aged 25-35; outpatient; elective

Researchers were asked to collect and calculate the data alongside hospital (or other provider) staff, to avoid delays of submitted cost data and calculation errors. In most cases, it was envisaged that medical staff would have to be interviewed face-to-face. Staff would be asked to provide data on the last 10 patients cared for in their institution; alternatively, administrative data covering more than 10 patients could be used (NB: No personalized data of the actual patients are needed or collected; estimates by clinicians based on the average of the last 10 patients were also acceptable). Whichever approach was adopted, it was necessary for the validity of the analysis that each patient fit the indications described in the case vignettes, as this should ensure that case mixes were comparable.

A detailed description of the methods that should be used to estimate labour costs was given. Personnel costs should include time spent directly with the respective case per day *and* the cost of time not directly spent with the respective case per day (but are allocated to it proportionally) e.g. staff assemblies, studying documents. It was agreed that, where possible, national wage rates (or national average wage rates) should be used.

All countries were to report prices for the year 2005 (although data collection took place in 2006). For each country where Euros are not the currency of use, costs were converted to Euros using the mean exchange rate for 2005. The application of purchasing power parities (PPPs) was considered, but not used within WP9.

However, PPPs may be used for the comparative articles that are due to be published in 'Health Economics' in 2007. A summary of the conversion rates used is given in Table 1. Particular caution is required when considering the exchange rate values for Hungary and Poland, because the Polish currency was somewhat unstable over 2005 (fluctuating between 0.2469 and 0.2597 €/PLN), whilst the Hungarian Forint was devalued against the Euro in 2006.

Table 1: Currency conversion rates used in WP9

Country	Own Currency	Conversion rate
Denmark	Danish Kroner (DKK)	1DKK = 0.134193 €
England	Great British Pounds (GBP)	1GBP = 1.462707 €
France	Euros	Not applicable
Germany	Euros	Not applicable
Hungary	Hungarian Forint (Ft)	1 Ft = 0.004047 €
Italy	Euros	Not applicable
Netherlands	Euros	Not applicable
Poland	Polish Zlotych (PLN)	1 PLN = 0.250000 €
Spain	Euros	Not applicable

2.2 Methods of statistical analysis

The aim of the analysis was to explore reasons for variation in costs for each vignette between and within countries. The primary objective was to carry out an analysis of variance (ANOVA) assuming fixed effects, since the main focus of the analysis was to estimate and test for differences in costs between the 9 countries who contributed to the study. ANOVA is formally able to test a null hypothesis: that there are no differences in mean costs between countries against a very general alternative: that there are differences in mean costs between countries. This test (the likelihood ratio or F-test) does not identify which means differ from the other ones. To investigate this further, 95% confidence intervals for each country mean were calculated, using least squares regression with dummy variables (LSDV), to see whether they include the overall mean. This is not a formal statistical test because multiple comparisons are being made but intended to allow a visual representation of the expected values and the uncertainty.

As a secondary objective, regression analysis was used to test whether any observed hospital-level characteristics might explain differences in costs. Most hospitals were able to provide data on mean length of stay for all vignettes. There was considerable missing data from most other hospital level variables. In this model, the constant represents the cost of average hospital in the average country for the average length of stay of all the hospitals in the sample for a given vignette.

The slope coefficient represents the expected increase in costs for an additional day for that vignette, assuming this is the same in all hospitals and countries. ANOVA was used to test whether costs differed between countries and LSDV to predict the mean cost for each country after taking account of observed hospital level characteristics.

A third objective of the analysis was to calculate the mean cost for each country, adjusting or “weighting” for the different amounts of data each country was able to provide for the vignette. The fixed effects analysis assumes that the costs in each country are unrelated to those of other countries, and each data point (hospital) is given the same weight in the analysis regardless of the country of location. Alternatively, a random effect model assumes that data within a country is “clustered”, that is, the costs within each country are correlated, measured by the intra-cluster correlation coefficient (ICC). In the random effect model the differences in costs between each country mean and the overall mean are thought of as being independently and normally distributed with mean 0 and constant variance. In the random effects model without covariates, the overall mean is unchanged compared with the fixed effects model but the mean cost for each country is closer to the overall mean than in the fixed effects model. This is because the estimate of the mean cost in each country is “informed” by data from other countries, reducing the uncertainty about the cost in that country relative to the overall mean. Therefore 95% confidence intervals for the country means will be smaller in the random effects model. The weight given by each country to the estimate of the overall mean is the same in the fixed and random effects analyses, but smaller countries contribute relatively more weight, and larger countries less weight, to the estimate of the variance of the overall mean in the random effects analysis than with fixed effects.

3 Application of methodology

Countries, and providers within countries, differed in their ability to provide data according to the required methodology. Some key structural differences between countries were identified. First hospital providers in many countries do not own their own assets, but it is also possible that international accounting standards regarding the cost of capital have not been fully implemented. Second, exchange rates for some countries were volatile against the Euro over the period of analysis and do not reflect purchasing power parity. Administrative differences between countries were also noted. These included legal barriers to accessing patient data; variation in the willingness to disclose data; variation in the quality of information systems between

countries and providers; and differences in the accounting rules used to allocate indirect and overhead costs to services. Where patient-level data could not be obtained, researchers used expert opinion, published surveys, national and local databases and imputation to estimate resource use and/or unit costs.

3.1 Findings on the application and feasibility of WP8

All countries succeeded in collecting some data for each vignette, although all experienced some challenges in applying the methodology from WP8. Common themes included:

- difficulties identifying providers willing to participate
- difficulties translating accounting system data into unit costs
- difficulties accessing patient-level data
- difficulties estimating overhead costs
- difficulties calculating vignette-relevant non-contact time spent by clinicians

Summaries of the data sources used by each country are provided in Table 2 and Table 3. Vignettes involving inpatient care are in Table 2. Vignettes relating to either hospital outpatient settings or to ambulatory settings are in Table 3.

Table 2: Data sources used in WP9: resource use and unit cost estimates (inpatient vignettes only: 1-3; 5-6)

Country	Data sources used								Providers / vignette (range)	All providers contributing data	Price year
	Patient level data		Expert estimates		Interviews / surveys		National / local databases				
	RU	UC	RU	UC	RU	UC	RU	UC			
Denmark	x	x	y	x	y	x	y	y	1 to 4	5	2005
England	x	x	y	x	y	x	y	y	2 to 5	6	2005
France	y	x	y	y	y	y	y	y	3 to 6	9	2006
Germany	y	y	y	x	y	x	y	y	8 to 15	15	2005
Hungary	x	x	y	x	y	y	y	y	2 to 3	4	2006
Italy	?	x	y	y	y	y	x	y	5 to 5	5	2005
Netherlands	x	x	y	y	y	y	y	y	6 to 10	18	2005
Poland	y	?	x?	y	y	y	x	y	6 to 6	8	2006
Spain	x	x	y	y	y	y	y	y	4 to 5	5	NA ^α

Key: RU: resource use; UC: unit costs; x: no; y: yes; ?: unclear

^α Spanish services are funded through a global budget and therefore there are no prices

Table 3: Data sources used in WP9: resource use and unit cost estimates (outpatient / community vignettes: 4; 7-10)

Country	Data sources used								Providers / vignette (range)	All providers contributing data	Price year
	Patient level data		Expert estimates		Interviews / surveys		National / local databases				
	RU	UC	RU	UC	RU	UC	RU	UC			
Denmark	y	y	?	?	y	?	y	y	3 to 4	15	2005
England	x	x	y	x	y	x	y	y	3 to 6	16	2005
France	y	x	y	y	y	y	y	y	1 to 5	17	2006
Germany	?	x	y	y	y	y	x	y	4 to 17	57	2005
Hungary	x	x	y	x	y	y	y	y	2 to 5	10	2006
Italy	x	x	y	y	y	y	?	y	5 to 6	18	2005
Netherlands	x	x	y	y	y	y	x	x	5 to 9	33	2005
Poland	y	?	x?	y	y	y	x	y	4 to 6	19	2006
Spain	?	x	y	y	y	y	y	y	4 to 5	13	2005

Key: RU: resource use; UC: unit costs; x: no; y: yes; ?: unclear

Denmark

In Denmark, resource use estimates for hospital vignettes were based primarily on interview data. However, these findings were supplemented by questionnaires from 7 hospitals (48 hospital departments were approached; 5 hospitals contributed inpatient data and 2 other hospitals contributed outpatient data). Local estimates of resource use were multiplied by unit costs taken from a single hospital to calculate total direct cost. A National Cost Database was used to validate findings and to allow overheads to be estimated. This database uses a top-down approach, which means that all hospital costs are included (including overheads). Data are available at individual patient-level, and are given at 'cost centre' level (e.g. laboratory services) although a breakdown of nursing and physician time on the ward is not given and this is why survey data were used in the analyses.

England

England was alone in facing one particular difficulty, which was that both central ethical approval and local research governance approval were required before clinical or managerial staff could be approached. These requirements delayed the start of the project and greatly increased the administrative burden of inviting organisations to participate. In total, eight hospitals were approached: all gave research governance approval and seven contributed data. For the vignettes on cough and filling, which are treated by NHS practices in an ambulatory setting, 10

primary care trusts were approached and six gave research governance approval, all of which contributed data to the project.

In England, neither healthcare nor managerial staff may access patient records without individual patient consent; obtaining patient-level data was therefore beyond the scope of the project. As a result, resource use was chiefly based on expert estimates. However, national routine databases of reference costs provided estimates of length of stay by Healthcare Resource Group (HRG) for individual hospitals. These estimates are for *all* patients within the relevant HRG, and so are less specific than the vignettes that are age and gender specific. In addition, overheads and some unit costs (e.g. laboratory tests) were available from reference cost databases.

France

Difficulties in recruiting hospitals to the study were encountered: some hospitals declined the invitation to participate because they were too busy dealing with finance reforms, others declined because the cost data required was unavailable or sensitive. In total, twelve hospitals (4 public; 4 private-not-for-profit; and 4 private-for-profit) contributed data to the findings, although some providers contributed data towards just one vignette. French researchers conducted many interviews with medical and nursing staff and had access to patient-level data for the hospital vignettes, including detailed records of resources used in theatre. However, it was not always easy to estimate the contact and non-contact time spent by nursing staff on wards. This information was not available from patient records, and staff found it difficult at first to make definite time estimates because contact times depend on individual patients' needs. They managed to produce careful estimates, however, although the non-contact times may have been slightly underestimated.

Another problem was collecting unit cost data in private-not-for-profit hospitals, since there was no central department that managed costs. Consequently, some costs were derived from hospital income and expenditure accounts. As services for cough, tooth filling or physiotherapy are typically provided by private practitioners, respondents were difficult to recruit. As a result, researchers had to rely on personal contacts to provide data.

Germany

In Germany, a mixed approach to data collection was adopted. There are 284 hospitals (16% of all hospitals) in Germany that participate in a data-sharing programme. This scheme involves an annual submission of hospital costing data to

the Institute for Hospital Reimbursement, who uses the data as the basis for cost weight DRG calculations. These costs are estimated using a step-down approach, but exclude (among other items) capital costs, core business expenses and building costs. For the inpatient vignettes, hospital-level total cost data were available from 15 of these 284 hospitals. Hospitals provided information on total costs, procedure-level costs and the allocation basis for diagnostic and therapeutic services. Accounting departments provided data on medications, laboratory and imaging services and implants. Interviews and/or questionnaires with clinicians provided supplementary detail. For the outpatient vignettes, data were mainly derived from interviews, with estimates of salary costs and hours worked taken from national salary statistics and surveys. Provider-level purchase prices were used for estimating the unit costs of drugs and devices.

Hungary

The Hungarian research team originally planned to use data from a 1999 National Health Insurance Fund survey undertaken for the purposes of calculating 'Hungarian DRGs'. However, prices and the services delivery patterns from this survey may not reflect current practice and hospital-level data were not available. Therefore, a new survey was undertaken for WP9. Seven providers (hospitals, outpatient clinics, dentists and general practitioners) were selected from each region of Hungary. All hospitals and the outpatient clinic were publicly funded, whilst some dentists and GPs were private practices. The questionnaires for hospital (inpatient and outpatient) vignettes were sent to hospital or clinic staff who acted as 'coordinators' for the project, or directly to GPs, with researchers offering support either face-to-face interviews or by email or telephone. The response-rate was very low for a number of reasons, including lack of approval of hospital management, staff shortages, and unfavourable conditions due to the restructuring of the Hungarian hospital system.

Unit cost data were extracted from hospital information / accounting systems. However, hospital information systems vary in their stage of development. One hospital could only provide personnel cost as a proportion of overhead. Some patient-level data could be accessed by the hospital coordinators, but these data were not available from the GP and dental accounting and information systems. Resource use quantities were typically based on expert estimates. The GPs and dentists also provided expert estimates, with unit costs for drugs taken from a national database. Reimbursement data were available from hospital and dental

accounting systems, but because Hungarian GPs are reimbursed on a capitation basis, data were not available for the cough vignette.

Hospital coordinators were responsible for data collection, so methods and definitions may differ between providers. This made it difficult to compare and aggregate data from different providers and the interpretation of the country-level mean unit and unit costs of materials and drugs is therefore unclear.

Italy

In Italy, patient-level cost data are unavailable for both hospital and ambulatory patients: there are no national, regional or local cost databases providing this information. Therefore, data collection relied principally upon interviews with relevant healthcare staff and upon accounting data. For the inpatient and hospital outpatient vignettes, interviews were conducted within a selection of independent hospitals and hospitals managed by Local Health Units, covering all three Italian regions. Providers were approached by writing a formal letter of invitation to the General Manager or Health Director asking for permission to approach clinicians and 'controllers' (hospital finance managers). With the exception of a private hospital, responses were positive. For each of the ambulatory vignettes (cough and tooth filling), five providers were selected from two Italian regions. Both public and private providers were included and small and large towns were represented. As for the hospital vignettes, resource use data were provided through interviews with clinicians and accounting systems were accessed to identify unit costs. The main difficulty encountered within WP9 was to do with estimates of unit cost: whilst the accounting systems accessed by the researchers were useful for providing estimates of cost per minute for personnel and costs of laboratory tests, the systems were designed to ensure organisational units were accountable. As a result, costs for particular procedures could not be derived from the systems. However, data from interviews with clinicians and controllers enabled all relevant costs to be calculated.

Netherlands

No major difficulties were encountered in applying the methodology for WP9. In the Netherlands, national cost databases formed the basis for the estimates of resource use and cost in hospital settings. These were supplemented with survey data, derived from a sample of 22 general hospitals. Questionnaires were completed by clinicians and finance managers or administrators, with data from accounting systems also informing calculations. For ambulatory settings (cough, filling and physiotherapy), relevant clinicians were identified and resource use estimates were

obtained from questionnaires. Unit costs for personnel in both hospital and ambulatory settings were based on national pay agreements.

Poland

In Poland, legal restrictions meant that researchers were unable to access patient-level data. Therefore, clinicians identified relevant patients and then extracted data on resource use. Clinicians interpreted the vignettes differently, with some apparently excluding any 'outlying' patients, those whose treatment pathway included 'atypical' care of any sort; this may mean that some costs were underestimated. Financial and accounting personnel provided information on unit costs, although this was not always straightforward: accounting data were sometimes insufficient and resource use categories identified by clinicians did not easily map on accounting categories. Therefore, co-operation between medical personnel and researchers was needed to estimate unit costs, which were sometimes informed by expert opinion. Furthermore, accounting practices varied between providers, and interpretations of overheads also varied, making it difficult for researchers to ensure that costing methods were uniform.

Spain

In Spain, resource use data for both inpatient and ambulatory care vignettes were collected principally from interviews with managers and clinicians. Unit costs were derived from accounting data, but this process was rarely straightforward because accounting cost categories did not translate easily into the unit cost requirements for the vignettes. Therefore, estimation of unit costs typically involved close collaboration with managerial personnel. Personnel costs were standardised, so that the same unit costs were used for all providers. Pharmaceutical prices are centrally regulated in Spain, and these consumer prices were used for medicines dispensed at community pharmacies. For medicines dispensed in hospitals, regulated ex-factory prices were used as a proxy. Although hospital associations typically negotiate prices for their members, in practice, hospitals may manage their own purchasing and may sometimes even receive drugs at zero cost, especially if the patient is expected to continue that treatment after discharge.

3.2 Personnel costs

Denmark

In the Danish report, personnel costs include all wage elements including costs of pension. The effective hourly wage is calculated by dividing the annual wage by the

sum of all working hours (subtracting holidays and average figures for absence due to illness, maternity leave, etc.).

England

In England, there are annually-published sources for unit costs for most healthcare personnel (PSSRU, 2005). These include the costs of salaries, on-costs (e.g. pension contributions), overheads and capital overheads and training costs (qualification costs are excluded from the WP9 calculations). The estimates rely on national average estimates for working weeks, hours per week and ratios of direct to indirect time on patient contacts. For estimates of cost per hour, the numerator was total annual cost for a particular clinician (salary, plus on costs, plus training cost) and the denominator was annual number of hours spent *directly* with patients. This clearly yields a high unit cost than an estimate that takes annual hours spent as work as its denominator. The advantage of this approach is that the personnel cost includes both direct patient contact and average administrative time without needing to estimate the time spent on administrative tasks relating to the vignette by the clinician. Overhead and capital costs were extracted from estimates of hourly cost (for GPs and dentists, extracted overheads and capital costs were included in the overhead calculations).

France

Unit cost of personnel was based on data from each interviewed hospital cost accounting system. Unit costs were calculated on the basis of total annual personnel costs which include salaries, employer contributions and taxes on salaries. The personnel costs rely on hospital average annual estimates for a given personnel, e.g. a surgeon, an obstetrician, a midwife or a specific nurse, for a total amount of working hours. For estimating the unit cost, French researchers divided the annual cost by the number of worked hours (including direct and indirect hours spent with patients).

For the wards, the unit “patient days” include personnel time directly and indirectly spent with the respective case per day. As French researchers were aware that underestimation may have occurred, particularly for non-contact time, they compared routine accounting data giving a cost per stay in a given ward with the data collected from the interviews. When necessary, they adjusted the data and included them in “running costs” of the wards within the item “other personnel costs”.

In their approach, they distinguished running costs of a ward or of an operating room (which could include medical and nursing costs) from hospital overhead costs. The

latter were estimated and updated from the hospital cost accounting system and then allocated to the case according to its length of stay.

For ambulatory practitioners, in order to estimate the value of doctor/dentist time (per minute) the researchers used the average yearly income - for consultations- from national data sources. In addition, information on net practice time was collected from the participants.

Germany

In Germany, unit costs of hospital personnel were based on cost data provided by a sample of hospitals participating in a data sharing programme. These data provided *total* DRG-related costs of nursing staff, technical and medical staff, together with the apportionment basis; unit costs are unavailable. For *normal wards*, the apportionment basis varied by type of staff, with costs for physicians and technical staff allocated by bed days; for nursing staff, costs are allocated according to a 'nursing minute' (PPR), which is a unique German methodology. The cost of one minute of nursing care is calculated and allocated to each case according to the intensity of care needed by each case. There are three levels of care for both general and special care, ranging from level 1 (basic care) to level 3 (very time-consuming care). The level of care assigned to each case is determined by which departmental staff are employed. Each combination of general and special care therefore receives a certain number of nursing minutes. *Operating staff costs* are allocated according to the surgery time, with the exception of anaesthetist costs which are allocated by time spent preparing and administering anaesthesia. For *other diagnostic and therapeutic hospital services*, staff costs are typically allocated according to the number of tariff (DKG-NT/GOÄ) points assigned to each service. If there is no relevant tariff, such as for occupational therapy or speech therapy, each hospital makes a decision on the number of points to assign based on resource consumption.

For ambulatory care physicians (including dentists), unit costs per minute were estimated using the mean annual income for practices of the relevant specialist group, divided by the mean number of 'productive' minutes worked annually (assuming a productivity rate of 87.5%). To estimate the cost per minute for healthcare assistants, gross monthly employer costs (including all employer contributions) formed the numerator, with mean time worked per month (in minutes) as the denominator.

