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# GUIDELINES FOR COST DEFINITIONS AND HARMONIZATION OF COST ACCOUNTING METHODOLOGIES FOR ECONOMIC EVALUATION

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# Contents

# LIST OF ABBREVIATIONS

A&E: Accident and Emergency

AOTMiT: Agencja oceny Technologii Medycznych I Taryfikacji, Agency for Health Technology Assessment and Tariffs

APC: Admitted Patient Care

AR: Autonomous Region

ASL: Azienda Sanitaria Locale, Local Health Authority

CT: Computerized Tomography

DES: Drug-eluting stent

DRGs: Diagnosis-Related Groups

EE: Economic Evaluation

FCE: Finished Consultant Episode

GDP: Gross Domestic Product

GHS: Groupe Homogène de Séjours, Homogeneus Groups of Stays

GKV-SV: GKV–Spitzenverband, National Association of Statutory Health Insurance Funds

GP: General Practitioner

HES: Hospital Episode Statistics

HTA: Health Technology Assessment

HRGs: Health-Related Groups

ICER: Incremental Cost-Effectiveness Ratio

ICD: International Classification of Disease

ICU: Intensive Care Unit

ISTAT: Istituto Nazionale di Statistica, National Institute of Statistics

IR-DRG: International-Refined Diagnosis-Related Group

MRI: Magnetic Resonance Imaging

NEF: *Notarzteinsatzfahrzeuge,* Emergency Medical Vehicles

NHS: National Health Service

NICE: National Institute for Clinical Excellence

PPP: Purchasing Power Parity

RTW: *Rettungswagen,* Ambulance

RVU: Relative Value Unit

SHI: Social Health Insurance

SSN: Servizio di Sanitá Nazionale, National Health Service

VAT: Value Added Tax

TFC: Treatment Function Code

WCD: Wearable cardioverter-defibrillator

# INTRODUCTION

There are two main elements in health economic evaluations (EE): the outcomes or health effects and the costs or resource effects. Health outcomes are ideally derived from the results of clinical trials and are normally applied to the all countries or jurisdictions where the EE is carried out, quite irrespectively from where the said clinical trials were carried out. Outcome data from a clinical trial carried out in a given setting is usually assumed to be transferable to other settings, although some exemptions can exist. In the case of large multi-country clinical studies, health outcomes for country-specific EEs are sometimes estimated only from the specific country subgroup of patients.

The estimation and transferability of costs for EEs is a more debated issue and there is not a consensus on which costs to include. First, the "actual" costs recorded in the context of a randomised controlled experiment might not reflect actual clinical practice, as some costs might be "protocol-driven", i.e. they are incurred in the experiment, but will not take place in real practice. Moreover, the unit costs in the experiment site –teaching hospital, region– may not be representative of the country. Second, resource costs vary across countries, hence, the costs calculated in a given country study, might not be directly transferable to a different country. The variation in costs might be produced by differences in the volume of resources used (units) or in the unit costs (monetary value). Last, but not least, when the countries concerned use a different currency, monetary values in the original study country will need to be expressed in the target country currency, which is not an obvious question, for instance, using current exchange rates vs. purchasing power parity (PPP) adjusted exchange rates.

In many countries, finding reliable and representative costs for an EE is a difficult task. A few countries publish comprehensive unit costs in a national public database (UK, and the Netherlands, for example), which can be used in EE. In other countries, there are some private databases that compile information from literature, official journals, etc. and then sell the information to researchers and sponsors that carry out EEs (in Spain, for example).

In very broad terms, the relationship between "costs" and "health outcomes" is generated by two mechanisms:

a) the resource used/required by a health intervention, or equivalently, resource inputs in a production process of health services (e.g. the acquisition cost of medicines to deliver an intervention).

b) the resource effects/consequences of an intervention (e.g. adaptation of the home for a disabled person, special education required/saved as a consequence of a health intervention, effects on productivity and leisure time, etc.). In that case, the (immediate) cause is the health outcome, and the resource effects/consequences, the effect of the relationship.

EE manuals and guidelines usually consider/suggest three steps in the quantification of costs of an intervention in an EE analysis:

1. Enumeration of the relevant cost items used in the intervention

2. Measurement of resource costs in specific/natural/appropriate units

3. Monetary valuation of the resource costs used

*1. Enumeration of the relevant cost items used in the intervention*

The resource costs to be included in an EE analysis depends on the perspective of the analysis. Usually defined as those borne or considered relevant by the decision maker assumed to use the EE analysis results to make/inform a decision.

*2. Measurement of resource costs in specific/natural/appropriate units.*

This measurement can be derived from clinical trials, observational and follow up studies, reported or recalled clinical practice, clinical guidelines and protocols, direct observation and reporting resource use and timing of tasks in actual clinical processes, etc. Often a combination of approaches is required and used.

*3. Monetary valuation of the resource costs used*

The third step is to assign a monetary value to costs. This is often done by multiplying the units of each resource item used by an appropriate monetary unit value (unit costs).

This report is one of the deliverables of the WP3 of IMPACT-HTA project (No 779312). The main objective of WP3 is to outline a costing methodology and a minimum common dataset of international costs (i.e. healthcare evaluation analyses and models across countries). To do this, three specific objectives have been proposed: 1) to produce a core dataset that incorporates direct health care costs across jurisdictions; 2) to propose a methodological framework for computing homogenous cost data across countries on a sustainable basis over time; and 3) to enable cost comparability across settings, including the explanation of factors that account for differences in healthcare costs across settings.

The structure of the report is as follows: First, we summarize what are the main commonalities and divergences related to the costing methodologies that are in the EE manual and guidelines. Secondly, we explain what are the health service costing methodologies and practices in a sample of EU countries. Thirdly, we discuss the key issues of costing methodologies raised by this research, including topics such as inflation indices, transferability in EEs, etc. Finally, we draw conclusions and make recommendations.

# CHAPTER 1. ECONOMIC EVALUATION MANUALS AND GUIDELINES – REFERENCES TO COSTING METHODOLOGIES. COMMONALITIES AND DIVERGENCES.

## Introduction

Economic evaluation (EE) has become a key tool within the Health Technology Assessment (HTA) process for the evaluation and reimbursement of healthcare technologies (1). The aim of EE of healthcare technologies is to provide information on the effect of a new treatment on health outcomes and costs, with the maximum achievable accuracy and precision given the existing evidence (2). When estimating costs in an EE, all the resources used in the production process of a new technology should be considered. These resources cover the whole time horizon to take into account the long term cost consequences of interventions (2).

Estimated costs should be reported in sufficient detail and appropriately adapted to the context in order both to be useful for decision makers and to form the basic input for a health economic model or study (3). Any method for estimating a cost need to address to broad questions, which influence the accuracy and precision that can be achieved: - the degree of disaggregation used in the identification and measurement of resources and cost component (micro-costing vs. gross-costing) and - the method for the valuation of resource and cost components (top-down vs. bottom-up). Each of these categories is described in the Table 1 using as reference the general framework for classifying costing methods for EE of health care of Spacirova Z et al. (4).

Three stages, at least, can be considered in cost evaluation: Selection of perspective and resource identification, resource measurement, and resource valuation. Most of the EU countries' guidelines inform about how to perform high-quality EE to be used as a decision-making tool for the inclusion of new health technologies. These guidelines are important to facilitate consistent decision-making and assist manufacturers in preparing their submissions. However, it has been identified that there are divergences in the methodological guidelines related to the estimation of the use of resources and their monetary valuation, including the cost measurement (4)(6). Moreover, health economic methodological guidelines frequently do not provide sufficient details about the recommended cost allocation methods. This generally entails poor reporting of cost data in EE, typically reported at aggregated level without addressing unit costs and the amount of resource consumption separately (5,7–10).

The objectives of this section is to review the recommendations of the EU economic evaluation manuals and guidelines, assess the methodologies suggested for identification, measurement and valuation of resource cost, and identify/clarify similarities and differences between them.

**Table 1. Description of costing methodologies**

| | Level and type of data collected |
|---|---|

| | | | |
|---|---|---|---|
| | | Expenditure data collected at organizational level (e.g., cost centre) | Resource use data collected for each individual patient and then multiplied by unit cost to estimate the expenditure |
| Level of identification of resource use items | Highly detailed resource use items are identified | Top-down micro-costing | Bottom-up micro-costing |
| | Aggregate resource use items are identified | Top-down gross-costing | Bottom-up gross-costing |

## Methodology

A literature review was carried out to identify guidelines, manuals and other documents that inform the methodology to be followed in estimating direct costs in EE studies in European countries. The search was done for the last 15 years and the main source of information consulted was the website of the International Society for Pharmacoeconomics and Outcomes Research (ISPOR), and the primarily ISPOR's 'Pharmacoeconomic Guidelines Around The World' database. Additionally, the publications were identified through an electronic search of Medline, Web of Knowledge and the reference lists of the identified articles were examined. Grey literature source such as Google Scholar, EUnetHTA, WHO, Center of Health Economics (University of York) were also search. To carry out this review, the following terms were used, alone or in combination: "Health technology", "Pharmacoeconomic', ''Pharmaceutical', 'cost analysis', 'Health technology assessment*', 'cost-effectiveness', 'cost-benefit', 'cost-utility', 'guide*'.

We included official EE guidelines of each EU country, cost manuals other documents that inform the methodology used in estimating a cost for the cost-effectiveness studies in any European country. Old versions of guidelines and checklists or tools for the evaluation of the quality of the EE were excluded for the revision.

Each guideline was reviewed in detail, and information was extracted by two authors independently. The results were tabulated according to the stages in assessing costs in a health EE mentioned above, and additional information on source of information of resources and costs by European country, the methodology for updating costs and discounting rate used in the EE with long terms horizon.

## Results

We have included 41 documents from 26 countries (Supplementary Table 1). Most of them were guidelines for the EEs used in different countries; others were costing manuals (11)(12). For some countries, there is more than one guideline. For example, within UK, England and Scotland each has its own separate guidelines. In Spain, Catalonia has its own guidelines. National Institute for Clinical Excellence (NICE) in England has three different guidelines (for all type of technologies, medical devices, and diagnostics).

### Selection of perspective and resource identification

The election of the perspective is the first step in the cost procedure. Costs included in health EEs depend on the perspective of the analysis. The broadest perspective is societal perspective, where all relevant costs (direct and indirect) and consequences of the health technologies evaluated are included in the analysis. Other narrower perspectives include public payer, health care service, the hospital or the patient itself.

Countries such as Belgium, Croatia, Czech Republic, England, Estonia and Latvia, Germany, Ireland, Italy, Scotland, Slovakia, Slovenia, and Switzerland recommend a health care perspective analysis for the reference case, whereas countries like Denmark, Finland, the Netherlands, Norway, Portugal, Spain and Sweden recommend the societal perspective (Table 2). Austrian guideline does not specify the perspective, it only recommends to specify the choice of perspective. In German guideline, four perspectives are differentiated: societal, social health insurance (SHI), SHI insurer (the health EE includes both the disease-related services covered by the SHI, which have to also be considered from a purely SHI perspective, and all costs that have to be borne by the insured individual), SHI considers reimbursable direct costs and transfer payments. The chosen perspective could extend beyond that of the SHI insurers and include other social insurance providers (e.g. long-term care insurance, statutory pension insurance), but it could also be the societal perspective that integrates productivity losses on the cost side (in the form of indirect costs).

EUnetHTA guideline recommends that EE should, at minimum, be conducted from a healthcare system perspective, but resource use related to other sectors can be included in a complementary analysis (6). The French guideline recommends a “collective perspective” that includes all direct costs (i.e. the resources used to provide the health intervention regardless of the source of funding (patients, compulsory and supplementary health insurance schemes, government, informal care, etc.).

**Table 2. Perspective on cost used by country**

| Perspective | Countries |
|---|---|
| **Health care system /Health care services /health payers** | Baltic guidelines, Belgium, Czech Republic, England and Wales, Ireland, Italy, Russian, |

| | |
|---|---|
| | Slovakia, Slovenia, Croatia, Catalonia region (Spain), Switzerland |
| **Public payer** | Germany, Hungary, Poland, Ireland, Catalonia (Spain) |
| **Social** | Denmark , Finland, The Netherlands, Norway, Portugal, Sweden, |
| **Societal and health care payers** | Spain (for NHS) |
| **Collective perspective** | France |
| **Not specified** | Austria |

Having defined the perspective, the resources are identified, measured and valued –typically in that order–. The type of cost and resource use associated with each perspective is detailed in Table 3 (13). When evaluating an intervention, a decision on what resources are related with a treatment under evaluation, as well as on resources originated because of secondary effects, complications or complementary treatments should be included. This is an important step in the incorporation of relevant costs for a decision making about technology being evaluated in order to avoid not inclusion of relevant units. The identification of units depends mostly on disease and treatment of the study.

**Table 3. Perspectives, type of cost (according to economic evaluation terminology) and resource consumption**

| Perspective | | | | Type of Cost | Example of resource consumption |
|---|---|---|---|---|---|
| Societal | Public payer | Health care services | Hospital | Hospital Direct cost | Health professionals, hospital services, Drugs, medical devices Equipment, space, facilities, and |
| | | | | Direct cost in other health care sector | Cost incurred in primary health sector: consultation with general practitioner, physiotherapist, prescription of a medicine.<br>Rehabilitation in a facility or at home* Community-based services, such as home care, social support* Long-term care in nursing homes |
| | | | | Direct costs to publicly funded services (other than health care) | Social services, such as home help, meals on wheels*<br>Income transfer payments paid (e.g., disability benefits)<br>Special education |
| | | | | Indirect costs to patients and their families | Out-of-pocket payments (including co-payments) for drugs, dental treatment.<br>Cost of travel for treatment. Lost time at unpaid work (e.g., housework) by patient and family caring for the patient |
| | | | | Productivity cost of the patient | Lost productivity due to reduced working capacity, or short-term or long-term absence from work (during friction period); Costs to employer to hire and train replacement worker for patient |

*Ref: toolbox HTA*(13) ** Some of these costs may be incurred by the publicly funded health care system, depending on the precise nature of these costs and the relevant jurisdiction;*

All guidelines mention the need for proper identification of all types of costs relevant to the disease and the technology evaluated, although both the degree of detail of the resources and their identification methodology are very heterogeneous. Some countries, such as Norway or Hungary, provides minimal information. Other countries include a detailed list of direct costs to be taken in account. For example, the Belgian guidelines states that only direct cost directly related to the disease in life years gained should be included in a reference case. Hence, non-healthcare costs such as travel expenses to and from hospital or informal care, and indirect costs such as productivity losses are only included in a separate analysis if they are deemed important for a specific treatment. This is similar for those countries that do not adopt a societal perspective.