Hungary

When estimating personnel costs, providers were asked to report '*costs directly spent with the respective case and costs which are not directly spent with the respective case per day (but are allocated to it proportionally) e.g. staff assemblies, studying documents*'. However, providers found the estimation of contact and non-contact time problematic. Unit costs for personnel were generally calculated by dividing the total personnel cost (gross salary plus additional related costs for employer) by the number of workable minutes, hours or patient days. Unfortunately, one hospital could only provide personnel cost as a proportion of overhead. The research team extracted this proportion from the overhead and used it in the personnel cost estimate. However, because of the approximate (not vignette-specific) nature of this estimate, the personnel cost from this provider may be over- or underestimated and bias may also be apparent in the mean cost for all providers.

Italy

In Italy, accounting databases were used to provide estimates of unit costs. As Italian providers are not obliged to follow standardised management accounting procedures, it is likely that providers used different methods to calculate direct unit costs for labour, and this may limit the comparability of the data. For example, unit cost data may be estimated on the level of the ward or of the hospital; working time may be based on that defined by the national contract or may be the actual time worked by that physician; costs may or may not include benefits and premiums. However, the researchers suggest that differences in methodology probably result in an estimate variation of around 10 to 20%.

Netherlands

In the Netherlands, costs of practitioners were based on time estimates and multiplied with standardised costs per time unit. For the inpatient vignettes, costs per time unit were based on the normative income and the number of workable hours per year as issued by CTG / ZAio. Because medical specialists generally work in independent corporations and are not on the payroll of the hospital, the normative income for these practitioners were based on a national rate that also includes some overhead costs. Costs per time unit for independent practitioners in the outpatient vignettes were based on data from National Statistics and calculated by inflating salary costs to include employer oncosts (such as pension costs) and/or practice expenses, then dividing by the number of annual working hours for that professional.

Poland

In Poland, data protection legislation meant that researchers could not access patient records and so data on personnel time were collected by medical personnel. Accounting departments then provided information on unit costs. Expert estimates were used where data were unavailable, although it is unclear whether this applied to labour cost estimates. Some providers were unable to differentiate physician costs from those of other medical personnel, and so only total labour costs were available.

Spain

In Spain, apart from dental providers, all the participating centres (both 'private' and public) were part of the public system and worked for the NHS. Therefore, unit costs for each type of personnel were used in the calculations. Staff costs included 'social cost' (Labour Social Security costs for the hospital), but excluded the administrative time of nursing and medical staff because there were insufficient data to allow these to be estimated.

3.3 Overheads

Overheads are a large proportion of the costs of many healthcare services, and there is likely to be considerable differences between and possibly within countries over which costs are included as overheads and how they should best be matched to health care services. This section reviews the methods used by the participating countries to estimate the costs of overheads for each vignette.

3.3.1 Methodology of WP8

To aid comparison, the methodology for WP8 requested the cost items to be grouped together under the categories of medical infrastructure, non-medical infrastructure, capital and other. Table 4 describes the overhead costs that were included in each category by the WP8 methodology.

Table 4: Categories of overheads included in total cost

Description	Items
Medical infrastructure	Laundry Sterilization Patient transports (within the hospital) Supply of food and drinks (if provided at all in the respective hospital/country) Administrative (non-patient contact) time of medical and nursing staff
Non medical infrastructure	Administrative personnel Cleaning Gardening Desk officers Technical/building maintenance Energy Water

	Waste disposal
	Taxes and insurance (related to patient services)
Depreciation	Rent (related to patient services)
	Equipment
	Buildings
Opportunity costs	Interest (notional or payable) on public or private sector capital employed
Apportionment	Method(s) used for apportionment of overhead costs to services
Sources	Source(s) of overhead costs

Capital costs might include: depreciation, interest and/or the opportunity costs of capital employed. It was not specified in the guidelines for WP8 which types of capital costs should be included. It was requested that the administrative time of medical and nursing personnel, insofar as it indirectly relates to patient care (such as record keeping) should not be classified as an overhead but instead included in direct patient costs. Training costs leading to professional qualifications were to be excluded from the analysis. It is assumed that the costs of research and development, and the costs of exceptional items such as major restructuring were excluded unless the authors of the individual country reports specified otherwise.

3.3.2 Variation in methods between providers within countries

Accurate costing of overheads for health care services is, almost by definition, a difficult task. Firstly, hospitals are usually structured according to functional departments, such as administration, maintenance of buildings etc, whose activity indirectly supports many different health care programmes. There is unlikely to exist a single measure of the work of the overhead function that fairly reflects its use by individual health care programmes, or even if in principle this could be defined, this data is often not collected. Therefore 'bottom-up' or microcosting is rarely a feasible method to allocate all of the overheads of a health care provider to healthcare services. Instead, top down or step-down approximations are often used to allocate overhead services to lower-level units, such as wards or surgical theatres, and then from wards to individual services and healthcare programmes. Other approximations are sometimes used, such as assuming that indirect and overhead costs can be reflected by a proportionate "mark-up" on the direct costs of the service. Consequently, providers are likely to differ in the methods they use to make these approximate allocations, and in the accuracy which they achieve. Secondly, health care providers are often publicly owned, and in many countries such bodies are not responsible for, and do not have to account for, all of the costs of providing that service. In particular, the costs of capital, which might include any or all of depreciation, rent, real or notional interest on loans, and the opportunity cost of

capital employed are in these cases the responsibility of another public body, such as local government. Thirdly, countries or providers may differ in the costs that they are able or willing to disclose. Some providers are able to identify the costs of their overhead departments through an audited process such as the annual accounts, and this data was made available to the researchers either by the individual provider or through databases available at national level. Other countries or providers do not have data at this level or are unwilling to disclose it. Consequently there are likely to be considerable differences between countries, between providers within countries, and between vignettes in the methods used to calculate indirect costs of health care services, the costs they include, and the sources of data that are available.

Table 5 shows the methodology each country used to cost overheads in each vignette. The items included are compared for each country and each vignette, grouped as medical infrastructure, non-medical infrastructure, depreciation, and opportunity costs of capital (land, building and equipment employed). The method broadly used to apportion resources to programmes is specified. For example, was a single apportionment base used (e.g. length of stay, time in theatre), a combination of apportionment bases or a method such as mark-up. The source of the overhead cost data is specified, for example, the annual accounts of the provider, an estimate given by the provider to the researchers, or an external source such as an equipment supplier.

German hospitals included all levels of medical and non-medical overhead costs, and depreciation. The opportunity costs of capital employed were not included by hospitals. The apportionment of overheads by hospital health care services was proportional to length of stay for overheads supporting ward activity and proportional to operating theatre time for overhead functions supporting theatre activity. Hospital cost data was made available to researchers from the annual accounts of the participating hospitals.

Hospitals in Italy differed in the categories of overhead cost they were able to include in each vignette. In general, most were able to include most classes of medical infrastructure. On the other hand, there was variation between Italian hospitals in the types of non-medical infrastructure included, with some providers not able to include costs of utilities such as energy or of administrative personnel. Not all hospitals were able to estimate depreciation. Overhead cost data was taken from the hospital annual accounts, and was apportioned to services proportional to length of stay for

overheads supporting ward activity and proportional to operating theatre time for overhead functions supporting theatre activity.

Dutch hospitals included all categories of medical and non-medical overheads, depreciation and interest on loans. This includes the opportunity cost of all the capital employed. Overhead cost data was taken from the hospital annual accounts, but not all hospitals in the sample were able to provide this data, mostly because they hold incomplete annual accounts or do not produce annual accounts at all. Where overhead data was not available, it was imputed as the mean value (in absolute terms) of the hospitals which were able to provide data. In some vignettes there was considerable missing data, for example, only 4 out of 10 hospitals in the appendectomy vignette and 3 out of 7 in the stroke vignette provided overhead costs. Overheads were apportioned to services according to a percentage mark-up, that is, proportional to the direct cost of the service, excluding the cost of clinicians.

It was not stated in the report which categories of medical and non-medical overhead costs were included by hospitals in Poland. The costs exclude depreciation and the costs of capital. It is stated that overheads were in general apportioned to services proportionate to length of stay, and also that there were differences between providers in the methods used, but that these methods were not known to the researchers. The source of the cost data was the estimates given to the researchers by the providers.

The French hospital system includes public, not-for-profit and for-profit providers and methods differed between them. The hospitals costs include all categories of medical and non-medical overheads and depreciation, but not always capital costs, especially for public hospitals. Hospitals made detailed cost data available from their annual accounts to the researchers who estimated the overheads. Costs were apportioned to services proportional to length of stay for overheads supporting ward activity and proportional to operating theatre time for overhead functions supporting theatre activity. The researchers state that private for-profit hospitals tended to have less complete cost data (for this exercise) than public and non-for-profit.

Hospital overhead cost data for England was mainly informed by a national database of costs of services for each provider, calculated according to a common methodology using data from the annual accounts of each provider. These costs include all categories of medical and non-medical overheads, depreciation and the

opportunity costs of capital employed in land, building and equipment. The common methodology required each provider to calculate the cost per day of long-stay outlier patients (known as excess bed days) for each DRG. This value included all standard ward based costs, such as nursing, together with overheads per patient per day for the DRG. The researchers assumed that the ward-based costs per day for each inpatient vignette could be represented by the most similar DRG. The method employed by the researchers includes the costs of standard nursing care as an overhead and therefore is likely to underestimate direct costs and overestimate overheads.

Medical infrastructure overhead costs in Spain include laundry and food. These costs were obtained from hospital accounts and were apportioned proportional to length of stay. Non-medical infrastructure costs include hospital management, admissions and planning, cleaning and general maintenance. These costs were not available from hospital accounts and the researchers state that they obtained these costs from hospital managers. Non-medical infrastructure costs were apportioned to services according to a mark-up, that is, proportionate to the direct costs. It is not clearly stated whether the other categories of medical and non-medical overhead were excluded. Depreciation and the costs of capital are accounted for by a different government department and are excluded from the analysis.

Overhead costs in Danish hospitals were calculated from a national database of the costs of services for each patient at each provider, calculated according to a common methodology using data from the annual accounts of each provider. Details of the apportionment measures used to calculate these costs were not stated in the report. These costs include all medical and non-medical expenditure, excluding depreciation and costs of capital. Researchers identified the patients in this database who most closely matched the vignettes, and calculated the mean total cost from the database for each provider. They assumed that overheads for each vignette were the difference between the mean total cost from the database and the mean direct cost of the vignette calculated using the WP8 methodology. They then estimated the proportion of overheads that were at department level and the proportion that were at hospital level, using the ratio calculated at one hospital which was able to provide detailed information to the researchers.

It is likely that calculation method of overhead costs varies between Hungarian hospitals. The research team did not determine common method but providers

should have listed the type of costs included in the overheads. In the case of hospitals, the source of the overhead cost data is accounting system, while in the case of GPs, the cost elements of overhead were mainly estimated by the clinicians themselves.

Hungarian hospitals provided estimates of the overheads costs of each vignette to the researchers and did not use a common methodology. Interpretation of the costs to include in overheads may vary between providers although the research team believe that all medical and non-medical costs were included. Not all providers included depreciation. Opportunity costs of capital and training costs were not included. In one provider the costs of administrative personnel are included in the costs of nursing care. Overheads were mainly calculated by top-down approach, that is to say, overheads were divided by total patient days. Hospitals obtained estimates of overhead costs from their accounting system.

3.3.2.1 Calculation of overheads in vignettes where healthcare is provided in non-hospital settings

The apportionment of overheads by German outpatient (primary care based) services was proportional to the number of patient sessions or the length of the sessions. Primary care providers gave estimates of their average monthly expenditures on the main overhead items to the researchers, and included an estimate of rent or interest on capital employed.

The overhead categories included in the cost of Italian primary care practices and dental practices varied between providers but generally included rent and practice furnishings, utilities, cleaning, waste management, insurance, data processing, miscellaneous purchases, administrative assistance and trainee costs. Data was obtained from estimates provided by the practice. Researchers allocated overheads to health care services proportional to the duration of the consultation.

Costs of overheads of case-vignettes concerning non-hospital care in the Netherlands were directly derived from the GP, dental and physiotherapeutic practices. Costs that were asked for included the costs of supportive personnel, insurance, telecommunication and administration. Capital costs (depreciation and interest) could not be obtained from the individual centres. For that reason, the standard practice costs were used as issued by the Healthcare Authority [14-17]. As

a consequence, the capital costs for the case-vignettes concerning non-hospital care are not valued separately but included in the costs per hour of the GP, dentist and physiotherapist. Overheads were allocated to each health care service in proportion to length of session.

Overhead costs for primary care services in Poland were obtained from the estimates given by each provider. It is not stated precisely which cost categories were included in the overhead. Overheads were allocated to services proportional to the length of the session. Depreciation and capital costs were not included.

Primary care, dental and physiotherapy costs in France include all categories of medical and non-medical overhead, depreciation and rent, which may be taken to include the opportunity costs of land, building and equipment. Cost data was taken from annual accounts. Overheads were apportioned to services proportionate to the length of the session for primary care and dental practices, and proportionate to the number of sessions for physiotherapy services.

In England, cost data for primary care was obtained from an annual national survey of general practitioners (GPs), which includes an estimate of the overhead, capital and equipment costs. Depreciation and capital costs for dentists were taken from a recent national survey of dental practitioners. Overheads for dentists were assumed similar to GPs, though the researchers warn that this may be an underestimate. Overheads were apportioned to services proportionate to the length of the session.

Overhead costs for primary care and dental services in Spain were calculated as a percentage of the total cost of the procedure.

Primary care costs in Denmark include all categories of medical and non-medical overhead, depreciation, interest and rent, which may be taken to include the opportunity costs of land, building and equipment. Cost data was taken from a recent national survey. Overheads were apportioned to services proportionate to the length of the session. For dental care, the included categories of medical and non-medical overhead varied between providers, but excluded capital costs and depreciation. Overheads were allocated to services by a mark-up on direct costs, calculated by the municipal authority that employs dentists or by the dental practice themselves.

In Hungary GPs provided estimates of overheads according to their own calculations. GPs generally included all medical and non-medical overhead costs but there might be some variation in the cost types included. Not all providers included depreciation. Opportunity costs of capital and training costs were not included. In one dentist surgery the costs of administrative personnel are included in the costs of nursing care. The apportionment of overheads was proportional to length of session for outpatient vignettes and GPs.

Table 5: Summary of the methodology used by each country to estimate overhead costs for each vignette. The column headings are explained in Table 4.

Country	Vignette	Medical infras	Non m inf	Depn	Opp costs	Apportion base(s)	Sources
Germany	Appendectomy	All	All	All	X	LoS, OT time	Accounts
Germany	Delivery	All	All	All	X	LoS, OT time	Accounts
Germany	Hip	All	All	All	X	LoS, OT time	Accounts
Germany	Cataract (Hospital)	All	All	All	X	LoS, OT time	Accounts
Germany	Cataract (non-hospital)	All	All	All	All	Number of sessions	Providers estimate
Germany	Stroke	All	All	All	X	LoS	Accounts
Germany	AMI (PTCA)	All	All	All	X	LoS (OT time)	Accounts
Germany	Cough (outpatient)	All	All	All	All	Length of session	Providers estimate
Germany	Colonoscopy (outpatient)	All	All	All	All	Number of sessions	Providers estimate
Germany	Filling	All	All	All	All	Length of session	Providers estimate, external
Germany	Physiotherapy	All	All	All	All	Length of session	Providers estimate
Italy	Appendectomy	All	Varies	Most	X	LoS, OT time	Accounts
Italy	Delivery	All	Varies	Most	X	LoS, OT time	Accounts
Italy	Hip	All	Varies	Most	X	LoS, OT time	Accounts
Italy	Cataract (Hospital)	All	Varies	Most	X	Length of session	Accounts
Italy	Stroke	All	Varies	Most	X	LoS, OT time	Accounts
Italy	AMI	All	Varies	Most	X	LoS, OT time	Accounts
Italy	Cough (primary care)	Varies	Varies	X	X	LoS	Providers estimate
Italy	Colonoscopy (hospital)	All	Varies	Most	X	Number of sessions	Accounts

WP10: International comparison of costs

Country	Vignette	Medical infras	Non m inf	Depn	Opp costs	Apportion base(s)	Sources
Italy	Filling (primary care)	Varies	Varies	X	X	LoS	Providers estimate
Italy	Physiotherapy (hospital)	All	Varies	Most	X	Number of sessions	Accounts
Netherlands	Appendectomy	Some Imputed	Some Imputed	Some Imputed	X	Mark up	Accounts
Netherlands	Delivery	Some Imputed	Some Imputed	Some Imputed	X	Mark up	Accounts
Netherlands	Hip	Some Imputed	Some Imputed	Some Imputed	X	Mark up	Accounts
Netherlands	Cataract (Hospital)	Some Imputed	Some Imputed	Some Imputed	X	Mark up	Accounts
Netherlands	Stroke	Some Imputed	Some Imputed	Some Imputed	X	Mark up	Accounts
Netherlands	AMI	Most Imputed	Most Imputed	Most Imputed	X	Mark up	Accounts
Netherlands	Cough (primary care)	All	All	All	X	Length of session	Providers estimate
Netherlands	Colonoscopy (hospital)	Some Imputed	Some Imputed	Some Imputed	X	Mark up	Accounts
Netherlands	Filling (primary care)	All	All	All	X	Length of session	Providers estimate
Netherlands	Physiotherapy (primary care)	Some Imputed	Some Imputed	Some Imputed	X	Length of session	Providers estimate
Poland	Appendectomy	N/S	N/S	X	X	LoS	Providers estimate
Poland	Delivery	N/S	N/S	X	X	LoS	Providers estimate
Poland	Hip	N/S	N/S	X	X	LoS	Providers estimate
Poland	Cataract (Hospital)	N/S	N/S	X	X	LoS	Providers estimate
Poland	Stroke	N/S	N/S	X	X	LoS	Providers estimate
Poland	AMI	N/S	N/S	X	X	LoS	Providers estimate
Poland	Cough	N/S	N/S	X	X	Length of session	Providers estimate
Poland	Colonoscopy	N/S	N/S	Varies	X	Length of session	Providers estimate
Poland	Filling	N/S	N/S	X	X	Length of session	Providers estimate
Poland	Physiotherapy	N/S	N/S	X	X	Length of session	Providers estimate
France (2)	Appendectomy	All	All	All	X	LoS	Accounts
France (2)	Delivery	All	All	All	X	LoS	Accounts
France (2)	Hip	All	All	All	X	LoS	Accounts
France (2)	Cataract (Hospital)	All	All	All	X	LoS	Accounts
France (2)	Stroke	All	All	All	X	LoS	Accounts
France (2)	AMI	All	All	All	X	LoS	Accounts

WP10: International comparison of costs

Country	Vignette	Medical infras	Non m inf	Depn	Opp costs	Apportion base(s)	Sources
France	Cough	All	All	All	X	Length of session	Accounts
France (2)	Colonoscopy	All	All	All	X	LoS	Accounts
France	Filling	All	All	All	X	Length of session	Accounts
France	Physiotherapy	All	All	All	X	Number of sessions	Accounts
England	Appendectomy	All	All	All	All	LoS	Accounts
England	Delivery	All	All	All	All	LoS	Accounts
England	Hip	All	All	All	All	LoS	Accounts
England	Cataract (Hospital)	All	All	All	All	LoS	Accounts
England	Stroke	All	All	All	All	LoS	Accounts
England	AMI	All	All	All	All	LoS	Accounts
England	Cough	All	All	All	All	Length of session	External
England	Colonoscopy	All	All	All	All	Number of sessions	Accounts
England	Filling	All	All	All	All	Length of session	External
England	Physiotherapy	All	All	All	All	Length of session	External
Spain (1)	Appendectomy	Varies, some imputed	Varies, some imputed	Varies, some imputed	X	LoS, Mark up	Providers estimate
Spain (1)	Delivery	Varies, some imputed	Varies, some imputed	Varies, some imputed	X	LoS, Mark up	Providers estimate
Spain (1)	Hip	Varies, some imputed	Varies, some imputed	Varies, some imputed	X	LoS, Mark up	Providers estimate
Spain (1)	Cataract (Hospital)	Varies, some imputed	Varies, some imputed	Varies, some imputed	X	LoS, Mark up	Providers estimate
Spain (1)	Stroke	Varies, some imputed	Varies, some imputed	Varies, some imputed	X	LoS, Mark up	Providers estimate
Spain (1)	AMI	Varies, some imputed	Varies, some imputed	Varies, some imputed	X	LoS, Mark up	Providers estimate
Spain (1)	Cough	N/S	N/S	N/S	N/S	Length of session	N/S
Spain (1)	Colonoscopy	Varies, some imputed	Varies, some imputed	Varies, some imputed	X	LoS, Mark up	Providers estimate
Spain (1)	Filling	N/S	N/S	N/S	N/S	Length of session	N/S
Spain (1)	Physiotherapy	Varies, some imputed	Varies, some imputed	Varies, some imputed	X	LoS, Mark up	Providers estimate
Denmark(3)	Appendectomy	All	All	X	X	Step down approach	Accounts

WP10: International comparison of costs

Country	Vignette	Medical infras	Non m inf	Depn	Opp costs	Apportion base(s)	Sources
Denmark(3)	Delivery	All	All	X	X	Step down approach	Accounts
Denmark(3)	Hip	All	All	X	X	Step down approach	Accounts
Denmark(3)	Cataract (Hospital)	All	All	X	X	Step down approach	Accounts
Denmark(3)	Stroke	All	All	X	X	Step down approach	Accounts
Denmark(3)	AMI	All	All	X	X	Step down approach	Accounts
Denmark(4)	Cough	All	All	All	X	Length of session	National survey
Denmark(3)	Colonoscopy (hospital)	All	All	X	X	Step down approach	Accounts
Denmark	Filling	All	All	X	X	Mark up	Providers estimate
Denmark	Physiotherapy	N/S	N/S	X	X	Mark up	Providers estimate
Hungary	Appendectomy	All	All	Varies	X	LoS	Accounts
Hungary	Delivery	All	All	Varies	X	LoS	Accounts
Hungary	Hip	All	All	Varies	X	LoS	Accounts
Hungary	Cataract (Hospital)	All	All	Varies	X	LoS, Length of session	Accounts
Hungary	Stroke	All	All	Varies	X	LoS	Accounts
Hungary	AMI	All	All	Varies	X	LoS	Accounts
Hungary	Cough	Varies	Varies	Varies	X	Length of session	Providers estimate
Hungary	Colonoscopy (hospital)	All	All	Varies	X	Length of session	Accounts
Hungary	Filling	Varies	Varies	Varies	X	Length of session	Providers estimate
Hungary	Physiotherapy	All	All	Varies	X	Length of session	Accounts

Notes

(1) Only providers from the Catalonia autonomous community of Spain were sampled

(2) Overhead costs from hospitals in France include an estimate of non-patient contact time by clinicians.