The French guideline understands the EE of health interventions as the analysis of a production function in which resources are consumed to produce other resources. They make no distinction between medical and non-medical direct costs, as the evaluation is based on the analysis of production costs independently from both the nature of costs and funding body. Direct costs that take into account production factors are for example the resources consumed (goods,

services and time) in the production of the interventions under study, or the time needed for the production of the interventions as far as these have not already been taken into account as a factor in the production of a service. For example, the time of a medical staff in a micro-costing analysis. Additionally, the transaction costs, the resources that are temporarily needed in order to move from the present situation to the situation when the assessed intervention is incorporated into the clinical practice on a routine basis, carers' time and time devoted to the intervention by the beneficiaries are included.

The German guideline states that a comprehensive identification of cost items relevant for the intervention options should be generated even if not all cost items are finally quantified and valued. The identification of the relevant resource inputs starts with the description of the production function of the health care intervention. The production function combines knowledge of the intervention options, the natural course of the disease, impact of treatments on the disease (including productivity changes) and the interactions of patient subpopulations and the health care system. Direct medical costs (both reimbursable and non-reimbursable) and direct non–medical costs must be included in the health EE from the perspective of the Social Health Insurance (SHI) payers.

The Hungarian guideline includes as direct costs all the costs closely connected to the given health service, direct healthcare costs avoided by means of the new technology, and co-payment of patients as direct cost. The Irish guideline makes express mention of capital costs and the need to be appropriately depreciated and included as direct cost. Additionally, the maintenance costs over the lifetime of certain equipment (for example, MRI scanner) should be included in the calculation of costs.

Some other guidelines propose methods that can help in resource identification. For example, the Danish guideline recommends reviews of earlier studies in this area, the performance of pilot studies, or modeling. Danish, Dutch and German guidelines also include expert opinions as valuable method in resource use identification, and the construction of decision trees showing the possible courses of the disease of the health technologies compared, and the resource consumption associated with the technology, epidemiological knowledge and possible complications, rehabilitation, etc. Dutch and German guidelines also includes additional sources for identifying units, such as clinical guidelines, hospital treatment protocols, registration data (observational studies or real world data).

In relation with future cost, there is a consensus among the guidelines that costs generated due to diseases not related to the given health service, costs emerging in the life lengthened by the therapy but not due to the disease examined in the analysis, or other indirect costs cannot be presented, or, in justified cases, can be presented in additional analyses.

Finally, the cost savings or cost offsets are also considered in the Irish guideline, for example, a new technology could lead to a reduction in staff requirements which may be difficult for the budget holder to translate into savings (such as, redeployment of staff). The guideline specifies that the inclusion of cost offsets must be clearly justified, as they may not be achievable in practice. Hence, these costs should not be included in the reference case, and it may be appropriate to include them separately in the report. Supplementary Table 2 shows a description of the methodology of use of resource and cost estimations by European Country.

## Resource measurement

Measuring costs is a rigorous process and relies upon clearly identifying and defining the cost inputs in the analysis. To ensure transparency in the cost analysis, it is recommended to report the use of resources of the compared technologies in physical and natural units, prior to its monetary conversion. In this sense, most of guidelines recommends separate reporting of unitary costs and resource consumption amounts. However, there is heterogeneity in the methodology proposed on how to measure resources used Supplementary Table 2). Belgian, Czech and Danish guidelines recommend that the measurement of resource use should be done by means of observations (average data), where the resource consumption is in practice assumed to be the same for all patients. Belgian guideline also provides source of information for the measurement of mean length of hospital stay per APR-DRG and other databases that can be used to obtain other resources. French guidelines also provide sources of information for average cost for hospital stay.

Belgian, Czech, Danish, Austrian, French, Dutch and Irish guidelines propose types of data sources that might be suitable for collecting resource use data. One can distinguish between “primary data” (which has been collected specifically for the task at hand, in this case, estimating resource use) and “secondary data” (which has been collected for other purposes). The most common are databases and patient registers, Randomized Controlled Trials (RCTs) prospective observational studies and real world data (data derived from various sources that are associate with outcomes in a heterogeneous patient population in real world-settings).

Dutch guideline recommends that the collection of data on health care use is integrated into the collection of medical data in clinical trials, by including questions about health care use in the called case report form (CRF). For the inventory of data outside the hospital such as general practitioner, physiotherapy and informal care, data may be collected by questionnaires that are completed by the patients themselves. If primary data are not available, then secondary data sources can be used, through financial information systems of healthcare institutions or databases of insurers.

The use of expert panel is also recommended by Austria, Belgium, Germany, Czech Republic, Netherlands, Denmark, Ireland and Italy. Although, Belgian guidelines specify that expert panels are preferable as a complementary source of information rather than as the sole source of information on resource use. Instead, Scottish guideline clearly specifies that panel of experts should be avoided if possible.

We can also distinguish between micro –costing and gross costing as methodologies to obtain resource use data (see Annex 1).

In Germany, the appropriate level of precision in measuring services and resources is influenced, for instance, by the tariff system. As tariffs in the inpatient sector in Germany are based on a DRG system (with the exclusion of psychiatry), diagnoses should be identified and quantified accordingly with the DRG system. Hence a detailed (bottom-up micro-costing) recording of the resource use is not required.

Hungarian guideline recommends a micro-costing method when the DRG source is not sufficiently precise or accurate to capture resource use. If the cost analysis takes the real institutional costs into account, then the calculation method must be presented in detail.

## Resource valuation

The valuation of a cost in monetary terms is the result of applying a unit cost to a certain quantity. Resources should be valued at their opportunity cost (i.e. the value of the best possible use of resources). But given the difficulties in implementing this approach, most of the countries recommend other ways of valuing resources, including market prices, tariffs, administrative fees, direct measurement, and calculation of shadow prices. Most countries agree that market prices in perfectly competitive markets reflect opportunity costs. However, most markets in the health care sector are imperfect as prices are regulated by public institutions, or are negotiated between associations of providers and health insurance funds (Germany, France, the Netherlands). For this reason, there are also other alternative options of resource valuations of costs (Supplementary Table 2).

All guidelines agree to use as up-to-date information on the costs as possible, and to use a local currency as well. However, there is a great heterogeneity in the description of the valuation of costs to be used in EE. For example, Baltic, Croatian, Slovakian and Swedish guidelines provide little information on valuation of resources, recommended methodology and source of information. Finnish guideline provides information on valuation of cost of medicines only and Slovenian guideline does not provide any information regarding resource valuation.

Czech, Swiss, Spanish, Hungarian, Norwegian, Portuguese, Russian, Austrian, and Italian guidelines recommend how to evaluate the costs of their corresponding jurisdictions and/or advise on the most appropriate costing method to be used. For example, according to the Russian guideline, the financial costs and/or tariffs applicable to the budget health insurance system may be used in the resource evaluation. Swiss guideline states that the monetary value is placed on the resources by reimbursement rates established by health insurers, tariffs and other administratively fixed rates; the second option are the market prices if the first one is not available. Czech guideline provides information only on code lists or decrees where the pharmaceutical costs, costs on medical devices and medical services may be obtained. Hungarian guideline states that the resources are valued by fees set in legal regulations, and in any case, additional analyses must be compared at real prices. Additionally, the costs of healthcare services need to be presented indicating the International Classification of Procedures in Medicine and DRGs list price values. Norway guideline states that market prices should be used as proxies for unit costs. Moreover, any additional information on resource items included in the total cost is provided. In this regard, the guideline states that capital costs associated with treatment are usually already included in physician fees, DRG-weights, outpatient clinic fares, grants to nursing homes, etc. Portuguese guideline recommends the valuation of resource use in market prices, shadow prices (DRGs or convention tables as the approximate price of health care), or fixing standard costs, and suggest that the less appropriate method of resource valuation is to use accounting costs.

Austrian guideline recommends (in the following order), market prices, scales of charges or fees or other forms of administrative reimbursement, shadow prices, and if there is no published data for the cost survey, calculations and individual assessments should be performed. Italian guideline establishes a preference order headed by the costs derived from adequately representative samples of Italian healthcare facilities, using the available accounting systems. In the absence of adequate estimates of production costs, the prices with which the services are purchased from the National Health Service (NHS) or the tariffs used to finance public or private structures can be used. In this sense, the

reference case would use prices and tariffs as a cost proxy. As a last option, costs may be adopted from other studies only if the costs are relevant for the context of the reference case of the evaluated technology.

Moreover, Spanish guideline recommends possible sources of unit costs, but they do not indicate order of preference. Polish guideline makes a reference to both different methods that can be used in resource evaluation and their use in different circumstances. For example, they recommend using local scales of charges, when an examined intervention is available only in a health care institution of a certain type; and to use direct calculation (bottom up method) of unit costs when there is a large impact of the intervention on the total or incremental cost, and in the cases, when no data from other sources are available. On this last point, the costing methodology (bottom up or top down) and the method of cost allocation resources should be specified. Additionally, advantages and disadvantages of each methodology are explained, concluding that the most common scenario is using the combination of both methods. In this respect, it is striking that the cost calculation is highly influenced by the choice of a centre, therefore, the cost should be taken from a sufficient number of centres, so that the estimated costs are representative of the variability between centres in clinical practice and types of patients treated. The Polish guideline also specifies that costs from other hospital wards, buildings and the cost of general purpose equipment and fixed costs should be estimated by the direct allocation method (top down method).

Other guidelines provide more detailed description of the methodology used in resource use evaluation, such as German, Dutch, Belgian, Danish, English, Irish, Scottish and French (Table 3).

The Belgian guidance recommends valuation in market price or some kind of mechanism used for the reimbursement of procedures. Alternative method should be, for example, micro-costing approach. This method can be presented using alternative scenarios, supported with arguments of why the analyst thinks these alternative cost estimates are most appropriate. The guideline also provides information on the methodology of some resources such as devices, per diem hospitalization, drugs, medical imaging, clinical biology in hospitalized patients, and transport costs to health care services (Supplementary Table 2).

The German guideline suggests how the resources should be valued taking into account the methodology used in the estimation of resources and the type of resources to be costed. For example, when using the micro-costing approach, valuation of resources should be made by resource prices. When cost estimation is focusing on medical procedures (e.g. examination, lab test, diagnostic imaging), using market prices, if available, is recommended, unless there are good reasons for adjusting to social opportunity costs, such as: when the market price do not cover all costs (investment costs are financed separately as occurred in DRG), an excess profits are observed in a health market, different prices exist for identical services, or prices only form a charging unit independent of actual resource use (e.g. costs per inpatient day), and/or substantial cross-subsidization is observed. In gross costing approach, some similar adjustments should be made, as regulated prices and tariffs in many cases do not reflect the social opportunity costs. For valuation of drugs, the recommendation is to make a rough estimation of long-term opportunity costs (on the basis of “market shares”). For other drugs (other than the intervention and the technologies compared in the health EE), adjusted market prices can be used. In the case of considering R&D costs, they should be reported separately. In addition, an analysis without considering R&D costs should be conducted.

Irish guideline recommends a flexibility regarding cost valuation as there is not cost model available. The true cost to the Health service Executive is impacted by a range of factors that must be considered when preparing the assessment. The origin of the cost data should be clearly identified and justified. Where alternative sources are available, the cost chosen should be justified and where appropriate, the implications of using alternative data examined by sensitivity analysis.

Two general approaches can be used for resource valuation: bottom-up (resource use is identified by individual patient and then it valued these using unit costs to obtain total cost per patient) and top down (involve the use of diagnosis-related group (DRG) or, in exceptional cases, average per diem costs). Cost will have to be estimated as a weighted average of several DRGs, where weights are based on the expected number of cases with each DRG code. For non-drugs, the public list price should be used in the reference case analysis. Prices for drugs supplied through the community drugs schemes are listed in the reimbursement files of the Primary Care Reimbursement Service (PCRS), which are updated monthly. For new drugs, a system of external reference pricing is used. In the absence of a published list price, the price submitted by a manufacturer of a technology may be used, provided this price would apply throughout the HSE. The drug cost used in the reference case should reflect that of the product, formulation and pack size that gives the lowest cost, if this represents a realistic choice for use in clinical practice. Drug administration costs, the cost of drug wastage (for example, from injection vials or from patient non-compliance), and the cost of therapeutic drug monitoring should be itemized and included where appropriate. In certain circumstances, it may be appropriate to take into account discounted prices that reflect the true cost to the HSE. The use of price reductions for the HSE should only be used if these are consistently available throughout the HSE and are known to be guaranteed for the time specified. Labour (pay) should be calculated using consolidated salary scales available from the HSE, adjusting for pay-related costs in Ireland.

In UK, English guideline recommends the use of public price list for technologies, and Health-Related Groups (HRG), and if HRG is not appropriate, micro-costing studies can be used.

Scottish guideline recommends as first point of reference the official listing published by the Scottish Government Health Department, National Services Division, and the Department of Health in England and/or the Welsh Assembly Government. Other references can be Scottish hospital costs; NHS Reference Costs; Primary care and community costs from the Unit Costs of Health Care publication. Where cost data are taken from literature, the methods used in the cost study to identify the sources should be defined.

Staffing costs should include all costs incurred by the NHS as an employer, not just the salary. The guidelines provide an illustration of how to calculate it. Capital costs should be annuitized and included in all types of costs where relevant. Medicine costs should be based on unit prices listed in the BNF or MIMS. Where a Patient Access Scheme (PAS) is proposed for the medicine under review, both the list price and the PAS price should be used for calculating the base case. For the comparator medicine cost, the product most likely to be replaced should be selected. If a volume-weighted average based on Scottish practice is used, a comparison with the cheapest medicine should be included in a sensitivity analysis.