(3) Total average hospital costs in Denmark were calculated from a national cost database, including allocation of all overhead costs. Department and hospital overhead costs were estimated as the difference between total average costs for the hospital and an estimate of department direct costs. National costs were trimmed to exclude lowest 1% and highest 1% of patients ranked by cost. It was not explained whether this excludes day-surgery patients.

(4) Overhead costs for GP was estimated using a national survey of GPs from 2004.

Key to Table 5

Medical infras	Medical infrastructure overheads
Non m inf	Non medical infrastructure overheads
Depn	Depreciation
Opp costs	Opportunity cost of capital
Accounts	The source of overhead cost data was the audited annual accounts of the provider, a national cost database derived from the annual accounts of providers, or annual submission to reimbursement or tax authorities
All	All overheads in this category are included by all providers
External	Overhead cost was estimated using an external source (eg equipment supplier,

	independent survey)
Length of session	Overhead costs were allocated to services proportional to length of session, consultation, treatment or visit
LoS	Ward-related overhead costs were allocated to services proportional to length of stay
Mark up	Overhead costs were allocated to services proportional to cost of direct services
N/S	Information on this category was not supplied in the report, or the method was not described
Number of sessions	Overhead costs were allocated to services proportional to the number of sessions, consultations, treatments or visits
OT time	Operating theatre overhead costs were allocated to services proportional to time in operating theatre or delivery suite
Providers estimate	The source of the overhead cost data was the estimate of the provider
Some (most) imputed	Some (most) providers were unable to estimate some or all types of overheads in this category and missing values were imputed using the mean of those who reported data
TBC	Report states that information is in draft form and to be completed
Varies	Inclusion / exclusion of overheads in this category varies between providers
X	All overheads in this category are excluded by all providers

3.4 Costs and prices: a comparison by vignette

This section provides an overview of the relationship between the total cost of care for each vignette and the reimbursement available to providers. The exploratory analysis of the correlation between prices (reimbursement) and costs showed that in delivery, stroke and colonoscopy, prices and costs match fairly well on average, though there are outliers. In the case of appendectomy, hip replacement, cataract and AMI, prices are on average greater than costs. In the vignette for tooth filling, prices seem likely to be lower than costs. Table 6 summarises the correlation between reimbursement and cost and the proportion of providers for whom reimbursement exceeded cost. There were no adequate data available to enable the relationship between cost and reimbursement for the treatment of cough (vignette 7) or for physiotherapy (vignette 10) to be investigated. In addition, there were no Spanish reimbursement data available for vignettes where providers are not paid on a per case basis.

Table 6: Overview of the correlation between reimbursement and cost (all providers)

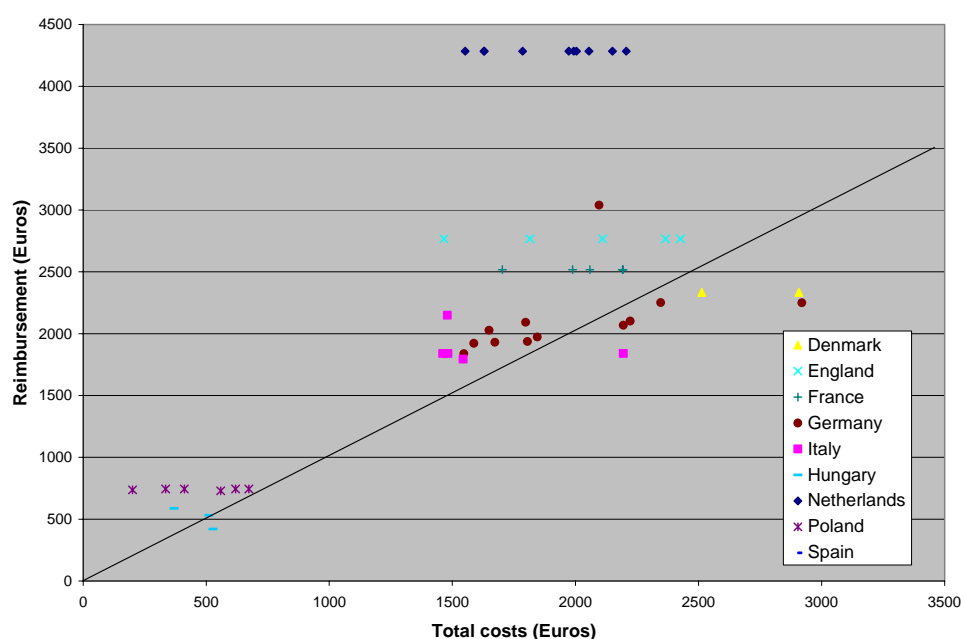
Vignette	Pearson's correlation coefficients	Proportion with cost less than reimbursement
Appendectomy	0.614	83%
Normal delivery	0.894	42%
Hip replacement	0.811	71%
Cataract	0.489	76%
Stroke	0.619	50%
AMI	0.750	67%
Cough	NA	NA
Colonoscopy	0.779	61%
Filling	0.285	47%
Physiotherapy	NA	NA

NA: not available

3.4.1 Vignette 1: appendectomy

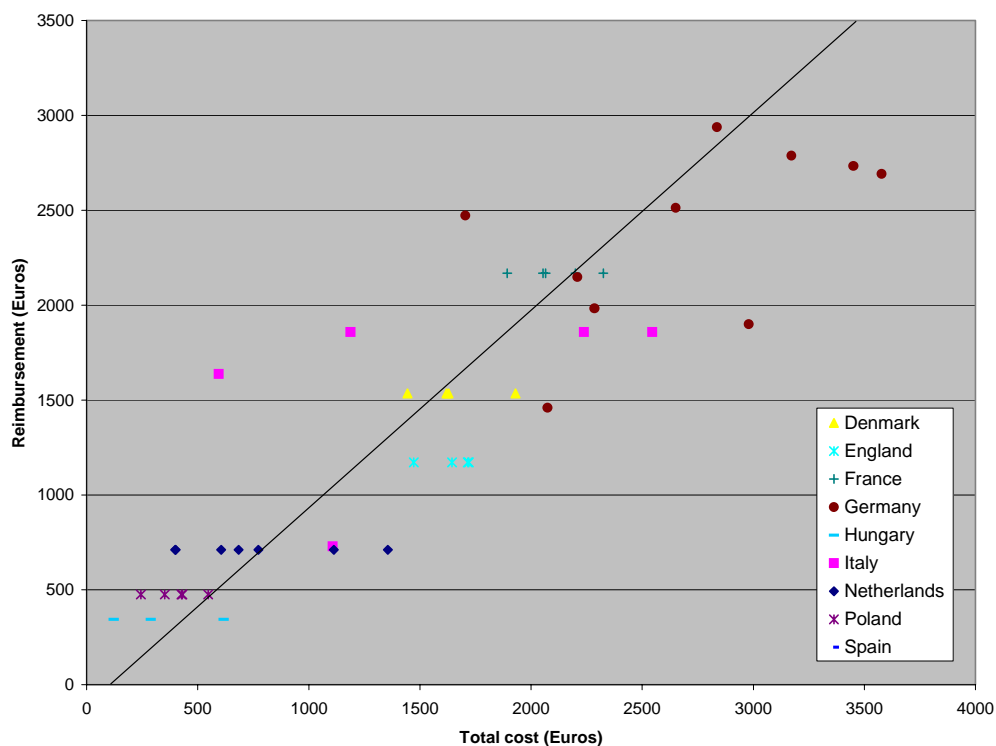
Figure 1 uses country-level data to demonstrate how the total cost of care for appendectomy relates to reimbursement. The line through the origin represents the values at which total cost is equal to total reimbursement. In general, there appears to be a direct correlation between total cost and reimbursement, with countries having lower costs also receiving lower levels of reimbursement (Pearson's correlation coefficient: $r = 0.614$). However, over 80% of providers receive reimbursement that is higher than the total cost of care for appendectomy. For these providers, the level of 'profit' (positive difference between reimbursement and cost) varied from €21 for a Hungarian hospital to over €2700 in a provider from the Netherlands (mean 'profit' value for all providers making a surplus: €907). Providers in the Netherlands generally appear to incur costs that are similar to those of most countries, but Dutch providers receive high levels of reimbursement relative to other countries. Reimbursement data for Spain were not available for this vignette: there are no tariffs because providers are not paid on a per case basis.

Figure 1: Price (reimbursement) vs. cost of care for appendectomy



also receiving lower levels of reimbursement (Pearson's correlation coefficient: $r = 0.894$). However, over half of all providers (58%) incurred costs in excess of reimbursement levels. For providers that incurred costs below reimbursement levels, the mean level of 'profit' was €260 (range: €27 (Netherlands) to €1044 (Italy)). Reimbursement data for Spain were not available for this vignette: there are no tariffs because providers are not paid on a per case basis.

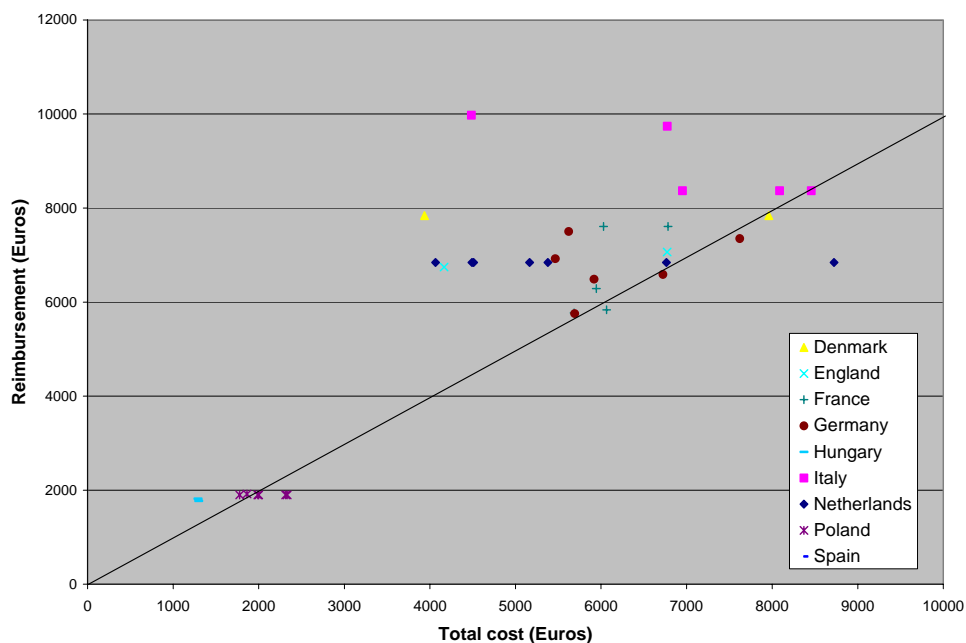
Figure 2: Price (reimbursement) vs. cost of care for normal delivery



3.4.3 Vignette 3: hip replacement

The relationship between reimbursement and the total cost of care for hip replacement is shown in Figure 3. There is a positive linear relationship between the two variables (Pearson's correlation coefficient: $r = 0.811$). The line through the origin represents the values at which total cost is equal to total reimbursement. About 70% of the data points lie above this line, indicating that most providers receive reimbursement in excess of the costs they incur for this intervention. The mean level of 'profit' for these providers was around €1460, with the statistic varying from around €60 for a Polish provider to almost €5500 for an Italian hospital. Reimbursement data for Spain were not available for this vignette: there are no tariffs because providers are not paid on a per case basis.

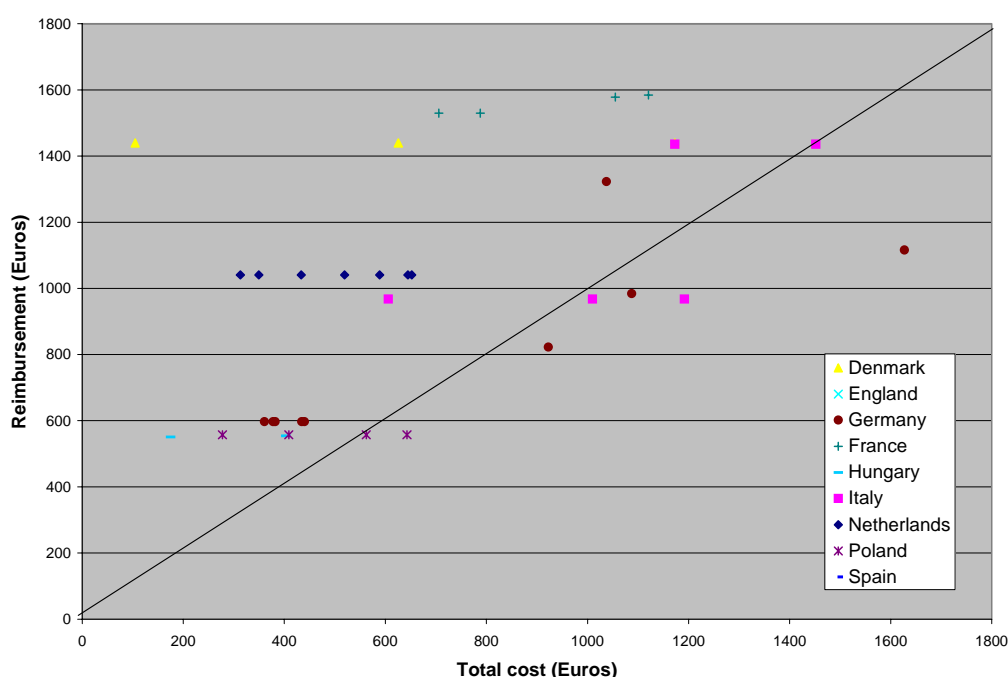
Figure 3: Price (reimbursement) vs. cost of care for hip replacement



3.4.4 Vignette 4: cataract

The relationship between reimbursement and the total cost of care for outpatient treatment of cataract is shown in Figure 4. There is a positive linear relationship between the two variables (Pearson's correlation coefficient: $r = 0.489$). The line through the origin represents the values at which total cost is equal to total reimbursement. About three-quarters (76%) of the data points lie above this line, indicating that most providers receive reimbursement in excess of the costs they incur for this intervention. Amongst those providers with costs less than reimbursement, the mean level of 'profit' (positive difference between reimbursement and cost) was around €470, with the statistic varying from around €150 for one Polish provider to over €1330 for a Danish hospital. There is currently no tariff available for this treatment in England, so this country contributed no data for this analysis. In addition, reimbursement data for Spain were not available for this vignette: there are no tariffs because providers are not paid on a per case basis.

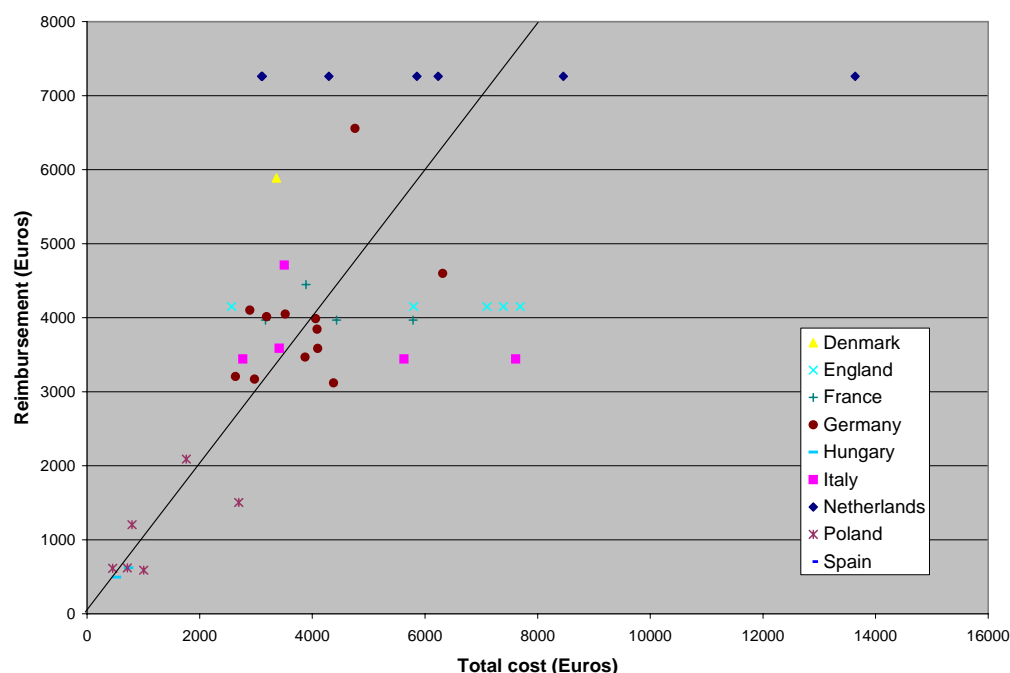
Figure 4: Price (reimbursement) vs. cost of care for cataract



3.4.5 Vignette 5: stroke

The relationship between reimbursement and the total cost of care for stroke is shown in Figure 5. There is a positive linear relationship between the two variables (Pearson's correlation coefficient: $r = 0.619$). The line through the origin represents the values at which total cost is equal to total reimbursement. About 50% of the data points lie above this line, indicating that half of all providers receive reimbursement in excess of the costs they incur for this intervention. For these providers, the mean level of 'profit' (positive difference between reimbursement and cost) was around €1300, with the statistic varying from around €160 for one Polish provider to over €4160 for a Dutch hospital. Amongst providers incurring costs in excess of reimbursement, the magnitude of the 'loss' ranged from €25 for a Hungarian provider to €6380 for a Dutch provider, with the mean loss incurred totalling just over €1600. Reimbursement data for Spain were not available for this vignette: there are no tariffs because providers are not paid on a per case basis.