French guideline recommends that the valuation of a resource must be based on its production cost. When this data is not available, tariff can be used, and for resources for which there is no tariff, they can valued at average acquisition

price paid, or by another method which must be specified. In France, HRG tariffs are used by national social insurers to reimburse hospital activity. Hospital costs are valued as closely as possible to the cost producing inpatient stays, being the preferred source of data, the National Cost study (ENCC). This cost represents average cost per DRG. When the ENCC data do not reflect characteristics of hospital stay linked to the evaluated intervention, any change can be made to the component of the average cost (i.e., length of stay). When the ENCC is not appropriate, the cost of the intervention is valued by HRG /healthcare resource group tariff or flat-rate price (i.e. organ retrieval) (Supplementary Table 2).

Whatever type of data is used (valuation per DRG from the ENCC or per HRG for tariffs), the reference case analysis favours a valuation that is as close as possible to actual conditions of practice: when the interventions studied are likely to be funded across several DRGs (or HRGs), the cost is valued taking into account the distribution of the interventions considered between DRGs (or HRGs) observed in the French hospital discharge database (PMSI); it is preferable to weight the tariffs from the public sector and the private sector (including fees) according to the distribution of activity found in the PMSI database for the interventions considered.

Costs in the outpatient sector are based mainly on tariffs. In circumstances where the evaluated interventions are likely to change the production cost of at least one component of medical product or service for which there is not a tariff, or when it is necessary to evaluate a new intervention for which no tariff is available, the micro-costing techniques can be used.

Danish guideline recommends a micro-costing method when the resource consumption is highly central for the analysis and a gross-costing method when costs are less central (by DRG). Market prices are used for example for medicines. In Supplementary Table 3, the method for valuation of healthcare resources such as labour, medicine hospital, capital equipment, overhead, or inpatient stay is described.

In Dutch guideline the main source for valuing resource units are references prices (database with reference prices for a number of common units), which are average unit costs. Various techniques are used to calculate the reference prices, depending on data availability. The gold standard is bottom-up micro-costing, when it is not available, gross-costing method is applied. Reference prices for emergency care, ambulances, blood products, daycare treatment in mental healthcare and rehabilitation were calculated using top-down gross-costing, for which data on costs and volumes were derived from healthcare providers. Data on expenditures and volumes derived from national healthcare database were used to calculate reference prices using top-down gross-costing, for primary care physicians, paramedical care, elderly care, home care, mental healthcare and healthcare for disabled patients. Finally, tariffs were used to value diagnostic procedures. For contacts with independent psychotherapists and psychiatrists, ambulatory consultation in a general institution and inpatients days in mental healthcare tariffs were used. Supplementary Table 3 shows sources recommended by the guidelines. The Guidelines also include a rough description of a cost estimation of each resource such as personnel cost, medical equipment, material cost in hospital, or costs of support departments (administration, laboratory, etc.) as well as methods used in allocating costs to medical departments.

## Source of costing information

All previously mentioned European guidelines recommend to use the most up-to-date data sources and to cite them correctly. Nonetheless, in some countries, guidelines lack detailed information on source of unit costs. Supplementary Table 4 contains sources of unit costs of those countries that provides them in their guidelines. The items are organized according to whether they are primary resources, composite goods and services or complex processes and interventions.

To ensure comparability, in addition to standardized methodology, the development of standard cost lists could be recommended. In this sense, some EU countries such as Netherland or Germany have standard cost lists that supplement guidelines for health EE. These standard cost lists present average valuations of cost for commonly used services and resources.

## Discounting

Costs and future consequences (beyond one year) should be discounted to reflect society's rate of time preference. The choice of discount rate is the decision of the jurisdiction in which the EE is performed. Most European countries use a discount rate between 3 to 5% for cost, and it is recommended to perform a sensitivity analysis to explore the effects of reducing the rate to zero. However, the explanation for defining the discount rate is not always specified. Only some countries explained a reason, for example Croatia indicated a discount rate of 5%, based on calculated mean of base rate for four quarters within respective year, over the last three year (reflecting the Croatian trend in Base rate and Discount rate over the last three years) according to Croatian Competition Agency. In Norway, the discount rate is equivalent to the one recommended by the Ministry of Finance for public projects with moderate systematic risk, reflecting the discount rate is a real interest rate. Germany has a rate of 3% according to the real interest rate of low-risk long-term government bonds. Finally, Hungary has a discounting rate of 3.7% based on domestic empirical data. Slovenia and Switzerland have not defined a discount rate recommended for the EE (Table 4).

**Table 4. Discounting rate recommended for cost by country**

| Discounted rate for cost considered in the reference case and sensitivity analysis (in brackets) | Country |
|---|---|
| 3% (0-5%) | Belgium, Sweden, Spain |
| 3% (0-6%) | Czech Republic |
| 3% | Finland, Denmark, Italy |
| 3.5% (1.5%) | England |
| 3.5% (0-6%) | Scotland |
| 3% (0, 5, 7, 10%) | Germany |
| 3.7 % (2-5%) | Hungary |
| 4% | France, Norway |
| 4% (0-10%) | Ireland |
| 4% (+-1.5%) | Netherland |
| 5% (0-5%) | Poland |
| 5% | Portugal , Russia |
| 5% (3-10%) | Austria, Croatia |
| 5% | Baltic countries |
| Not specified | Slovenia, Switzerland |

## Methods for updating cost to the relevant year and currency

The simplest form of adjustment, which greatly facilitates the comparability of studies mentioned in all manuals, is an inflation and currency adjustment. This adjustment is necessary because the studies often come from different years and monetary systems with different price levels or, even if they come from the same monetary systems (for example, euro zone), the purchasing power in the countries is different.

The adaptation can take place in different degrees and ranges, from relatively simple methods of inflation and currency adjustment to the adaptation of resource or cost data or complete model structures. In this sense, not all revised EE guidelines give recommendations on the price index to be used or the currency conversion method, to transfer cost data from one country to another. Table 5 shows a summary of the methods used for those countries that inform on this topic. E.g., Finnish guideline recommends using a price index for public expenditure on municipal health services, and the suitable price indexes in regard to other costs. In Germany, inflation rates specific to healthcare should be applied. As these specific inflation rates are not available for most healthcare services in Germany, it is recommended that the general price index (published by the Federal Statistical Office) is used. Hungarian guideline recommends using the consumer price index published by HCSO (the Hungarian Central Statistical Office), regardless of whether the costs (and savings) pertain to the technology examined in the analysis or emerge outside of the healthcare system. The basis of the conversion should be the annual consumer price index (inflation, aggregate value category) published by HCSO. Ireland, Hungary, Netherland, Portugal recommend consumer price index and the Ireland guideline offers a detailed description.

## Transferability and currency conversion

Some guidelines make a particular mention of the problem of transferability and, in relation to the costs, indicate the methodology of currency conversion. A more detailed description of how some European methodological guidelines deal with the problem of transferability can be seen in Chapter 3.

Broadly, there are two methods to measure prices of a specific good or service in different countries using a common monetary unit: market exchange rates, and Purchasing Power Parity (PPP) indexes.

In a floating exchange rate system (with no central bank intervention) the market exchange rate between two currencies is set each day according to the volume of transactions in each currency. Most transactions between currencies occur in order to be able to trade goods and services between the two countries. If currencies were only exchanged to facilitate trade in goods and services, then one could plausibly claim that, at least on average over the long run, the market exchange rate should broadly reflect the relative price level of goods and services in each country. However, in practice, this is unlikely to be the case on a day-to-day basis, for at least three reasons. Firstly, transactions in the currency market can be undertaken for reasons other than trade in goods and services, such as speculation (buying assets in another country expecting the price of the asset to increase in the future), or taking advantage of opportunities for arbitrage. These short-term financial capital flows can be of considerable size and are often unpredictable, and can make the relative prices of currencies extremely variable. Second, one or both of the central banks in each country may intervene in the market as a lever of monetary policy, and so "fix" the market exchange rate at a value that does not reflect the relative prices of goods and services. Third, there are many barriers to trade, including regulations, quotas and taxes, which mean that some goods and services are traded at prices that do not correspond to their opportunity costs of production. Finally, not all goods and services can be traded internationally. Many types of healthcare service fall into this category. Taken together, these limitations mean that the market exchange rate does not always reflect the true relative value of goods and services produced in each country.

Hence using the market exchange rate between currency A and B on a particular day responds the question "how many units of currency A would be needed to purchase good X on that day in a country with a different currency B". For example, a good costs 1€ in France, and 0.90£ in the UK in 2018. Let us say that, on a particular day, say 31 December 2018, the market exchange rate for the pound was 1.1301€. Then a French consumer would require 1.1301 x 0.90 = 1.02€ to acquire the good in the UK. The conclusion would be that the French consumer requires 1€ to acquire the good in France but 1.02€ in the UK, so the good would appear to be "more expensive" in the UK.

However, for the reasons discussed above, the market exchange rate does not necessarily measure the opportunity cost of the good or service. The opportunity cost of good or service X is the other goods or services which are foregone in order to acquire X. The market exchange rate does not consider what goods and services the "euro" monetary unit can buy in France, compared with what goods and services the "pound" monetary unit can buy in the UK. Purchasing Power Parity indexes are constructed with this question in mind. Using PPP indexes, the price or cost of good X in country A and country B can be expressed in a common unit of currency, called the "international dollar, I$". The idea is that, if in the United States (the arbitrarily chosen reference country) a dollar is able to buy a given basket of goods and services,

then the PPP index express the number of units of local currency that would be needed to acquire an identical basket of goods and services in the other country.

For example, a good costs 1€ in France, and 0.90£ in the UK in 2018, as before. The PPP index for France (relative to the international dollar) in 2018 was 0.754, and the PPP index for UK in the same year was 0.687. Hence the good would be valued at 1/0.754 = 1.32 I$ in France, and 0.9/0.687 = 1.31 I$ in the UK. The conclusion from this calculation is that UK residents must forego fewer "other goods and services" (that is, "purchasing power") than French residents, so the good is "cheaper" (that is, a lower opportunity cost) in the UK.

Because PPP indexes measure relative domestic price levels, and not foreign currency trades, they can be constructed for countries within a single monetary union. Hence, the Eurostat data includes PPP indexes for France, Germany, and Spain and so on separately (as well as for the eurozone as a whole). According to these data in 2018, an international dollar (a common basket of goods and services) was valued at 0.756€ in France but 0.635€ in Spain, reflecting higher prices in France for the same basket of goods and services.

Under the Eurostat methodology, PPPs are calculated using a weighted average of prices for all the components of GDP (consumption goods and services, government provided goods and services, and investment goods). Hence PPPs are estimated based on the prices of a much wider range of goods and services (both traded and non-traded) than those included in the market exchange rate, which only takes account of the volume of currency trades between the two countries on a particular day. Hence, PPPs are often called "GDP-PPPs". PPPs contain two elements related to healthcare, one for out-of-pocket healthcare expenditure, and the other for government (nom-market) healthcare expenditure. The consumer health component of the PPP index is estimated with prices collected from the Eurostat "furniture and health" survey. This covers pharmaceuticals and other medical goods (including therapeutic appliances and equipment) and medical, dental, and paramedical services delivered to outpatients. Medical goods and hospital services provided by non-market producers are covered under government-produced health services for which input prices are required.

In Austrian guidelines, the use of purchasing power parities (PPP) is recommended for currency conversion, since exchange rates lead to distorted results. If both inflation and currency adjustments are applied, consistency should in any case be the same reference system for purchasing power parities and price indices (e.g. Gross Domestic Product (GDP) price index and GDP-PPP).

The CPS Task Force specifies a technical form of adaptation (Task Force on Community Preventive Services 2010). The adaptation process is precisely defined. It starts with the currency adjustment followed by the inflation adjustment. The following step is the adaptation of the discount rate, followed by the conversion of the program costs as well as the cost savings and productivity losses.

Irish guideline states that when costs are applied from other countries, the assumptions necessary to transfer this data must be explicitly reported, with all costs converted to their Irish equivalent in euro using Purchasing Power Parity indices. If transferring costs from another country in a previous year, costs should first be updated to the current price year using the local Consumer Price Index.

**Table 5. Methods for Price and Currency adjustment by country**

| Price and Currency adjustment method | Country |
|---|---|
| *Price adjustment* | |
| GDP Price | Austria |
| General inflation rate | Czech Republic |
| Price index for public expenditure on municipal health services / health service price index. | Finland, England, Scotland |
| Consumer price index | Ireland, Hungary, The Netherlands, Portugal |
| UK health service price index. | Scotland, England |
| Health index | Belgium |
| *Currency adjustment* | |
| GDP-PPP | Austria |
| Purchasing Power Parity indices | Ireland, The Netherlands |

## Method to handle missing cost data

Belgian, Polish, Scottish, Swedish, and Dutch guidelines included recommendations on dealing with missing cost data. Belgium, Sweden and The Netherlands recommend to describe the proportion of missing cost data, the reasons for data missingness, and the methods used in handling with the missing data in the analysis. The Swedish guideline points out that missing data should never be assumed to occur completely at random. The Belgian, Polish, Scottish, and Dutch guidelines recommend to describe the applied imputation method, and Dutch guideline adds to assess the robustness of the applied imputation method by performing sensitivity analyses with different imputation techniques.

# Discussion

This chapter analyzes how a set of national Guidelines for the Economic Evaluation of Medicines and other Health Technologies addresses and makes recommendations and prescriptions on identifying, measuring and valuing the resource costs of the interventions compared.

In most EE, analysts derive the information on the volume of resource units used by each intervention compared from RCT, observational studies, direct information from experienced health personnel, etc., and multiply the respective volume of units by a monetary unit value - usually referred to as its “unit cost”, although they are not always derived from the analytical accounting of certain health care institutions, but are market prices, tariffs, shadow prices, etc. These values are often calculated independently from the EE analysis concerned and are reported elsewhere and assumed to be representative of the jurisdiction where the results of the EE is expected to apply.

National guidelines normally recommend either a certain set of methodological practices to calculate unit costs or the use of a source of already calculated unit costs or a combination of the two options. However, there is a variability in

the description and methodology applied by each country in estimation of the cost of resources to include in an EE of health technologies. There is no international standard to stand as a reference, so each country adjusts its methods to the national cost accounting methodology of its health systems.

Some countries such as UK, Belgium, Germany, France or the Netherlands make a more detailed description of their cost estimation methodologies for resources uses. However, most of the European guidelines go no further than defining the cost valuation method (tariff, market prices, etc.) without describing which items are included or how are the unit costs placed to them.