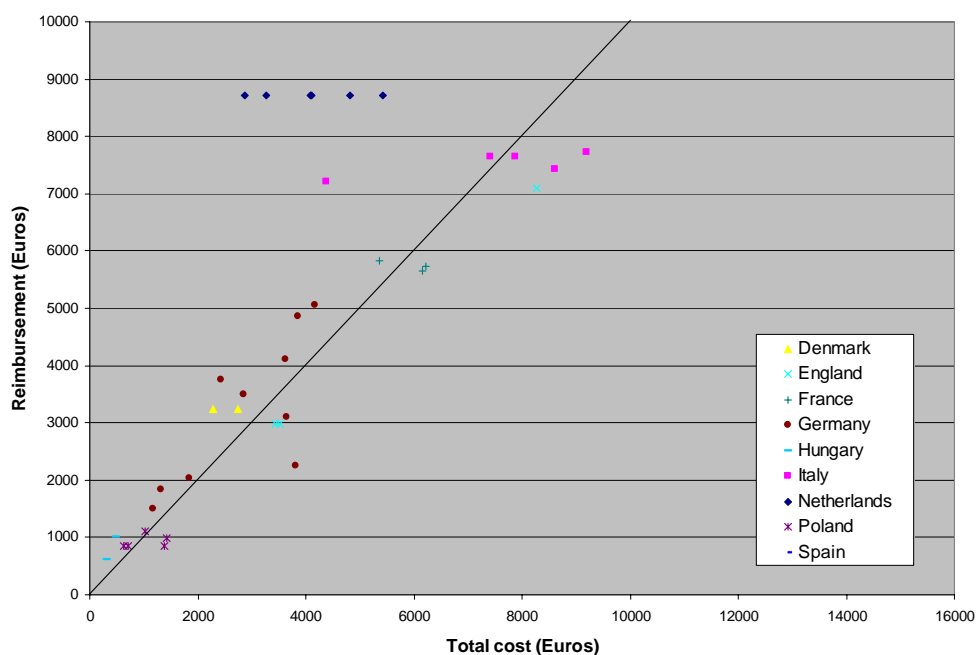
Figure 5: Price (reimbursement) vs. cost of care for stroke



3.4.6 Vignette 6: AMI

The relationship between reimbursement and the total cost of care the treatment of acute myocardial infarction (AMI) is shown in Figure 6. There is a positive linear relationship between the two variables (Pearson's correlation coefficient: $r = 0.750$). The line through the origin represents the values at which total cost is equal to total reimbursement. About two-thirds of the data points (67%) lie above this line, indicating that most providers receive reimbursement in excess of the costs they incur for this intervention. For these providers, the mean level of 'profit' was just under €1700, with the statistic varying from around €70 for one Polish provider to over €5800 for a Dutch hospital. Amongst providers incurring costs in excess of reimbursement, the mean loss incurred was around €760, with the magnitude of the 'loss' ranging from €220 for an Italian provider to €1570 for a German provider. Reimbursement data for Spain were not available for this vignette: there are no tariffs because providers are not paid on a per case basis.

Figure 6: Price (reimbursement) vs. cost of care for AMI



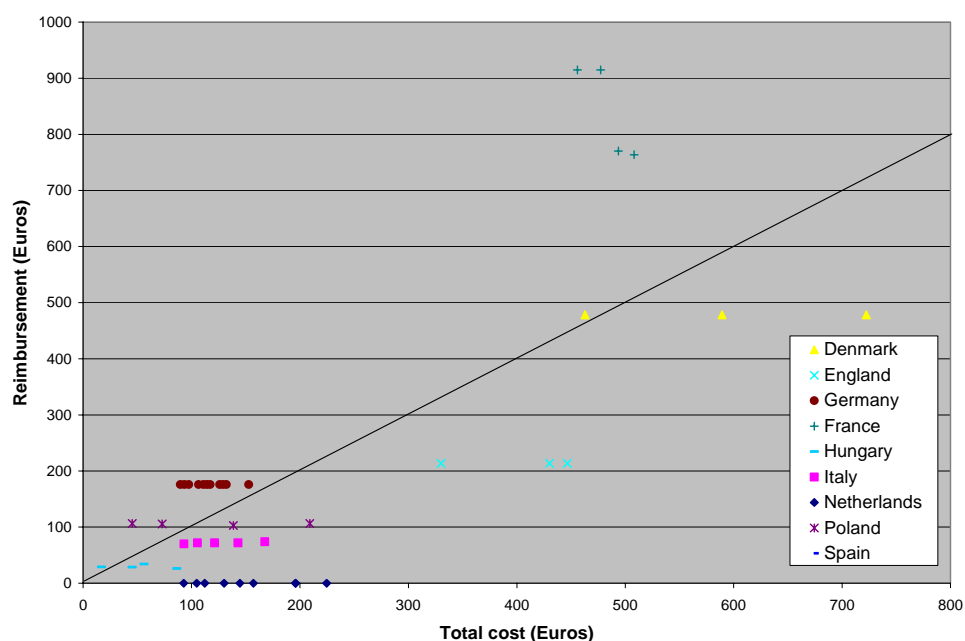
3.4.7 Vignette 7: cough

There were no adequate data available to enable the relationship between cost and reimbursement for the treatment of cough to be investigated.

3.4.8 Vignette 8: colonoscopy

The relationship between reimbursement and the total cost of colonoscopy as a diagnostic procedure is shown in Figure 7. There is a positive linear relationship between the two variables (Pearson's correlation coefficient: $r = 0.779$). The line through the origin represents the values at which total cost is equal to total reimbursement. About six in ten of the data points (61%) lie above this line, indicating that most providers receive reimbursement in excess of the costs they incur for this intervention. For these providers, the mean level of 'profit' was just over €110, with the statistic varying from around €2 for one Italian provider to around €460 for a French provider. Amongst providers incurring costs *in excess* of reimbursement, the magnitude of the mean 'loss' incurred was slightly lower than the corresponding profit levels made by others (€96), with figures ranging from €3 for an Italian provider to €240 for a Danish provider. Reimbursement data for Spain were not available for this vignette: there are no tariffs because providers are not paid on a per case basis.

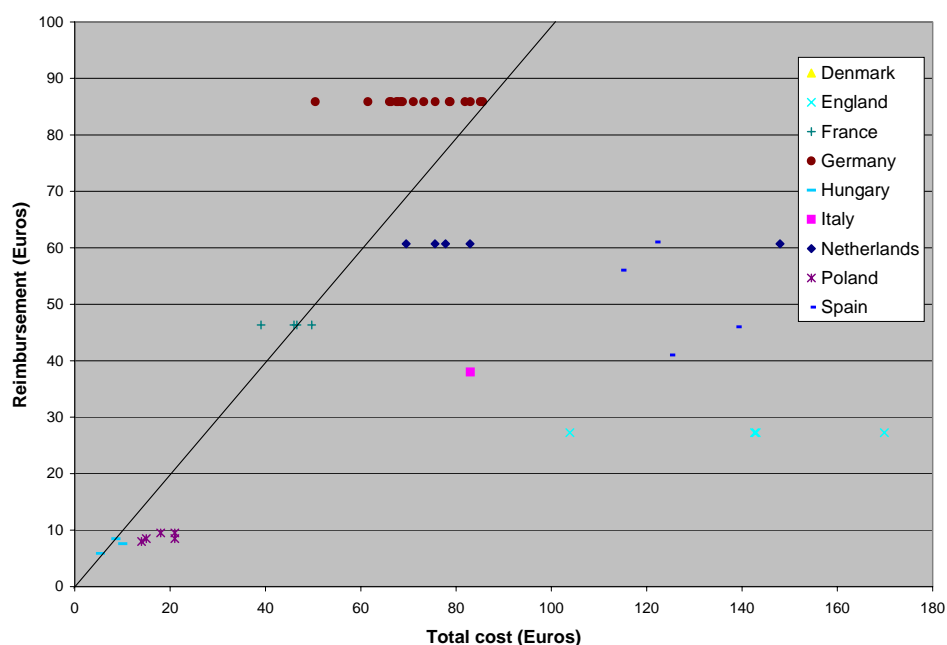
Figure 7: Price (reimbursement) vs. cost of colonoscopy



3.4.9 Vignette 9: tooth filling

The relationship between reimbursement and the total cost of tooth filling is shown in Figure 8. There is a weak positive linear relationship between the two variables (Pearson's correlation coefficient: $r = 0.285$). The line through the origin represents the values at which total cost is equal to total reimbursement. Just under half (47%) of the data points lie above this line, indicating that providers are slightly more likely to make a 'loss' for this intervention. For providers with a surplus, the mean level of 'profit' was €11.90, with the statistic varying from around €0.25 to over €35 (both providers were German). Amongst providers incurring costs in excess of reimbursement, the magnitude of the mean 'loss' incurred was €43, with figures ranging from €0.15 for a Hungarian provider to €143 for an English provider. Reimbursement and co-payment statistics were available for just one Italian provider because most Italian dentists contributing data to the survey were not publicly funded. In Denmark, dentists are paid through the annual budget of the municipality and not paid under a fee-for-service system, so reimbursement statistics are unavailable. There are no patient co-payments for this vignette in the Netherlands, Denmark, England, Poland and Hungary.

Figure 8: Price (reimbursement) vs. cost of tooth filling



3.4.10 Vignette 10: physiotherapy

There were no adequate data available to enable the relationship between cost and reimbursement for the treatment of physiotherapy to be investigated.

3.5 Cost categories: a comparison by vignette

This section reports, for each vignette, how the broad categories of total cost were distributed for each country. For most vignettes, the total cost of care in Hungary, Poland and Spain was below average. Differences in personnel costs appeared to explain international variations for the cough and filling vignettes, with differences in treatment setting appearing important for colonoscopy and possibly stroke. Overheads as a proportion of total cost varied widely both between countries and between vignettes. In general, the proportion of overheads in Denmark was high, comprising at least 70% of total costs in five of the vignettes. In Spain, overheads as a proportion of total costs ranged from 7% to 21%. A summary of the variation in overheads as a proportion of total cost is provided in Table 7.

Table 7: Variation in overheads as a proportion of total cost, by vignette and by country

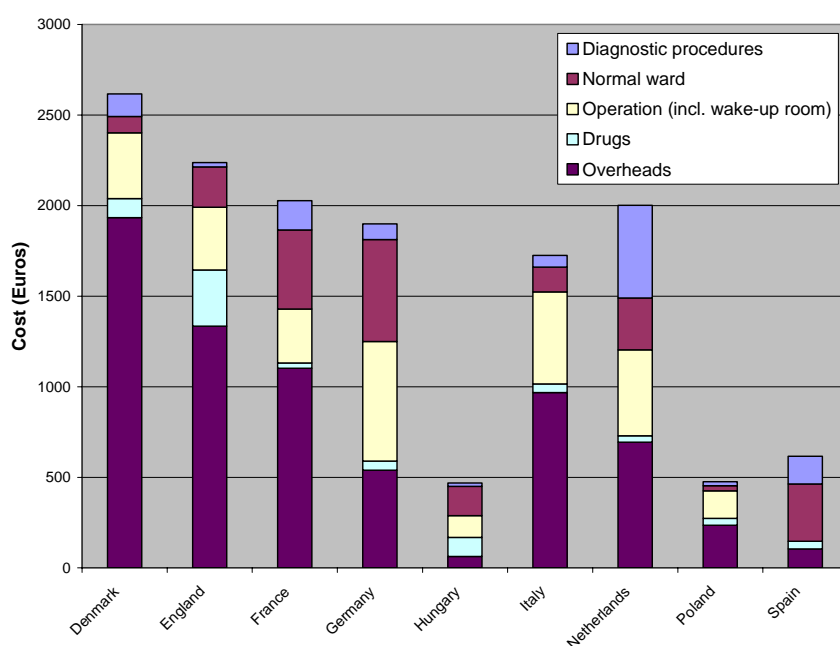
Vignette	Denmark	England	France	Germany	Hungary	Italy	Netherlands	Poland	Spain
Appendectomy	74%	60%	54%	28%	13%	56%	35%	49%	17%
Normal delivery	75%	50%	61%	33%	29%	64%	36%	37%	18%
Hip replacement	76%	49%	34%	25%	11%	35%	32%	12%	18%
Cataract	86%	43%	26%	34%	7%	51%	23%	57%	11%
Stroke	42%	52%	44%	30%	43%	65%	43%	37%	20%
AMI	NA	28%	24%	24%	24%	47%	12%	20%	19%
Cough	33%	10%	24%	49%	11%	37%	26%	10%	10%
Colonoscopy	70%	43%	44%	43%	42%	39%	20%	24%	11%
Tooth filling	19%	7%	31%	38%	19%	23%	17%	21%	40%
Physiotherapy	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA: not available

3.5.1 Vignette 1: appendectomy

The cost of care for appendectomy ranged from €469 (Hungary) to €2617 (Denmark). Total costs were sharply dichotomised, with three countries having 'low' costs (below €620), and the remaining six countries having 'high' costs (in excess of €1700). From Figure 9 it is clear that overheads appear to explain a good deal of this polarisation, as for five of the six 'high' cost countries, this particular cost component (*overheads*) exceeds the *total cost* of care in all three 'low' cost countries. In addition to the differences in the magnitude of overheads, the proportion of total cost it represents varies, ranging from 13% of total Hungarian costs to 74% of Danish costs.

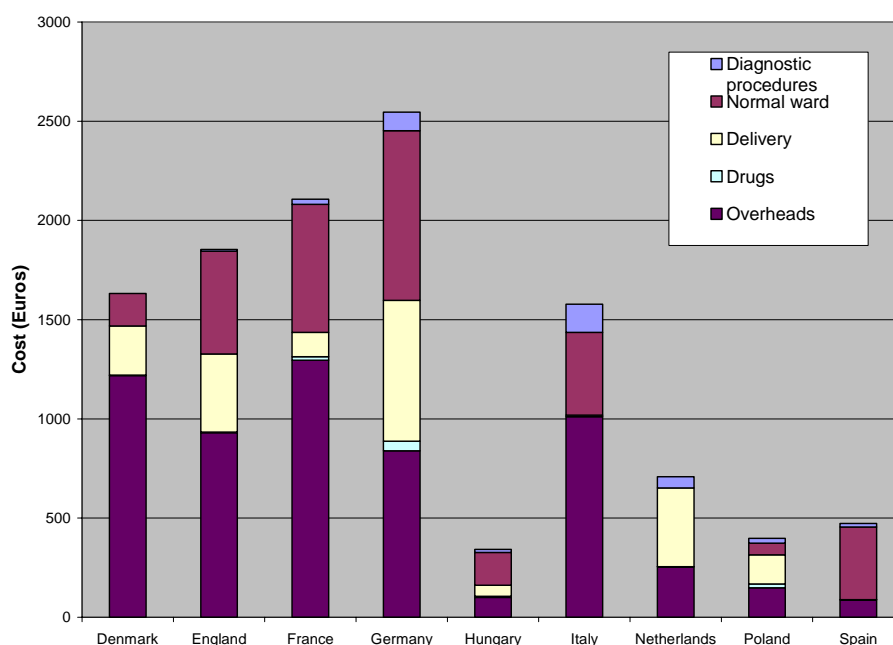
Figure 9: Appendectomy (vignette 1): comparison of costs by country



3.5.2 Vignette 2: normal delivery

The cost of care for normal delivery ranged from €342 (Hungary) to €2547 (Germany). The high total mean cost of care for Germany appears to be explained by the high labour costs both on the normal ward and during delivery. Figure 10 shows that the proportion of overheads relative to total cost varied widely and it is possible that in some countries, labour costs may have been subsumed within overheads. On average, overheads accounted for 45% of costs, with the figure ranging from 18% of total Spanish costs to 75% of Danish costs. However, this proportion was relatively low in Germany (33%), the Netherlands (36%) and Poland (37%).

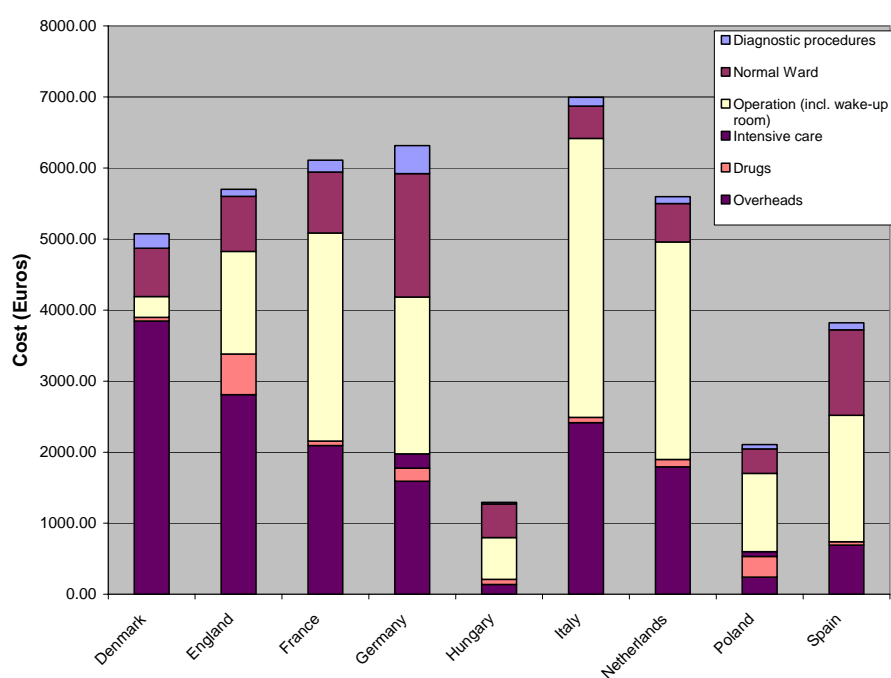
Figure 10: Normal delivery (vignette 2): comparison of costs by country



3.5.3 Vignette 3: hip replacement

The cost of care for hip replacement was highly variable and ranged from €1290 (Hungary) to almost €7000 (Italy). Six of the nine countries had total costs above €5000. Figure 11 demonstrates a high variation in the proportion of overheads to total cost, ranging from 12% for Poland to 76% for Denmark (see section 3.3.1 for a discussion of the differing methodologies that help to explain this effect). In addition the proportion of total cost represented by theatre cost varied from 6% (Denmark) to 56% (Italy). This suggests that some of the Danish theatre costs may have been subsumed in the overhead calculations.

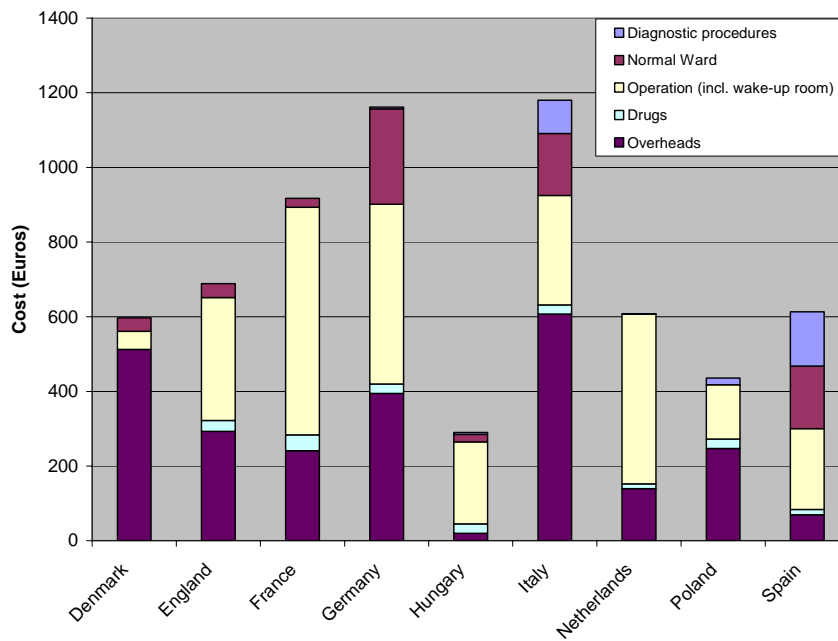
Figure 11: Hip replacement (vignette 3): comparison of costs by country



3.5.4 Vignette 4: cataract

Cataract operations are one of the most commonly performed surgical procedures. There was a large variation in cost of treatment of cataract, with cost ranging from €290 (Hungary) to almost €1200 (Italy), i.e. varying by a factor of four. The proportion of overheads relative to total cost varied widely, with Denmark incurring 86% of its total cost in overheads compared with 7% in Hungary. In Italy, only 25% of the total cost was attributed to theatre-related activity, whilst in France, theatre cost formed 66% of total cost and the figure was round 75% in both Hungary and the Netherlands (Figure 12).

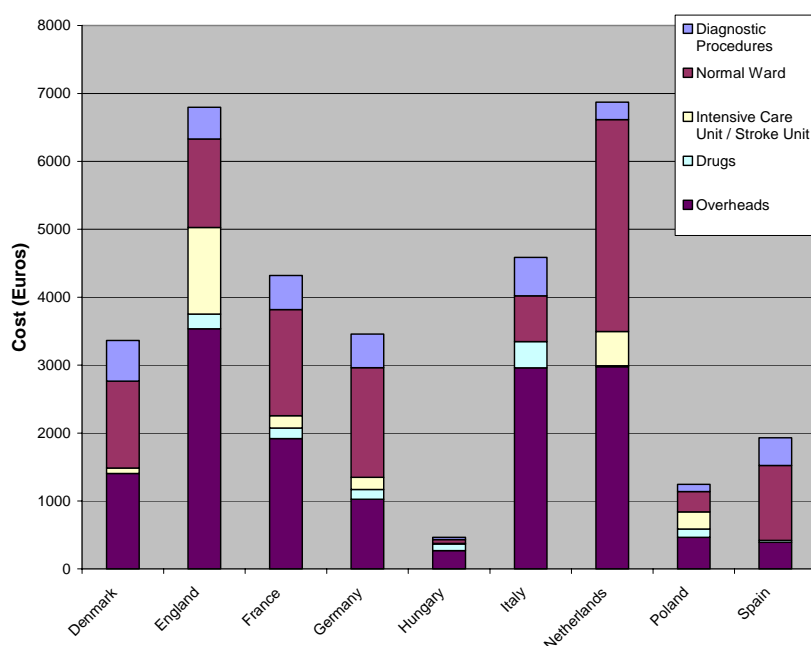
Figure 12: Cataract (vignette 4): comparison of costs by country



3.5.5 Vignette 5: stroke

There was a large variation in cost of care for stroke, with three countries having costs below €2000, four countries having cost in the region of €3500 to €4500 and two countries having costs in excess of €6500 (Figure 13). England has the highest total cost, which appears to be explained by the relatively large proportion of overheads and intensive care unit costs, both of which are directly related to length of stay. In two of the five hospitals in the English sample, patients received care principally on an intensive care unit. Both hospitals had high mean length of stay (13.9 and 16.7 days) relative to the mean length of stay for all countries (12.6 days). The Netherlands also had high cost of care for stroke, which appears to be related to the high mean length of stay in the Netherlands (15.8 days; range: 9 days to 30 days, N=7). Length of stay for stroke is likely to be reflect the care pathway within a country: for example, the availability of rehabilitation or intermediate care may shorten length of stay by allowing patients to be discharged more quickly.

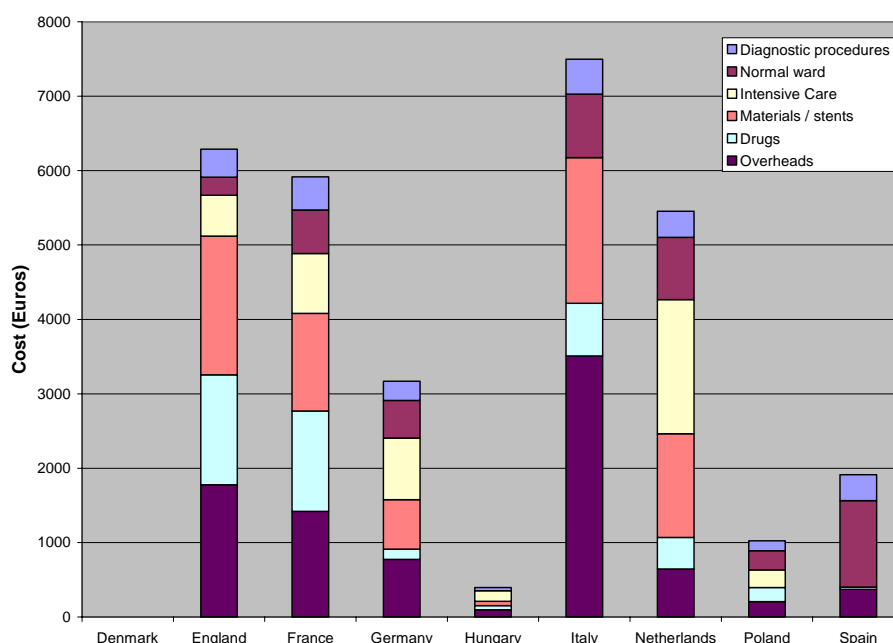
Figure 13: Stroke (vignette 5): comparison of costs by country



3.5.6 Vignette 6: AMI

There was a very large variation in cost of care for acute myocardial infarction, with the highest total cost country (Italy: €7500) exceeding the cost of the lowest cost country (Hungary: €400) by a factor of around 19. The proportion of overheads relative to total costs for Hungary (24%) was around half the corresponding proportion for Italy (47%) (Figure 14). The country with the lowest proportion of overheads to total cost was the Netherlands (12%). Neither Poland nor Spain identified any costs for stents or related materials, whereas this cost category accounted for one-quarter of total costs for Italy and the Netherlands and almost one-third of the total cost for England. Danish data were not available for this analysis.

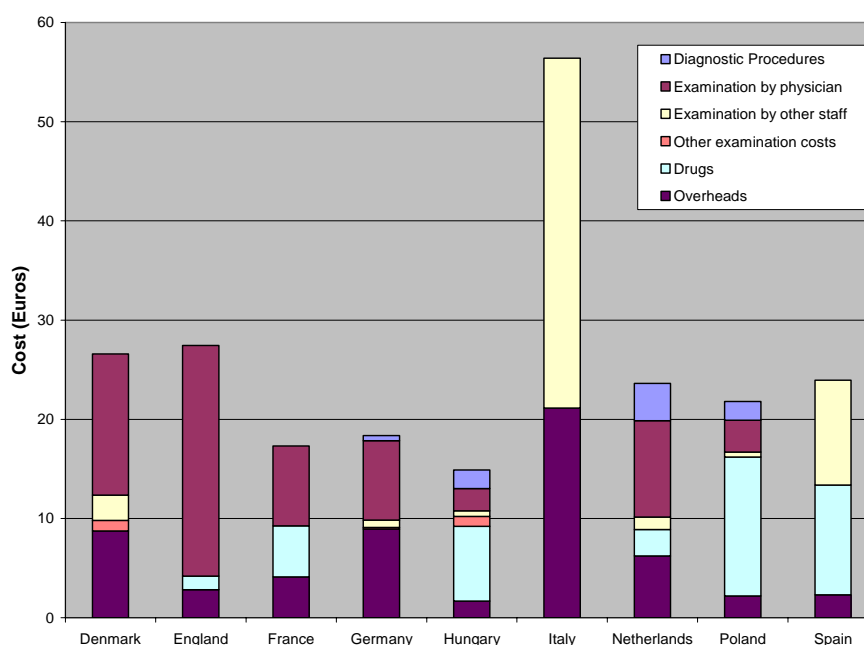
Figure 14: AMI (vignette 6): comparison of costs by country



3.5.7 Vignette 7: cough

The median cost of care for treating a two-year old boy with a cough was around €23, with the highest total cost country (Italy: €56) exceeding the cost of the lowest cost country (Hungary: €15) by a factor of around four. However, Italy appears to be an outlier in this analysis, as all other country estimates were below €30. In Italy, paediatric care is mainly provided by general paediatricians (specialists) who have a status very similar to those of Italian General Practitioners. However, GPs do sometimes provide paediatric care. In addition, care outside of normal office hours is mainly provided by hospital-based ambulatories. Therefore, the Italian providers comprise of three paediatricians, one GP and one hospital-based paediatric ambulatory. This explains the high absolute value of overheads in the Italian estimate of total cost and the atypical pattern of provider type evident in Figure 15. Apart from Italy, only in Spain did a clinician other than a general practitioner chiefly provide treatment.

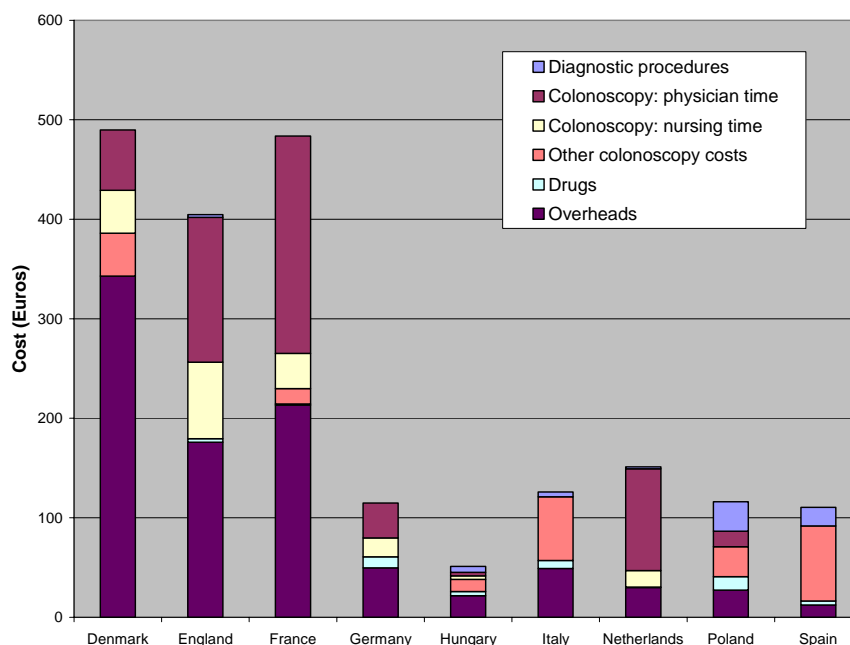
Figure 15: Cough (vignette 7): comparison of costs by country



3.5.8 Vignette 8: colonoscopy

The cost of colonoscopy as a diagnostic procedure varied by a factor of around 10, ranging from €51 in Hungary to €490 in France. Interestingly, estimates were dichotomised with three countries having relatively high total costs of care (Denmark, England and France) compared with the remaining six countries (Figure 16). The *magnitude* of the overheads in the three ‘high cost’ countries substantially exceeded the total cost of care in each of the six ‘low cost’ countries, suggesting that treatment setting may be an important explanatory factor for this effect. The *proportion* of overheads relative to total cost also varied, ranging from 11% for Spain to 70% for Denmark.

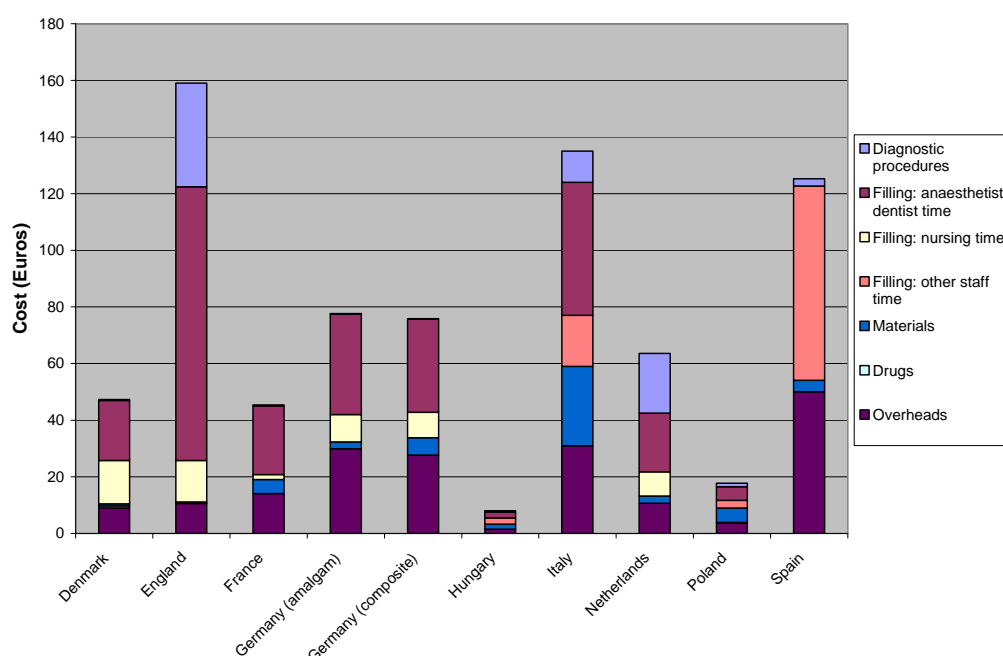
Figure 16: Colonoscopy (vignette 8): comparison of costs by country



3.5.9 Vignette 9: tooth filling

The cost of a tooth filling for a twelve-year old child varied from around €8 in Hungary to €160 in England; the highest and lowest estimates therefore varied by a factor of 19. However, overheads contributed only 7% of total costs for England and it appeared that the cost of physician time (60% of total cost) was the main explanation for the relatively high cost of a filling in England. Costs incurred in the diagnostic stage as a proportion of total costs ranged from 0.1% for Germany to 33% for the Netherlands. An assessment of the impact of type of filling (amalgam vs. composite) was undertaken only by Germany and Figure 17 shows that this factor appeared relatively unimportant in determining total cost.

Figure 17: Tooth filling (vignette 9): comparison of costs by country



3.5.10 Vignette 10: physiotherapy

There were no adequate data available for this vignette.

4 Results of statistical analysis

The ANOVA revealed significant differences in mean cost between countries at the 5% level for all vignettes. A visual inspection of the 95% confidence intervals for each country showed that, for the inpatient vignettes, Denmark, England France and Germany and Italy were consistently either at or above the mean, whereas Hungary, Poland and Spain were consistently at or below the mean. Where applicable, length of inpatient stay was a significant factor associated with differences in cost between hospitals.

4.1 Stroke

Table 8 shows the analysis of variance ANOVA for the stroke vignette, and Table 9 adjusting for length of stay. Length of stay accounts for most of the variation in total costs in the sample. There is significant variation in costs between countries both before and after accounting for differences in length of stay.

Table 8: ANOVA table for stroke vignette with no explanatory factors

Source	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Country	154209425 (52%)	8	19276178	5.63	0.0001
Residual	140257205 (47%)	41	3420907		
Total	294466630	49	6009523		

Table 9: ANOVA table for stroke vignette with length of stay and country as explanatory factors

Source	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Model	221926678	9	24658520	16.96	0.000
Length of stay	78860714	1	78860714	54.26	0.000
Country	151004824	8	18875603	12.99	0.000
Residual	55233710	38	1453519		
Total	277160388	47	5897030		

Table 10 shows the average length of stay in each of the countries. There was considerable variation between and within countries in length of stay. In some hospitals patients were routinely discharged to a rehabilitation unit, and this may account for some of the variation, however, there was considerable missing data on whether this is routinely done.

Table 10: Average length of stay for stroke in each country and whether patients are routinely discharged to a rehabilitation unit

	Number of hospitals contributing data	Average length of stay (days)	SD	Proportion discharged to rehabilitation unit (range)
Denmark	1	4.6		100%
England	5	10.75	2.83	N/A
France	4	10.39	3	23 to 60%
Germany	14	13.14	3.3	N/A
Hungary	2	9.24	0.45	5% to 20%
Italy	5	10.59	1.56	30 to 100%
Netherlands	7	15.86	7.38	0 to 100%
Poland	6	14.73	2.61	N/A
Spain	5	10.2	2.86	100%
Total	48	12.42	4.3	N/A

Table 11: Mean total cost, between and within-country standard errors for (i) a model with only country as an explanatory factor and (ii) a model with country and length of stay as explanatory factors

	Country only		Hospital level factors	
	Mean	SE	Mean	SE
Intercept	3919	262	3745 (a)	180
Length of stay	NA		360 (b)	50
Between country standard error	2027		1984	
Within-country standard error	1849		1211	
Intra-cluster correlation coefficient (ICC)	0.55		0.73	

- (a) Overall mean cost for mean length of stay in the sample. This differs from the mean cost in the model with a intercept only because hospitals with missing data were dropped from the analysis of length of stay
- (b) Additional cost of an additional day compared with the mean length of stay in the sample

Table 11 shows the overall mean cost for two models: firstly with only country as an explanatory factor; and secondly after adjusting for length of stay assuming that the slope (the increase in cost per additional day) does not differ between hospitals or countries. An additional day in hospital contributes on average an additional 360 Euros to total cost.

Figure 18 shows the unexplained difference in total cost of stroke between countries, and Figure 19 shows unexplained differences in total cost after adjusting for length of stay. The small dots show the unexplained difference in cost of each hospital from the overall mean (hospital-level residuals). The dark coloured circles shows the difference between the overall mean and the country mean assuming a fixed effect for each country, that is, costs in each country are unrelated to those of other countries (country-level means FE). The light coloured circles show the random-effect for each country, that is, the difference between the overall mean and the country mean assuming costs within each country are correlated (country-level means RE). The diameter of the dot is proportional to the weight given by each country to the fixed and random effects models. 95% confidence bars ($\pm 2 \times$ standard errors) are shown for the fixed and the random effect models. Costs in a country are said to differ from the overall mean at the 5% significance level if the confidence bar does not cross the horizontal axis.

In the stroke vignette, mean costs are higher than the mean in England and the Netherlands and lower than the mean in Spain, Hungary and Poland regardless of whether a fixed or random effects model is used. These relative results are similar after accounting for length of stay, although costs in Italy now appear to be higher than the mean. Costs in other countries are either similar to the mean or there is either insufficient data to show a difference.

Figure 18: Differences in total costs within and between countries for stroke, without adjusting for any explanatory factors

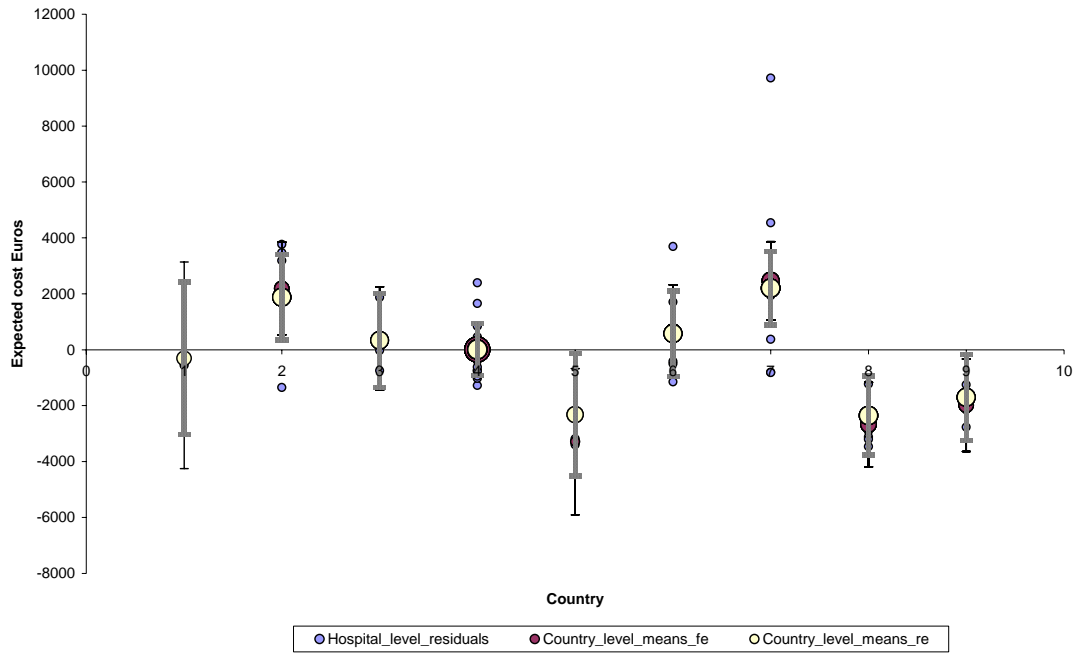
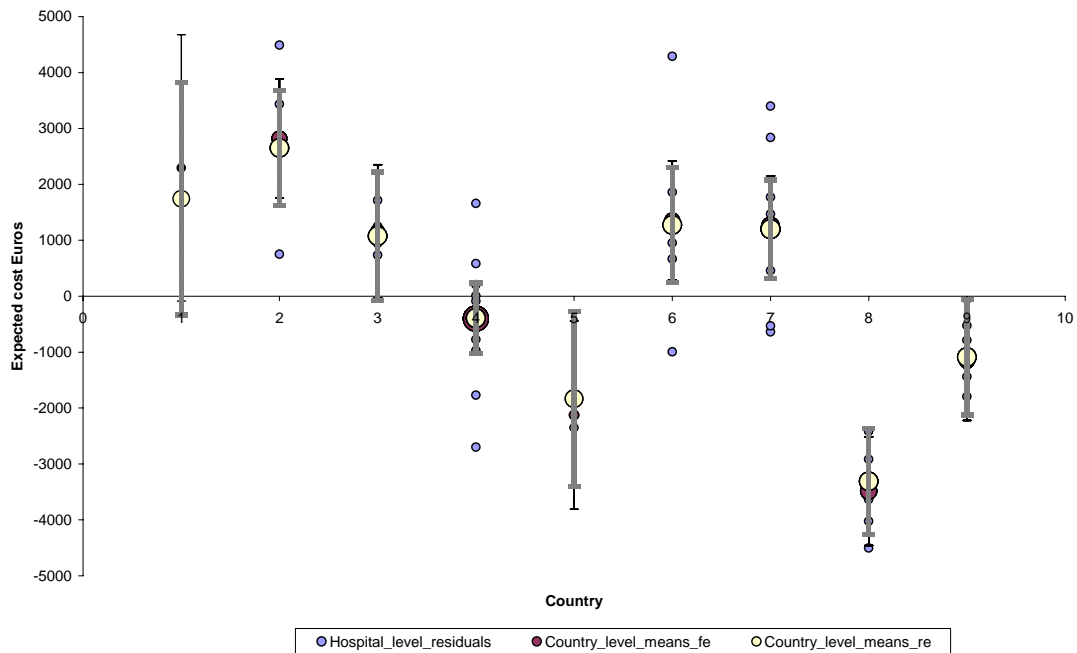