All guidelines stated clearly which costs should be included in a health EE, and pointed out that all relevant direct healthcare costs for which differences are expected between treatments should be included. However, there was large variation between the guidelines with regard to the valuation of the resources used. The valuation methods were recommended in the guidelines, including the use of standard unit costs, micro-costing tariffs, lowest price, diagnosis-related groups and macro costing. Some guidelines do not provide information on the most appropriate source of unit costs, which leads to the discretion of a researcher, analyst or provider of the technology, who can take the cost that is the best alternative for him. For example, in countries such as Spain or Italy, where the health competency is transferred to the autonomous regions, undertaking EEs in order to make decisions at a central level can have important biases in relation to costs due to the inexistency of standardized cost lists.

Those jurisdictions that describe only tenuously the costing methodology, provide less transparent Incremental Cost-Effectiveness Ratio (ICER) results. The method used in estimating costs of technologies, procedures, etc. influences the final costs. EE undertaken in countries that do not publish a standardized cost list (DRGs or other list of unit costs) will require a greater use of discretion by researchers, and hence introduce greater variability in cost estimates with possibly a loss of precision. Taking data from different sources gives different ICER results and this may influence decisions concerning the pricing and reimbursement of drugs and other technologies. To establish clear guidelines, as detailed and transparent as possible, ensures a level playing field.

Cost estimation requires comprehensive data collection that may be both time-consuming and resource-intensive. In some cases, the development of national standard unit cost lists using (internationally accepted) standard methodology would be very useful (14,15). Standardization could reduce method biases, but other type of biases such as scale bias, case mix bias or site selection bias (5). The use of standard cost lists or reference prices ensure that differences in costs result from differences in the use of healthcare resources and not from the methodology of cost estimation.

A recent study found that a standard cost list, such as the reference prices provided in the costing manual, is only available in four out of 30 pharmacoeconomic guidelines (16). Regarding European guidelines, we have found that both Germany and the Netherlands have costing manuals. In the Netherlands, next to reference prices published in the costing manual, the manual provides guidance on the methodology of calculating unit prices when reference prices are not available. The Dutch costing manual can be very useful tool, example of best practice, for developing costing manuals in other countries.

Finally, there is also still a challenge to improve the reporting of cost data in the EE, and comply with the recommendations of the guides.(15)(15)(15)(15)

## Conclusions

The results of our review of national guidelines show a broad variability / heterogeneity across countries regarding methodological costing norms and practices, including the calculation and identification of the monetary value of a unit of a resource, usually referred to as its "unit cost". This is not an unexpected result, as few countries have tried and achieved a country-wide standardization of accounting practices in the health sector. This heterogeneity in accounting poses a big challenge if our objective is to assess the variability in unit healthcare costs across countries and to identify the factors that explain the existing differences.

However, the main objective of the WP3 is to allow and facilitate the reuse, multiple use and transference across EU countries of analytical EE tools, such as core decision analyses and mathematical models and algorithms in order to make a more efficient use of the the existing EE analytical capacity in the EU.

In order to ensure transferability of a model across countries the main conditions that must meet are:

1. The characteristics of the health systems and more specifically of the health care production functions are the same – or at least, fairly similar – in the two or more countries involved in the transference of the model or algorithm.

2. The type of resources involved in the transference of the model accountable for the cost of the interventions compared exist in the two countries concerned and have included the same internal composition of more basic resources. For instance, if the original study included the cost of one day of hospitalization and the cost of this resource included the food and the physician's, it must be verified that the unit cost of one day of hospitalization in the country of secondary use also includes food and physicians' retributions.

# CHAPTER 2. HEALTH SERVICE COSTING METHODOLOGIES AND PRACTICES IN A SAMPLE OF EU COUNTRIES

## Rationale for developing the European Healthcare and Social Cost Database (EU HCSCD)

The rationale for developing the EU HCSCD for use in HTA across countries is to provide a common dataset of international costs, which can feed into health EEs carried out by transferring EE analysis and models across countries. The project build on previous work undertaken in HealthBASKET (17) by gathering cost information on different healthcare and non-healthcare resources. One of the objectives of IMPACT-HTA, led by WP3 and WP4, is to construct a publicly available dataset of costs for use in HTA across countries. Establishing common dataset of unit costs for across EU countries will be a useful tool for, at least, two objectives:

1) Firstly, it will make it easier to carry out multi-country studies and to adapt EEstudies from country to country, thus saving human resources time (and consequently costs) in the task of looking for healthcare and social costs:

2) Additionally, it will enable analyses that try to understand and explain the differences in costs of healthcare resources within and across countries.

These two objectives are partially related, but not the same, and they have different requirements.

In order to ensure the validity of using a given EE model or algorithm in different settings by substituting the unit costs of the original country by those of the target country (objective 1), it is necessary that the resource units involved are equivalent in the two countries, either in the traditional meaning in microeconomics –i.e. the resource units are indistinguishable– or in the sense that they have the same effect in terms of health outcome of the interventions where the resource is used as an input of the production process. In that context, the potential differences in the way a monetary value is assigned to a given resource unit is quite irrelevant, only the way the cost item is defined counts.

In the context of objective 2, i.e. to enable the comparability of the monetary value of a resource unit across countries and/or institutions, the previous condition –the homogeneity or equivalence of the resource item− still holds, i.e., the unit cost should refer to homogeneous objects (services). That means that to be able to meaningfully compare the cost of, for example, mastectomy across hospitals of several countries, the procedure should be comparable because the combination of resources is exactly the same in all hospitals. However, in that case the unit cost data of all institutions compared should have been computed using the same accounting methods and criteria for allocating a monetary value to a resource unit. If this condition does not hold, the analysis will not be able to identify whether differences in unit costs are “real”, i.e. attributable to a more efficient use of the resources, or a spurious effect of different cost allocation methods across countries.

## Design of the EU HCSCD structure

The EU HCSCD structure, containing the information that would be required for each unit cost item to be included, has been designed based on the literature review of different costing methodologies taking as references the Centre for Health Economics of the University of York(5), manuals for economic evaluation(2), costing guidelines(18,19) and accounting manuals(20).

Cost accounting is a procedure for allocating costs to resource items or activity. To obtain costing data from and to make meaningful comparisons across countries, we need to understand (A) how are resource units identified and measured in each country, and (B) how are costs allocated to those units in each country (Table 6).

**Table 6. Typology of resource units and costing methods**

| | PRIMARY RESOURCES | GOODS AND SERVICES | PROCESSES AND INTERVENTIONS |
|---|---|---|---|
| Description | A "basic" or "indivisible" input to healthcare | A composite resource consisting of several primary resources consumed jointly | A composite resource defined at a more aggregate level than "goods and services" |
| Examples of resource units | Staff (hour), devices, medicines, health products/disposables | Day in hospital, visit to specialist, visit to primary care, diagnostic test | Diagnostic Related Group (DRG) hospital admission, inpatient day |
| Examples of typical methods for estimating cost of each unit | Estimated from list prices (devices/ medicines), nationally agreed salaries (staff). The cost does not usually include provider overheads | May be estimated by micro-costing or top-down methods, or a combination | Usually estimated by top down costing. Usually includes fully allocated provider overheads |

***Source:*** *Prepared by authors based on Drummond (2015)*(2) *and Mogyorosy (2005)*(5)

1) Primary resources

Many primary resources are likely to be defined in a fairly standard way across countries, e.g. medicines by name, dose, etc., devices by manufacturer & model. Staff grades may be more complicated. Health professionals may have quite different functions, e.g. in some countries, a senior doctor has a dedicated % of time for administration, travel or research, but not in other countries. In some countries, nurses can take senior roles ("consultant nurse"), in other countries their role is more restricted.