Figure 19: Differences in total cost within and between countries for stroke, after adjusting for length of stay as an explanatory factor



Key:	1	2	3	4	5	6	7	8	9
	Denmark	England	France	Germany	Hungary	Italy	Netherlands	Poland	Spain

4.2 Acute Myocardial Infarction

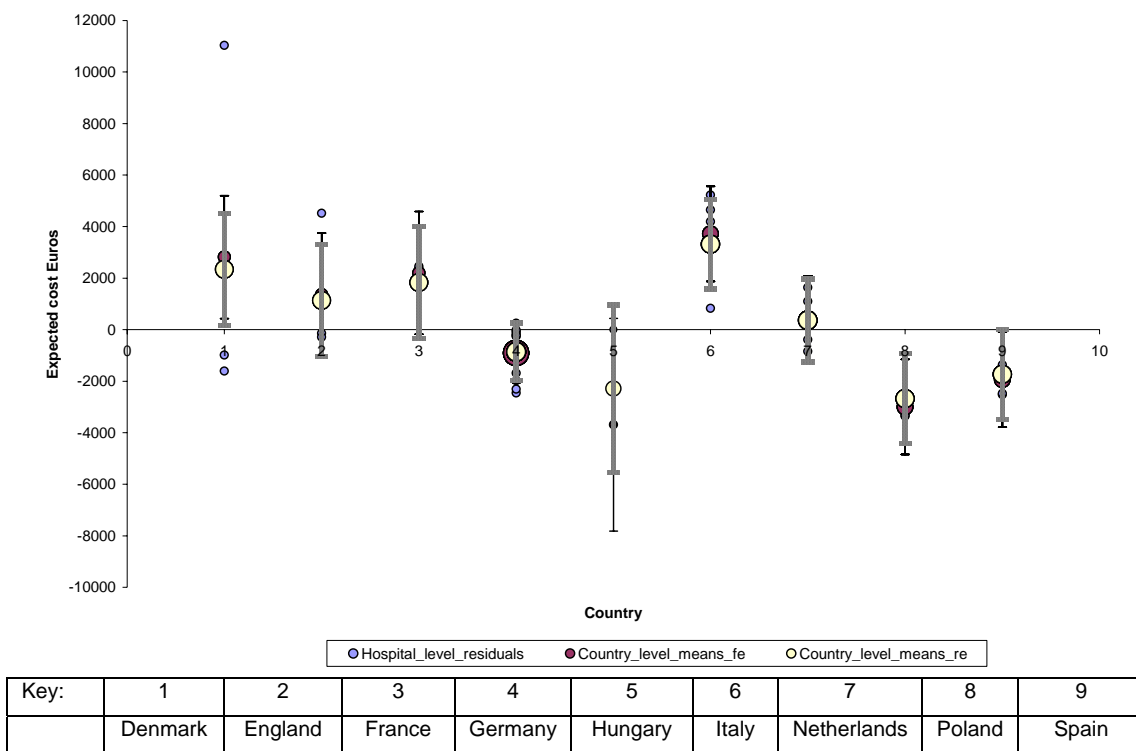
Table 12 shows ANOVA for the AMI vignette. Length of stay, use of cardiac catheterisation, PTCA, stents or drug-eluting stents were insignificant and results are not shown for these variables. The mean cost is 3720 Euro (SE 300). The estimate of the within-country standard error is 2010 and the between-country standard error is 2520 Euros, ICC = 0.61.

Table 12: ANOVA for acute MI

	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Country	199772685 (58%)	8	24971586	6.18	0.0001
Residual	145394401 (42%)	36	4038733		
Total	345167086	44	7844707		

Figure 20 shows the unexplained differences in costs between countries for AMI. Costs in Italy and Denmark are significantly greater than the average, and in Poland and Spain are significantly less than average, regardless of whether a fixed or random effects model is used. Costs in other countries are similar to the overall mean or there is insufficient data to show a difference.

Figure 20: Differences in costs between countries for AMI



4.3 Appendectomy

Table 13 shows ANOVA for the appendectomy vignette. Length of stay, and use of open vs. laparoscopic surgery were insignificant and results are not shown for these variables. The mean cost is 1612 Euro (SE 39). The estimate of the within-country standard error is 293 Euros and the between-country standard error is 815 Euros, ICC = 0.89.

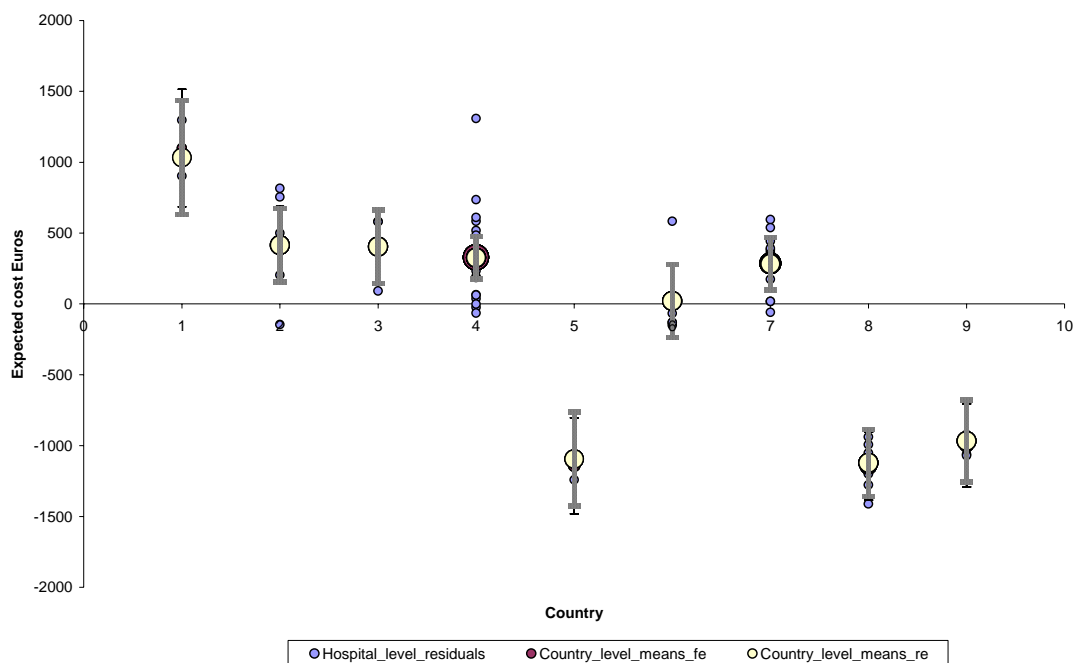
Table 13: ANOVA for appendectomy

	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Country	22399890 (85%)	8	2799986	32.54	0
Residual	3958013 (15%)	46	86044		
Total	26357904	54	488109		

Figure 21 shows the unexplained differences in costs between countries for appendectomy. Costs in England, France, Germany, and Denmark are significantly

greater than the average, and in Poland, Hungary, and Spain are significantly less than average, regardless of whether a fixed or random effects model is used.

Figure 21: Differences in costs of appendectomy between countries



Key:	1	2	3	4	5	6	7	8	9
	Denmark	England	France	Germany	Hungary	Italy	Netherlands	Poland	Spain

4.4 Hip replacement

Table 14 shows ANOVA for the hip replacement vignette and Table 15 including the number of nursing staff in each hospital, which was the only statistically significant explanatory variable. The number of nursing staff in each hospital was statistically significant but did not have a noticeable effect on results and was omitted from the final model. The mean cost is 5137 Euro (SE 181). The estimate of the within-country standard error is 1161 and the between-country standard error is 1999 Euros, ICC = 0.75.

Table 14: ANOVA for hip replacement with no explanatory variables

	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Country	116578401 (73%)	8	14572300	10.8	<0.001
Residual	43157822 (27%)	32	1348682		
Total	159736223	40	3993406		

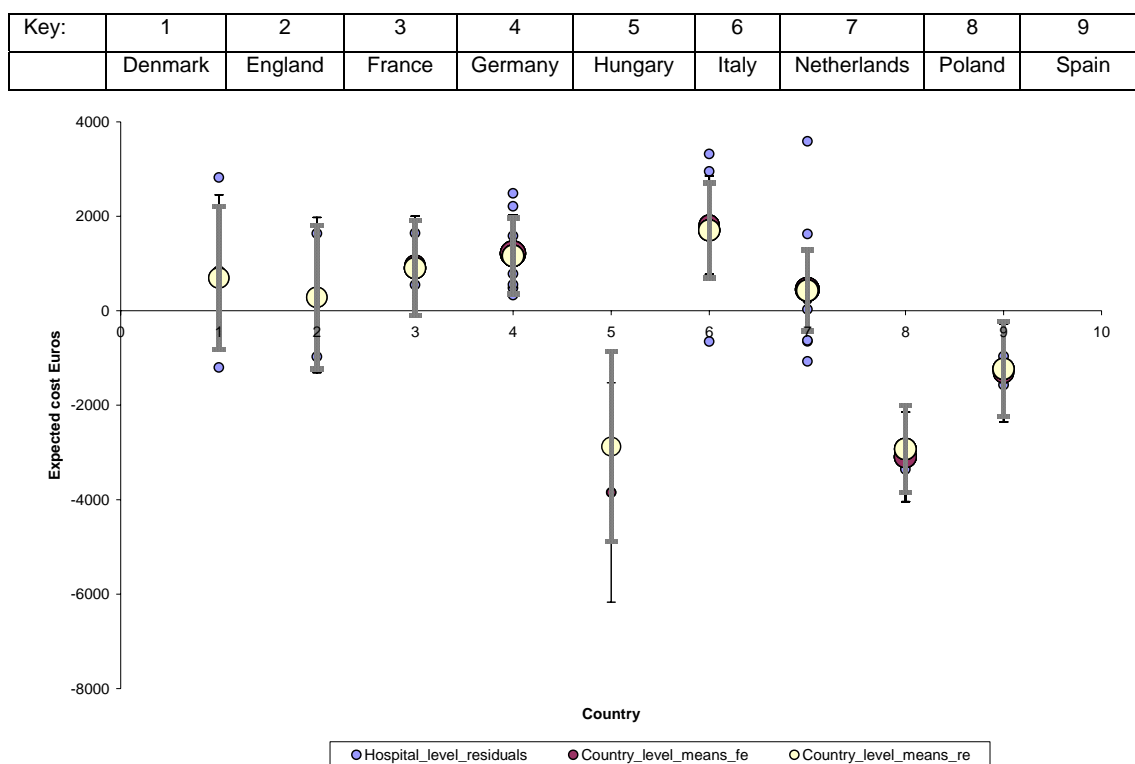
Table 15: ANOVA for hip replacement including number of nursing staff as an explanatory variable

	Sum of	Degrees of	Mean Sum	F	Prob>F

	Squares	Freedom	of Squares		
Model	113729657	8	14216207	10.7	0.000
Number of nursing staff	7015097	1	7015097	5.28	0.030
Country	111773745	7	15967677	12.01	0.000
Residual	35883277	27	1329010		
Total	149612935	35	4274655		

Figure 22 shows the unexplained differences in costs between countries for hip replacement with no explanatory variables. Costs in Germany and Italy are significantly greater than the average, and in Poland, Hungary, and Spain are significantly less than average, regardless of whether a fixed or random effects model is used.

Figure 22: Differences in the costs of hip replacement with no explanatory variables



4.5 Delivery

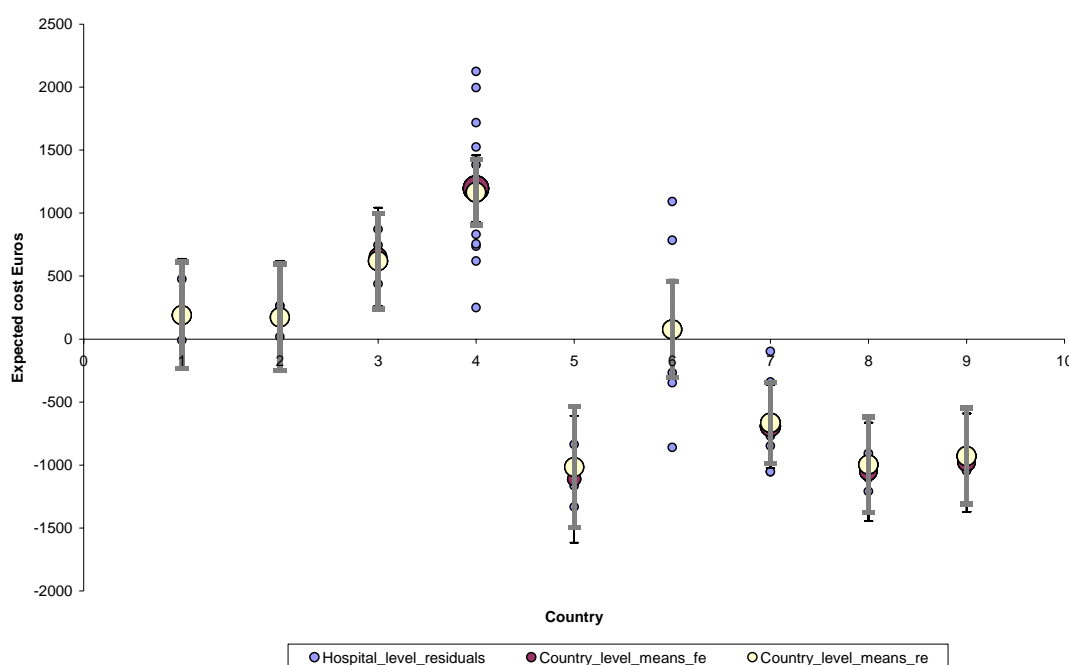
Table 16 shows ANOVA for the delivery vignette. The mean cost is 1454 Euro (SE 63). The estimate of the within-country standard error is 437 and the between-country standard error is 826 Euros, ICC = 0.78.

Table 16: ANOVA for delivery

	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Country	35579574 (82%)	8	4447447	23.33	0.000
Residual	7625733(18%)	40	190643		
Total	43205307	48	900111		

Figure 23 shows the unexplained differences in costs between countries for delivery. Costs in Germany and France are significantly greater than the average, and in Poland, Hungary, Netherlands and Spain are significantly less than average, regardless of whether a fixed or random effects model is used.

Figure 23: Differences in the costs of delivery



Key:	1	2	3	4	5	6	7	8	9
	Denmark	England	France	Germany	Hungary	Italy	Netherlands	Poland	Spain

4.6 Cataract

Table 17 shows ANOVA for the cataract vignette without explanatory variables and Table 18 including a variable showing the proportion of patients receiving soft lenses at the hospital. Hospitals that routinely used a soft lens were associated with significantly greater cost compared with those that used a hard lens. However, Germany and Denmark were unable to provide this data and there was relatively little variation within the remaining countries. Therefore this variable could be reflecting a collinear country level effect and was omitted from the final analysis. The mean cost

of the cataract procedure was 666 Euro (SE 42). The estimate of the within-country standard error is 278 and the between-country standard error is 243 Euros, ICC = 0.43.

Table 17: ANOVA for cataract without explanatory variables

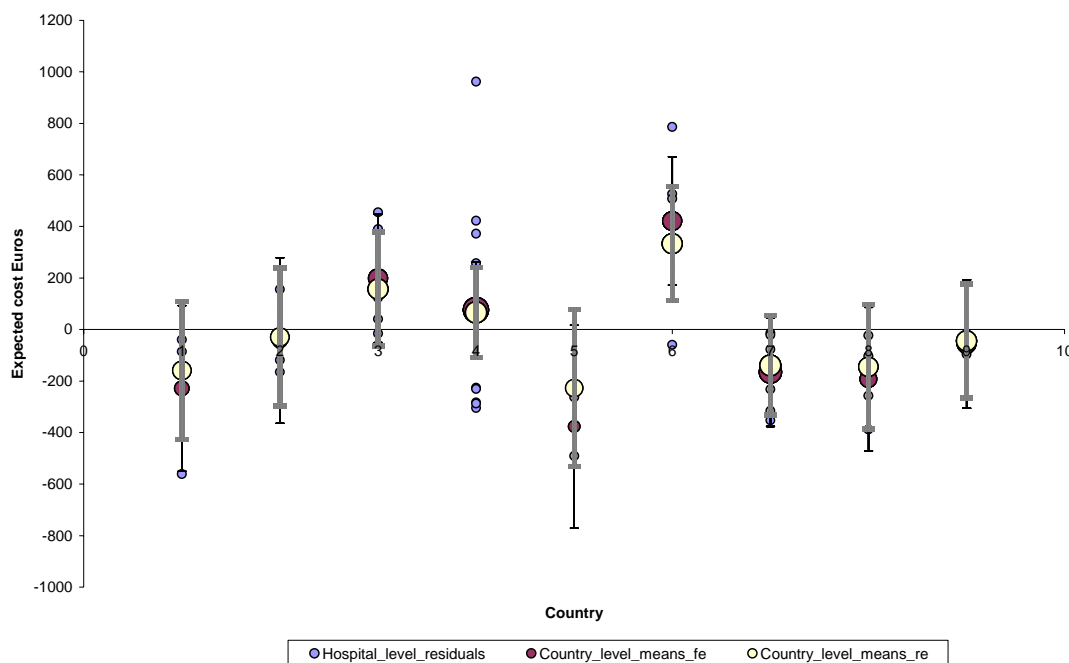
	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Country	1936601 (42%)	8	242075	3.12	0.0093
Residual	2634992 (58%)	34	77500		
Total	4571593	42	108847		

Table 18: ANOVA for cataract including a variable showing the proportion of soft lens used in the hospital

	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Model	1903207	7	271887	9.88	0
Soft lens	220547	1	220547	8.01	0.0097
Country	1897591	6	316265	11.49	0.0000
Residual	605617	22	27528		
Total	2508823	29	86511		

Figure 24 shows the unexplained differences in costs between countries for the cataract procedure. Only costs in Italy are significantly greater than the average.

Figure 24: Differences in the costs of the cataract procedure with no explanatory variables



Key:	1	2	3	4	5	6	7	8	9
	Denmark	England	France	Germany	Hungary	Italy	Netherlands	Poland	Spain

4.7 Colonoscopy

Table 19 shows ANOVA for the colonoscopy vignette and Table 20 ANOVA with number of physicians in the department and a dummy variable indicating for that provider whether the procedure took place in the outpatient department of a hospital (1) or elsewhere (0). There was an association between cost and the number of physicians in the department, and between cost and whether the procedure took place in the outpatient department of a hospital or elsewhere. However, there was considerable missing data for these variables and they were omitted from the final analysis. The mean cost of the colonoscopy procedure was 197 Euro (SE 7). The estimate of the within-country standard error is 49 and the between-country standard error is 197 Euros, ICC = 0.94.

Table 19: ANOVA for colonoscopy without explanatory covariates

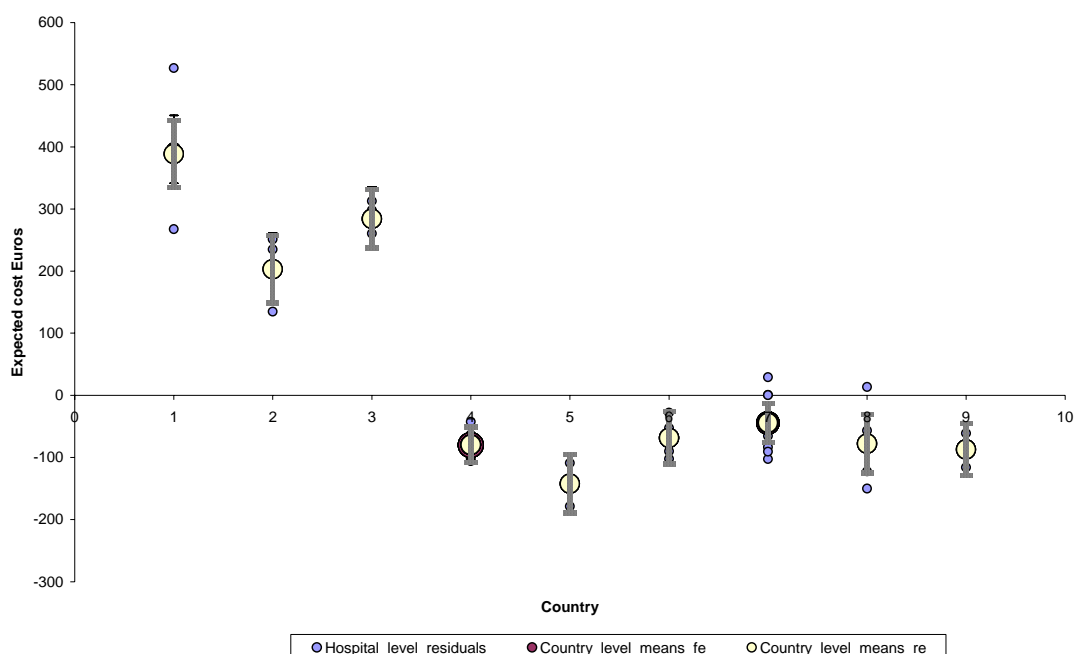
	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Country	1191078 (93%)	8	148884	66.49	0
Residual	87331 (7%)	39	2239		
Total	1278409	47	27200		

Table 20: ANOVA for colonoscopy procedure with explanatory covariates

	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Model	1012043	6	168674	120.22	0.0000
Number of physicians in department	28906	1	28906	20.6	0.0001
Outpatient department of hospital	13092	1	13092	9.33	0.0048
Country	838846	4	209712	149.47	0.0000
Residual	40689	29	1403		

Figure 25 shows the unexplained differences in costs between countries for the colonoscopy procedure. Costs in Denmark, England and France are significantly greater than the average.

Figure 25: Differences in the costs of the colonoscopy procedure without adjusting for other explanatory factors



Key:	1	2	3	4	5	6	7	8	9
	Denmark	England	France	Germany	Hungary	Italy	Netherlands	Poland	Spain

4.8 Tooth filling

Table 21 shows ANOVA for the tooth filling vignette. The mean cost is 76 Euro (SE 3). The estimate of the within-country standard error is 18 and the between-country standard error is 50 Euros, ICC = 0.88.

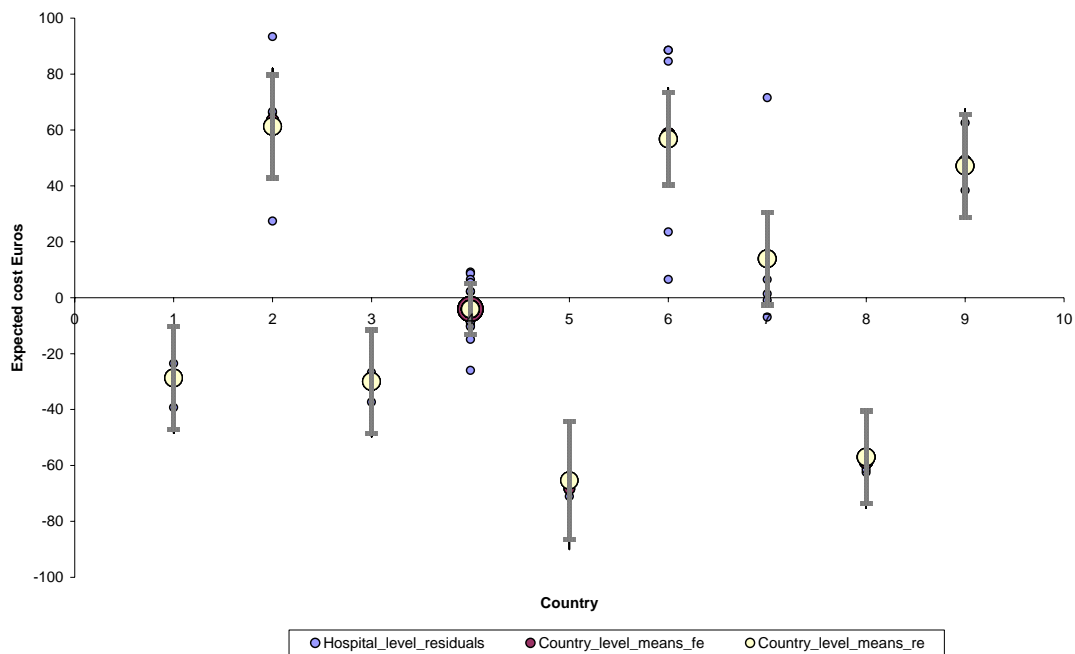
Table 21: ANOVA for tooth filling

WP10: International comparison of costs

	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	Prob>F
Country	82550 (85%)	8	10319	29.4	0
Residual	14739(15%)	42	351		
Total	97289	50	1946		

Figure 26 shows the unexplained differences in costs between countries for tooth filling. Costs in England, Italy and Spain are significantly greater than the average, and in Denmark, France, Hungary, and Poland are significantly less than average.

Figure 26: Differences in the costs of tooth filling



Key:	1	2	3	4	5	6	7	8	9
	Denmark	England	France	Germany	Hungary	Italy	Netherlands	Poland	Spain

5 Discussion

The aims of this study were to:

- identify and develop a methodology for cost comparison
- assess whether prices are a good estimate of costs of individual services
- explore the reasons underlying variations in the costs of individual services

The method used in this Work Package (WP10) was for researchers in each of the nine participating countries to collect data on the costs and prices of a set of specific inpatient and outpatient services. The treatment setting, patient characteristics and other details were carefully specified in order to standardise the definition of these services where possible.

This report shows the results of WP10. Firstly, an assessment was made about the challenges reported by researchers to apply the methodology and the constraints they faced in their country. Secondly, the costs of services were compared with prices. Thirdly, the mean costs for each country were analysed by categories. Fourthly a statistical analysis was carried out to identify differences in cost within and between countries.

The most important issue to consider when interpreting findings from WP9 is the comparability of the data. There are several factors that limit comparability.

The first factor is to do with *structural* issues. In particular, the methods used to calculate capital costs varied within and between countries. Only England consistently included the opportunity cost of capital in hospital costs, but this was a small percentage of total cost (about 2.8%). Counties and providers within countries varied in the way in which depreciation was handled; hospitals in some countries do not own their assets or International Accounting Standards do not appear to have been fully implemented.² Another structural limitation is to do with the application of exchange rates: for each country where Euros are not the currency of use, costs were converted to Euros using the mean exchange rate for 2005. However, the exchange rate values for Hungary and Poland are particularly unstable and this

² International Accounting Standards Board. International Financial Reporting Standards: International Accounting Standard 16. IASB 2006.

undermines the validity of the analyses. The application of purchasing power parities (PPPs) may be considered for the comparative articles that are due to be published in 'Health Economics' in 2007.

A second factor that limits the comparability of the data is difficulties in estimating resource use and price. Access to and interpretation of information was problematic and although some countries used consistent approach, in others, the approach varied within the country. The number of providers contributing data to each vignette varied between countries (from 1 to 17) as did the numbers of patients sampled by each provider. Not all countries were able to obtain access to individual patient data for resource use and unit costs as recommended by the WP8 methodology. As a substitute for or to complement individual patient data, researchers obtained data from expert estimates, interviews, surveys and national and local databases. In some cases no data was provided or imputation was used. Therefore sample for some providers may not correspond with the characteristics of patients required by the vignette. Furthermore, whilst accounting rules were relatively uniform in some countries, there was an absence of nationally determined accounting practice in others. Not all providers were able to estimate time spent by clinicians on necessary administrative tasks as required by the methodology. In some cases, an approximation was made by calculating the cost per hour of clinicians' time by dividing by "productive hours" rather than total hours. Methods to calculate overheads varied considerably. Most countries said they included most medical and non-medical overhead categories, though there were differences in the way these were apportioned to costs of services. In some cases a "percentage mark up" was applied to direct costs, while in others more detailed step-down costing was undertaken. Taken together, these factors have meant that providers from the same country might have calculated inputs and costs differently.

A simple analysis was undertaken to estimate the correlation between prices and costs. This appeared to show that in appendectomy, delivery, stroke and colonoscopy prices and costs match fairly well on average, though there are some outliers. In hip, cataract and AMI, prices are on average greater than costs. Only in tooth filling do prices seem on average to be less than costs. However, this analysis is only exploratory at this stage.

Analysis of Variance (ANOVA) was used to explore whether there are statistically significant differences in the cost of health care services between countries.

Likelihood ratio tests (F-tests) showed costs differed significantly between countries in all the vignettes. To identify which countries costs were greater or lesser than the overall mean, a least squares regression with dummy variable was used to estimate 95% confidence intervals for each country mean. Although not a formal test this method does allow visual inspection of the data. Table 22 shows whether a 95% confidence bar for the mean cost of each country was entirely above or below the mean for all countries and hospitals. For the inpatient vignettes, Denmark, England France and Germany and Italy were consistently either at or above the mean whereas Hungary, Poland and Spain were consistently at or below the mean. These results did not differ when a random effects model was used.

A secondary objective of the analysis was to undertake an exploratory analysis of the data to identify hospital-level factors that could be associated with differences in cost, and whether country-level differences persisted after adjusting for those factors. In the stroke vignette, length of stay was a significant factor in explaining differences in costs between hospitals. However, in general, countries with higher costs than average before adjustment for length of stay had higher costs after adjustment, and similarly with countries with lower than average costs. In the cataract vignette, the use of soft lenses was associated with a significantly higher cost, though there was considerable missing data and there was little variation within countries in the use of soft lenses, which limited the analysis. No other explanatory variables at hospital level were both statistically significant and made a noticeable difference to the mean cost.

Table 22: Summary of whether a 95% confidence interval for the mean cost of each country was entirely above (+) or below (-) the overall mean. A blank cell indicates that either costs were not statistically different from the mean or there was insufficient data to show a difference

	Denmark	England	France	Germany	Hungary	Italy	Netherlands	Poland	Spain
Stroke		+			—		+	—	—
AMI	+					+		—	—
Append	+	+	+	+	—			—	—
Hip				+	—	+		—	—
Delivery			+	+	—		—	—	—
Cataract						+			
Colon	+	+	+						
Tooth	+	+	—		—	+		—	+

This analysis is clearly limited by the structural differences between countries and difficulty accessing data highlighted above. A second limitation of this analysis was that it did not account for the additional uncertainty arising from measurement error

by each provider. In fact, costs at each provider are the average of a sample of patients, or in some cases constructed from expert opinion. Accounting for measurement error by each provider would require a multi-level analysis of patients-within-providers-within countries. Properly accounting for the uncertainty arising from using expert (prior) opinion might require an explicitly Bayesian analysis.

Further work is underway to provide a detailed examination of each vignette, which, among other things, will explore whether differences in cost can be attributed to relative differences in the price of inputs or use of those resources

6 Appendix

6.1 The fixed and random effects statistical models

The statistical model is

$$y_{ij} = a_0 + b_1 x_{ij} + a_j + e_{ij}$$

where y_{ij} is the cost of the vignette in hospital i in country j , x_{ij} is an explanatory variable (for example, length of stay), a_0 is the mean overall cost, a_j is the additional mean cost in country j compared with the overall mean cost, and e_{ij} is an error term, assumed normally distributed with common variance $e_{ij} \sim N(0, \sigma_w^2)$.

For the fixed effect model, $\sum_{j=1}^I a_j = 0$, where I is the number of countries.

The fixed-effect country means a_j^{FE} are estimated by $\frac{1}{n_j} \sum_{i=1}^{n_j} (y_{ij} - (a_0 + b_1 x_{ij}))$ and with variance $= \sigma_w^2 / n_j$.

For the random effect model, a_j are distributed identically and independently $a_j \sim N(0, \sigma_b^2)$ and a_j are independent of e_{ij} . The random-effect country means a_j^{RE} are shrunk towards the overall mean using the empirical bayes weights $w_j = n_j \sigma_b^2 / (n_j \sigma_b^2 + \sigma_w^2)$ with mean $a_j^{RE} = w_j a_j^{FE}$ and variance $= 1 / (\sigma_b^{-2} + n_j \sigma_w^{-2})$. The intra-cluster correlation coefficient (ICC) is defined as $\rho = \sigma_b^2 / (\sigma_b^2 + \sigma_w^2)$.

6.2 Guidelines for the Completion of Work Package 9

Deliverable 24, Phase III, REVISED, NOVEMBER 2005

Reinhard Busse, David Epstein, Anne Mason, Zsolt Mogyorosy, Jonas Schreyögg, Peter Smith, Marcial Velasco-Garrido

Objective of WP9

With this Deliverable the third phase of the HealthBASKET Project begins. To estimate and compare the costs and prices of 10-12 different health services (episode of care) in the EU member states at the micro-level (in- and out-patient care). Information on the resources used and its associated costs to provide care for a set of exemplary cases will be collected by each project partner during WP 9. Costs will be calculated from the **provider perspective**. Prices will also be collected taking the **purchaser perspective**.

Working steps within WP9

In a first step, a sample of at least 5 (preferably 10 or more) representative health care providers in each country will be identified for each setting relevant to the case-vignettes (i.e. at least 5 hospitals, 5 GPs etc.). Regarding case-vignettes for inpatient settings, providers expected to differ from the average of providers (e.g. tertiary care hospitals if the service is provided mainly in general hospitals) are to be excluded from the sample, since their cost structure differs considerably from other hospitals. It is advisable to use "general acute hospitals" with ca. 200 to 400 beds unless the majority of providers in the country differ from this.

The case-vignettes and accompanying questionnaires developed in WP8 will be given to them. Experience from other projects strongly suggests that **researchers of each country collect and calculate the data together with the hospital (or other provider) staff**. This approach has the potential to avoid delays of submitted cost data and mistakes concerning its calculation. In most cases the medical staff will have to be interviewed for the information needed, as the controlling departments do usually not collect information in such detail. The staff will have to be asked to provide the last 10 patients cared for in their institution; alternatively, administrative data covering more than 10 patients may be used (NB: No personalized data of the actual patients are needed or collected; estimates by clinicians based on the average of the last 10 patients are also fine). If databases are used this can also be an average of several providers. In any case it is vital for the validity of the analysis that each patient fits to the indications described in the respective case vignette description.

Data collected will be analysed and synthesized by the researchers with the aim of providing an estimation of the direct costs associated with each case-vignette. Description of the underlying cost structure will be provided. Any cost variations, e.g. due to structural reasons (general hospital vs. specialized hospital) identified within the providers will be analysed and documented.

Timetable

Work progress reports including detailed work plans are to be presented to the scientific director by each of the project partners by the **end of January** (i.e. timely available for MC-4). Draft versions of the reports are to be provided by the **beginning of August** (i.e. timely available for WS-4).

Framework for Data Collection

The frameworks presented here should be used to guide the assessment of resource consumption of the selected needs for care by clinicians (i.e. based on clinical documentation of a sample of the last treated patients in their setting). The intention of the proposed paths is to provide clinicians with a help in order to report all procedures and technologies applied during the episode of care. In order to make this easier we have divided each episode of care in different phases following the temporal axis.

Selection of case vignettes

The selection of the cases (cf. Table) is based on existing collections of community health indicators, such as the ones used in the “Health for All 21” databank or the one developed by the European Community Health Indicators-Project. Most of the “needs for care” are directly related to conditions or procedures belonging to the set of health indicators designed by ECHI. These conditions or procedures were chosen by ECHI because they represent large burden of disease (measured as number of people affected, costs related) or because they are related to preventive measures, and are valid and sensitive to assess the achieving of targets formulated in health policies.

Table 23: Selection of Case-Vignettes

Need for care	Age group	Type of Care			ECHI*
Appendectomy	14-25	In-patient	Surgery	Emergency	-
Normal delivery	25-34	In-patient	Obstetrics	Elective	+
Hip-replacement	65-75	In-patient	Surgery	Elective	+
Cataract	70-75	Out-patient (day case)	Surgery	Elective	+
Stroke	60-70	In-patient	Medical	Emergency	+
AMI (PTCA)	50-60	In-patient	Medical	Emergency	+
Cough	approx. 2	Out-patient	Paediatrics/GP	Emergency	-
Colonoscopy	55-70	Out-patient	Diagnostic	Elective	+
Tooth filling	approx. 12	Out-patient	Dental	Emergency	+
Physiotherapy (knee)	25-35	Out-patient	Rehabilitative	-	-

*ECHI: related to European Community Health Indicators set (+ yes/ - no)

6.2.0.1 Vignette 1 - Appendectomy

Healthy male, ca. 14-25 years old, presents to hospital (accident and emergency department if existing; otherwise directly to surgical department) with acute abdominal pain. Start of case vignette: hospital door. Abdominal palpation yields typical signs of appendicitis. End of vignette: discharge.

Phase	Elements	Units	No. of units used/ patient	Unit Cost	Total costs
Pre-operative (admission and planning)	<i>Diagnostic Procedures</i>				
	Imaging (e.g. ultrasound)	No.			
	Laboratory (e.g. blood count)	No.			
	Laboratory (e.g. blood coagulation, C-reactive protein (CRP), etc.)	No.			
	Other (ECG, etc.)	No.			
	<i>Care before OP</i>				
	Surgeon/Physician input	Patient days*			
	Nursing input	Patient days			
	Other (paramedical)	Patient days			
	<i>Drugs, infusions, injections, etc. Drug A, Drug B, etc.</i>	DD**			
Operation	OP-Team (altogether or separately)	Min.			
	Surgeon	Min.			
	Anaesthetist	Min.			
	OP-nurses etc.	Min.			
	Drugs (anaesthetics, other?)	DD			
	OP-Theatre running costs (e.g. sterilisation)	Min.			
Wake-up room***	Personnel	Hours			
Post-operative	<i>Normal Ward</i>				
	Surgeon/Physician	Patient days			
	Nursing	Patient days			
	Other (e.g. Physiotherapy)	Patient days			
	Drugs	DD**			
	Diagnostic Procedures (e.g. imaging, laboratory)	No.			
	Therapeutic Procedures (e.g. punctures, drainages, special wound dressing)	No.			
Overhead (including administration, catering, etc.)	Total, or: - On ward level - On departmental level - On hospital level	Patient days			
Capital costs (if taken into account in your country)					

*The unit patient days include personnel costs directly spent with the respective case per day and personnel costs which are not directly spent with the respective case per day (but are allocated to it proportionally) e.g. staff assemblies, studying documents.

WP10: International comparison of costs

Example: there might be 20 min (at an hourly wage of €30/0.50 Cent per minute this results in €10) directly spent with the respective case per day. Additionally there are approx. €1000 of personnel costs per day spent in the respective ward for care not directly spent with patients. Given, there are 20 beds on the ward the additional costs would be €50. Thus, unit costs per day would sum up to €60. Please make sure that personnel costs are not double-counted (e.g. a surgeon whose time is allocated to the operating theatre should not be allocated to the ward at the same time),

**DD: daily doses,

***if not included under operation or post-operative and if relevant

Reimbursement for provider by purchaser (incl. patient co-payments if applicable):

Vignette 2 - Normal Delivery

Healthy woman, 25-34 years old, presents to hospital after 39 weeks of an uncomplicated first pregnancy with labour pains. Start of case vignette: hospital door. Upon examination of the woman, the baby presentation is normal (i.e. cephalic/ vertex; one foetus) and a vaginal "normal" delivery is carried out without complications (no transfer to paediatric department or new born intensive care unit). End of vignette: discharge of mother and child (both are well).

Phase	Elements	Units	No. of units used/patient	Unit Cost	Total costs
Pre-delivery (admission and planning)	<i>Diagnostic Procedures</i>				
	Imaging (e.g. ultrasound)	No.			
	Laboratory (e.g. blood count)	No.			
	Laboratory (e.g. blood coagulation, C-reactive protein (CRP), etc.)	No.			
	Microbiology (e.g. examination of swab)				
	Cardiotocography	No.			
	Other (ECG, lung-function, etc.)	No.			
	<i>Care before delivery</i>				
	Obstetrician input	Patient days*			
	Midwife input	Patient days			
	Other (paramedical)	Patient days			
	<i>Drugs, infusions, injections, etc. Drug A, Drug B, etc.</i>	DD**			
Delivery	Delivery Team (altogether or separately)	Min.			
	Midwife	Min.			
	Obstetrician	Min.			
	Anaesthetist	Min.			
	Paediatrician	Min.			
	Delivery room running costs (e.g. sterilisation)***	Min.			
Post-delivery (normal ward for mother and child)	Obstetrician	Patient days			
	Nursing	Patient days			
	Other (e.g. Physiotherapy)	Patient days			
	Drugs	DD**			
	Diagnostic procedures of mother and child (e.g. imaging, laboratory: blood count, bilirubine)	No.			
	Therapeutic procedures (e.g. punctures, drainages, special wound dressing)	No.			
Overhead (including administration, catering, etc.)	Total, or: - On ward level - On departmental level - On hospital level	Patient days			
Capital costs (if taken into account in your country)					

*The unit patient days include personnel costs directly spent with the respective case per day and personnel costs which are not directly spent with the respective case per day (but are allocated to it proportionally) e.g. staff assemblies, studying documents.

Example: there might be 20 min (at an hourly wage of €30/0.50 Cent per minute this results in €10) directly spent with the respective case per day. Additionally there are approx. €1000 of personnel costs per day spent in the respective ward for care not directly spent with patients. Given, there are 20 beds on the ward the additional costs would be €50. Thus, unit costs per day would sum up to €60. Please make sure that personnel costs are not double-counted (e.g. a surgeon whose time is allocated to the operating theatre should not be allocated to the ward at the same time),

**DD: daily doses,

***if not included under general overhead costs

Reimbursement for provider by purchaser (incl. patient co-payments if applicable):

Vignette 3 - Hip replacement

Female, 65-75 years old, with hip osteoarthritis requiring hip replacement because of considerable impairment is finally (after waiting time if normal in the hospital) admitted for her first hip replacement (one side). The patient is without co-morbidity (i.e. expensive drugs due to treating co-morbidity should be excluded), the surgeon uses the most frequently used implant for female patients; the operation is without severe complications; end of case vignette: discharge (home or to separate rehabilitation institution).

WP10: International comparison of costs

Phase	Elements	Units	No. of units used/ patient	Unit Cost	Total costs
Pre-operative (admission and planning)	<i>Diagnostic Procedures</i>				
	Imaging (e.g. X-Ray)	No.			
	Imaging (e.g. ultrasound)	No.			
	Imaging (e.g. CT)	No.			
	Laboratory (e.g. blood count)	No.			
	Laboratory (e.g. blood coagulation, C-reactive protein (CRP), etc.)	No.			
	Other (ECG, lung-function, etc.)	No.			
	<i>Care before OP</i>				
	Surgeon/Physician input	Patient days*			
	Nursing input	Patient days			
	Other (paramedical)	Patient days			
Operation	<i>Drugs, infusions, injections, etc. Drug A, Drug B, etc.</i>	DD**			
	<i>Devices (type of implant, stent, etc.) total price paid by hospital</i>	No.			
	OP-Team (altogether or separately)	Min.			
	Surgeon	Min.			
	Anaesthetist	Min.			
	OP-nurses etc.	Min.			
Wake-up room****	Drugs (anaesthetics, other?)	DD			
	OP-Theatre running costs (e.g. sterilisation)***	Min.			
Post-operative	<i>Intensive Care Unit</i>				
	Surgeon/Physician	Patient days			
	Nursing	Patient days			
	Other	Patient days			
	Drugs	DD**			
	Diagnostic Procedures (e.g. imaging, laboratory)	No.			
	Therapeutic Procedures (e.g. punctures, drainages, special wound dressing)	No.			
	<i>Normal Ward</i>				
	Surgeon/Physician	Patient days			
	Nursing	Patient days			
	Other (e.g. Physiotherapy)	Patient days			
	Drugs	DD**			
	Diagnostic Procedures (e.g. imaging, laboratory)	No.			
Therapeutic Procedures (e.g. punctures, drainages, special wound dressing)	No.				
Discharge planning	Drugs given to patient until contact with GP	DD			
	Medical aids given to patient	Units			
	Planned Re-admissions (when part of care episode)				
Overhead (including administration, catering, etc.)	Total, or: - On ward level - On departmental level - On hospital level	Patient days			
Capital costs (if taken into account in your country)					

*The unit patient days include personnel costs directly spent with the respective case per day and personnel costs which are not directly spent with the respective case per day (but are allocated to it proportionally) e.g. staff assemblies, studying documents.

Example: there might be 20 min (at an hourly wage of €30/0.50 Cent per minute this results in €10) directly spent with the respective case per day. Additionally there are approx. €1000 of personnel costs per day spent in the respective ward for care not directly spent with patients.

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Given, there are 20 beds on the ward the additional costs would be €50. Thus, unit costs per day would sum up to €60. Please make sure that personnel costs are not double-counted (e.g. a surgeon whose time is allocated to the operating theatre should not be allocated to the ward at the same time),

**DD: daily doses,

***if not included under general overhead costs,

****if not included under operation or post-operative and if relevant

Reimbursement for provider by purchaser (incl. patient co-payments if applicable):

Vignette 4 – Cataract operation

(day-surgery/out-patient procedure): Male, 70-75 years old, has consulted a hospital clinic/ ophthalmologist's office because of blurred vision. After clinical assessment a diagnosis of *Cataracta Senilis* is made and the patient put on the operating list. The case vignette concerns the actual operation in the hospital/ ophthalmologist's office (depending on country, please state) including any pre-operative assessment (possibly in separate visits). Please specify the type of implant/ ocular lens used (especially if costs differ).

Phase	Elements	Units	Unit Cost	No. of units used	Total costs
Site of consultation/ operation	<input type="checkbox"/> Physicians' office <input type="checkbox"/> Out-patient department of hospital				
Pre-operative Assessment	<i>Diagnostic Procedures</i>	No.			
	Slit-lamp, other?	No.			
	Laboratory (e.g. blood count, INR, CRP, etc.)	No.			
	Other (ECG, lung-function, etc.)	No.			
Procedure	<i>Devices (type of intra-ocular lens.) total price paid by hospital</i>				
	OP-Team (altogether or separately)	Min.			
	Surgeon	Min.			
	Anaesthetist	Min.			
	OP-nurses etc.	Min.			
	Drugs (anaesthetics, other?)	DD			
	OP-Theatre running costs (e.g. sterilisation)*	Min.			
After-Care	Drugs or other given by provider	No.			
Overhead	Running Costs of ambulatory service (overhead)	Min.**			

*if not included under general overhead costs, **Min: Length of total ambulatory contact in minutes (hours)

Reimbursement for provider by purchaser (incl. patient co-payments if applicable):

Vignette 5 – Stroke

So far healthy female (i.e. no co-morbidity), 60-70 years old, with sudden severe hemiparesis (right side) and dependency, with severe aphasia: Admission to hospital (accident & emergency, medical or neurological department depending on country/ hospital) by ambulance car. Start of case vignette: hospital door. All the interventions including diagnostic and treatment are delivered in the same hospital. The patient is diagnosed and treated according to normal hospital standards (which may or may not include a stroke unit, early rehabilitation etc.); progress is average for age. Transient (TIA), short and reversible (RIND) and prolonged and reversible (PRIND) ischaemic neurological deficits are excluded. End of vignette: discharge to rehabilitative institution or home.

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Phase	Stroke	Units	Unit Cost	No. of units used	Total costs
Emergency dpt.	Nursing	Hours			
Initial diagnosis (Assessment)	<i>Diagnostic Procedures</i>				
	Imaging (e.g., CT)	No.			
	Imaging (e.g., MRI)	No.			
	Imaging (e.g., echo-doppler)	No.			
	Imaging (e.g., angiogram)	No.			
	Laboratory (e.g. blood sugar, etc.)	No.			
	Other	No.			
Main Therapy	Lysis				
	Drugs				
Hospital care (convalescence)	<i>Intermediate Care Unit (Stroke unit)</i>				
	Physicians	Patient days*			
	Nursing	Patient days			
	Other	Patient days			
	Drugs	DD**			
	Diagnostic procedures (e.g. imaging, laboratory)	No.			
	Other therapeutic procedures	No.			
	<i>Normal Ward (which? _____)</i>				
	Physicians	Patient days			
	Nursing	Patient days			
	Other	Patient days			
	Drugs	DD			
	Diagnostic procedures (e.g. imaging, laboratory)	No.			
	<i>Early rehabilitation</i>				
	Physiotherapist	Patient days			
	Speech therapist	Patient days			
	Other	Patient days			
Discharge planning	Drugs given to patient until contact with GP	DD			
	Medical aids given to patient	Units			
Overhead (including administration, catering, etc.)	Total, or: - On ward level - On departmental level - On hospital level	Patient days			
Capital costs (if taken into account in your country)					

*The unit patient days include personnel costs directly spent with the respective case per day and personnel costs which are not directly spent with the respective case per day (but are allocated to it proportionally) e.g. staff assemblies, studying documents.

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Example: there might be 20 min (at an hourly wage of €30/0.50 Cent per minute this results in €10) directly spent with the respective case per day. Additionally there are approx. €1000 of personnel costs per day spent in the respective ward for care not directly spent with patients. Given, there are 20 beds on the ward the additional costs would be €50. Thus, unit costs per day would sum up to €60. Please make sure that personnel costs are not double-counted (e.g. a surgeon whose time is allocated to the operating theatre should not be allocated to the ward at the same time),

**DD: daily doses

Reimbursement for provider by purchaser (incl. patient co-payments if applicable):

Vignette 6 – AMI

Up to the moment of presentation healthy male, 50-60 yr. old, who has developed a sudden acute chest pain. An ambulance is called and transports the patient within 2 hours of the onset of symptoms to hospital (accident & emergency department, cardiology or ICU depending on country/ hospital). Start of case vignette: hospital door. The patient shows typical ECG alterations and is admitted and treated for AMI. The patient is diagnosed and treated according to normal hospital standards (if a PTCA is performed, there are no complications, i.e. a referral to cardio-surgery is excluded); progress is average for age. End of vignette: discharge to rehabilitative institution or home.

Phase	AMI	Units	Unit Cost	No. of units used	Total costs
Emergency dpt.	Nursing	Hours			
Initial diagnosis (Assessment)	<i>Diagnostic Procedures</i>				
	Imaging (e.g., Echocardiogram)	No.			
	Imaging (e.g., Angiography)	No.			
	Imaging (e.g., Scintigraphy etc.)	No.			
	Laboratory (e.g., creatine kinase)	No.			
	Laboratory (e.g., troponin, etc.)	No.			
	Other (Electrocardiography etc.)	No.			
Main Therapy	Lysis	DD			
	Drugs	DD			
	PTCA, stenting	No.			
Hospital care (convalescence)	<i>Intensive Care Unit</i>				
	Physicians	Patient days*			
	Nursing	Patient days			
	Other	Patient days			
	Drugs	DD**			
	Diagnostic procedures (e.g. imaging, ultrasound, laboratory)	No.			
	Other therapeutic procedures	No.			
	<i>Normal Ward</i>				
	Physicians	Patient days			
	Nursing	Patient days			
	Other	Patient days			
	Drugs	DD			
	Diagnostic Procedures (e.g. imaging, laboratory)	No.			
	<i>Early rehabilitation (if during hospital stay)</i>				
	Physiotherapist	Patient days			
Discharge planning	Drugs given to patient until contact with GP	DD			
	Medical aids given to patient	Units			
Overhead (including administration, catering, etc.)	Total, or: - On ward level - On departmental level - On hospital level	Patient days			
Capital costs (if taken into account)					

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in your country)					
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*The unit patient days include personnel costs directly spent with the respective case per day and personnel costs which are not directly spent with the respective case per day (but are allocated to it proportionally) e.g. staff assemblies, studying documents.

Example: there might be 20 min (at an hourly wage of €30/0.50 Cent per minute this results in €10) directly spent with the respective case per day. Additionally there are approx. €1000 of personnel costs per day spent in the respective ward for care not directly spent with patients. Given, there are 20 beds on the ward the additional costs would be €50. Thus, unit costs per day would sum up to €60. Please make sure that personnel costs are not double-counted (e.g. a surgeon whose time is allocated to the operating theatre should not be allocated to the ward at the same time),

**DD: daily doses

Reimbursement for provider by purchaser (incl. patient co-payments if applicable):

Ambulatory Needs for Care

In General: please always take the typical setting (e.g. hospital based outpatient service, free standing specialised clinic, community centre (health centre)) for your country and mention it explicitly in your report. The setting (especially in terms of overheads) largely influences the costs.

Vignette 7- Cough

Parents presenting at a GP/ paediatric GP office with their 2 yr. old boy having cough and fever (38.5°C) since two days. Drug prescriptions and whether a second visit is scheduled should be noted.

Phase	Elements	Units	Unit Cost	No. of units used	Total costs
Assessment	<i>Diagnostic Procedures</i>				
	Imaging	No.			
	Laboratory (e.g. blood count, CRP, etc.)	No.			
	Other (ECG, lung-function, etc.)	No.			
	Physician	Min.			
Therapy + further care	Other personnel (nurse etc.)	Min.			
	Drugs prescribed	DD*			
	Drugs or other goods given by provider	DD/No.			
	Other diagnostics prescribed				
	Second visit scheduled: O YES O NO				
Personnel (for writing prescriptions etc.; if separate from above)	Min.				
Overhead	Running costs of ambulatory service	Min.**			

*DD daily doses prescribed, **Min: Length of total ambulatory contact in minutes (hours)
Reimbursement for provider by purchaser (incl. patient co-payments if applicable):

Vignette 8 – Colonoscopy

Male 55-70 year old with positive Faecal Occult Blood test is referred to an internist's/ gastroenterologist's office/ hospital out-patient department for diagnostic colonoscopy. Start of vignette: patient presents for the first time in office/ out-patient department. Please include all visits including the one where the colonoscopy is performed (i.e. most likely two), specify explicitly if and which sedatives, e.g. Benzodiazepines (flumazenil), fluids etc. are used/ prescribed. Cases with polypectomy during colonoscopy, pathological examinations and follow-up visits are excluded.

Phase	Elements	Units	Unit Cost	No. of units used	Total costs
Site of consultation	O Physicians' office O Out-patient department of hospital				
Assessment + Preparation	<i>Diagnostic Procedures</i>	No.			
	Imaging	No.			
	Laboratory (e.g. blood count, CRP, etc.)	No.			
	Other (ECG, lung-function, etc.)	No.			
	Physician	Min.			
	Other personnel	Min.			
	Drugs prescribed/ provided Fluids prescribed/ provided				
Examination (colonoscopy)	Physician	Min.			
	Other personnel	Min.			
	Use of instrument (running and depreciation costs)	No.			
	Drugs provided (especially sedatives)				
Overhead	Running costs of ambulatory service	Min.**			

*DD daily doses prescribed, **Min: Length of total ambulatory contact in minutes (hours)
Reimbursement for provider by purchaser (incl. patient co-payments if applicable):

Vignette 9 - Tooth filling

Ca. 12 y/o child presents with a toothache in a lower molar tooth at dentist's office; after diagnosis, the dentist decides to provide an Amalgam filling.

Phase	Elements	Units	Unit Cost	No. of units used	Total costs
Assessment	Imaging (e.g. X-ray)	No.			
	Dentist	Min.			
	Other personnel	Min.			
Therapy	Dentist	Min.			
	Other personnel	Min.			
	Material (amalgam)				
After care	Drugs prescribed	DD*			
	Drugs given by provider	DD			
	Second visit scheduled: O YES O NO				
Overhead	Running costs of ambulatory service	Min.**			

*DD daily doses prescribed, **Min: Length of total ambulatory contact in minutes (hours)
Reimbursement for provider by purchaser (incl. patient co-payments if applicable):

Vignette 10 - Ambulatory Physiotherapy

Male 25-35 years after anterior cruciate ligament reconstruction, consulting for ambulatory rehabilitation after discharge from hospital (with a referral if necessary in the country). Repair and hospital stay were without complications and discharge occurred after average length of stay. Please specify the duration and frequency of physiotherapy (e.g. 4-6 weeks, 3 times per week with 1 hour per session).

Phase	Elements	Units	Unit Cost	No. of units used	Total costs
Site of consultation/ operation	O Physicians' office O Out-patient department of hospital				
Therapy Week 2	Physiotherapist (number of sessions x duration per session: ___ x ___)	Min./hours			
Therapy Week 3	Physiotherapist (number of sessions x duration per session: ___ x ___)	Min./hours			
Therapy Week 4	Physiotherapist (number of sessions x duration per session: ___ x ___)	Min./hours			
Therapy following weeks	Physiotherapist (number of sessions x duration per session: ___ x ___)	Min./hours			
Overhead	Running costs of ambulatory service	Min.**			

*DD daily doses prescribed, **Min: Length of total ambulatory contact in minutes (hours)
Reimbursement for provider by purchaser (incl. patient co-payments if applicable):

Cost categories to be included in overhead costs

In general: please state explicitly which overhead costs are included in your calculations

Overhead costs for the medical infrastructure (only for case-vignettes in hospitals):

- Laundry
- Sterilization
- Patient transports (within the hospital)
- Supply of food and drinks (if provided at all in the respective hospital/country)

Overhead costs for the non-medical infrastructure

- *Administrative departments e.g. finance dept.*
- *Cleaning*
- *Gardening*
- *Desk officers*
- *Technical/building maintenance*
- *Rent*
- *Taxes, insurance policies*
- *Energy*
- *Water*
- *Waste disposal*

Capital costs

Others

Please note: personnel costs for medical staff which is not directly related to patient care (e.g. reading documents) are not included in overhead costs, they have to be allocated to each case. See footnote of each inpatient case-vignette.

Further Data Needed

Data on number of beds, physicians, nurses and other clinical personnel (i.e. physiotherapist, etc.) for the department and the hospital examined needs to be collected as well.

How should the deliverable look like?

- 1) **General:** Before presenting the results of the case-vignettes it can be useful to give some general information:
 - How did you select the provider/did you make use of databases?
 - Did you work together with clinicians, controllers etc.?
 - What are the main difficulties you were faced with?
 - Are there certain cost categories which are generally excluded from the results e.g. capital costs?
- 2) **Number of tables:** for each case vignette at least 6 tables have to be shown (one table for each provider and one table showing the calculated mean values with data from all 5 providers).
- 3) **Before each table:** please mention for each provider (before each table) the number of beds, physicians, nurses and other clinical personnel (i.e. physiotherapist, etc.) for the department and the hospital examined. For the sixth table (calculated averages) a range has to be given for the included providers e.g. hospitals from 250-350 beds with 50-100 physicians etc.
- 4) **Design of tables:** please use the above shown tables and adapt them for your own use. It is always possible, that the above shown tables do not completely correspond to the practice in your country. However, it is essential that each procedure/technology used Angiography, Scintigraphy etc. is displayed in a separate row of the table. Please also state precisely which cost categories are included in overhead costs.
- 5) **After each table:** please indicate the reimbursement for provider by purchaser (incl. patient co-payments if applicable) directly after each table. If several purchasers could be in charge, please state the amount each of them would be paying.
- 6) **Text:** Costs and prices of each case-vignette (differences between single providers and deviation from the mean) should be compared and interpreted. Please take the following criteria into account when interpreting potential differences:
 - a) resource consumption (number of used units),
 - b) prices for material or wage levels (unit costs),
 - c) used technology or applied therapy,

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- d) morbidity of patients (e.g., hospital located in suburb where patients are known to be less healthy than elsewhere),
 - e) department size and setting (economies of scale and scope); e.g., could explain high overheads of certain providers,
 - f) included cost categories in overheads,
 - g) costing methodology, e.g., when prices largely differ from the calculated costs.
- 7) Conclusion: please draw general conclusions (incorporating all case-vignettes) from your results and interpretations.