2) Goods and services

"Goods and services" here are bundles of several primary resources that are consumed jointly. For example, a day in hospital will include some staff activity (nursing, doctors ward rounds), some amenity services (catering, laundry) and often more general overheads (energy, general maintenance, portering, etc.). We need to understand if there are important differences in the way such services are defined between countries. There may be quite important differences, even for items with similar-sounding labels. For example, a laboratory test is a service that includes some

consumables, along with laboratory technician time, administration, communication of results to the patient etc. A similar test (e.g. cholesterol) might be provided in hospitals, clinics, primary care etc., leading to differences in cost between countries. Another example: an "outpatient" consultation may take place in hospital, clinic, or an office. There may be procedures or tests carried out, or not. The consultation may be led by a doctor, nurse or other professional (sometimes in teams). Again, these might lead to differences in cost.

3) Processes and interventions

"Processes and interventions" are activities that aggregate several procedures, "goods and services" and primary resources. For example, many countries use a DRG system to classify hospital admissions or discharges. The challenge here is to understand how the classification system is constructed and how the systems are similar or differ between countries. Previous EU projects have investigated these questions, which provided a useful starting point.

## Ways of ensuring comparability of unit cost across countries

Ensuring comparability of unit cost across countries implies much more that identifying local figures for a certain cost term, but it requires collecting detailed information on costing methodologies used to estimate cost of each item included in the EU HCSCD. By detailed information, we understand the knowledge about what resources are included in the cost, how were the resources estimated and how was the unit cost calculated and assigned to the resources. In addition, this will enable economic analysts to analyze similarities of cost methodologies between countries.

In the long term, comparability could be more easily attained if all countries/institutions used the same accounting methodology. So far, when trying to compare unit costs across countries, jurisdictions or sites, the analyst should be aware of the fact that the unit values available at present have different origins, (market prices, tariffs, public prices, etc.), but often are also obtained by different cost accounting methodologies from health care organizations.

All the fields that have been included in the cost database to mitigate the problems of comparability are described in detail in the document titled Technical aspects of the European Healthcare and Social Cost Database (EU HCSCD). Its draft version can be found elsewhere(21).

Selected costing items were organized in the following subcategories: medicines, medical devices, health products/disposables, personnel, outpatient visits, hospitalization, image diagnosis, laboratory tests, ambulance services, diagnostic procedures, therapeutic procedures, inpatient medical and surgical processes and day case procedures/outpatient surgery. These subcategories were, in turned, organized in three main categories: primary resources, composite goods and services and complex processes and interventions(21).

## The categories of the selected direct healthcare cost items

As mentioned earlier, three main categories of direct healthcare cost items have been identified: costs of primary (homogenous) resources, composite goods and services and complex processes and interventions (Table 6). All of them are further divided into subcategories.

**PRIMARY HOMOGENOUS RESOURCES** are subdivided into medicines, medical devices, disposables and personnel costs.

**Medicine** refers to a drug or other preparation for the treatment or prevention of disease.

**Medical device** refers to an article, instrument, apparatus or machine that is used in the prevention, diagnosis or treatment of illness or disease, or for detecting, measuring, restoring, correcting or modifying the structure or function of the body for some health purpose(22).

**Health products/Disposables** refer to the items designed for single use or those that may be used more than once after proper cleaning and sterilisation and/or disinfection(23).

**Personnel** refers to the labour time of health care professionals (e.g., workers employed in health care institutions or processes).

**COMPOSITE GOODS AND SERVICES** comprise outpatient visits, hospitalizations, image diagnosis and laboratory tests, ambulance services, diagnostic procedures and therapeutic procedures.

**Outpatient visit** refers to the visit of a patient who is not hospitalized overnight but who visits a hospital or clinic for diagnosis or treatment(24). Home visits (medical or nursing staff attending a patient at his home) and Accident and Emergency (A&E) visits were also considered.

**Hospitalization** refers to the admittance to the hospital as an inpatient(24).

**Image diagnosis** refers to the radiography, sonography, and other technologies used to create a graphic depiction of the body for diagnosis or therapeutic purposes(24).

**Laboratory tests** are services provided by medical laboratories for the diagnosis of disease(24).

**Ambulance service** refers to the service provided by a vehicle which can transport medical patients to the treatment site or back to their place of residence, and in some instances will also provide out-of-hospital medical care to the patient during the transportation. This subcategory is further divided into non-emergency patient transport and intensive care ambulance.

**Non-emergency patient transport** refers to the transport for patients who require clinical monitoring or assistance but do not need a time-critical emergency ambulance(25).

**Intensive care ambulance** is well-equipped ambulances that provides emergency medical care. Once it is activated by an incident that causes serious illness or injury, the focus of intensive care ambulance is emergency care of the patient(s)(26).

**Diagnostic procedures** refer to the type of test used to help diagnose a disease or condition(27).

**Therapeutic procedures** refer to the medicine or therapy used to cure disease or pain by the involvement and intercession of proactive, therapeutic practice(28).

**COMPLEX PROCESSES & PROCEDURES** comprise complex processes and surgical procedures.

**Inpatient medical and surgical processes** require patients to stay the night following the surgery.

**Day case procedures/Outpatient surgery** refers to a patient or case that comes into hospital for a surgical procedure and is dealt with and released in the course of one day(29).

## Source of inputs introduced into the EU HCSCD

In order to obtain all the information on unit costs (described in the User's guide)(21) from the countries where partners are involved in the project IMPACT-HTA (England, France, Germany, Italy, Poland, Portugal, Slovenia, Spain and Sweden), the partners from the project teams were contacted. Therefore, both unit costs and methodology were obtained in their entirety from consortium partners.

## Unit health care costs: typology of sources

Unit costs may come from different sources

1. Regular cost accounting systems of health care organisations, which are usually done for fiscal and management purposes. They are often considered the first choice from an economic, social opportunity cost, point of view.

2. Market/transaction prices. They are supposed to reflect production/opportunity cost in markets under perfect competition.

3. Tariffs. They are the prices paid by (public and private) health insurers to (private and public) health providers, e.g. hospitals.

4. Public prices. The prices (occasionally) paid to public health providers by individual private users, organisations or insurers.

Tariffs and public prices may or may not reflect accounting cost. However, they can be considered the valid opportunity cost for the purchaser, irrespective of how they have been calculated.

5. Shadow prices. They might be estimated in different ways. A hospital which building has been donated by a philanthropic donor might not have an explicit monetary cost, but it certainly has an opportunity cost, which should be estimated for the external validity of an EE. The reason is that when the intervention is applied in a hospital that pays an explicit cost/rent for the building, there will certainly be a rent cost to be considered.

Manuals and guidelines usually prescribe/recommend that the analyst should separately perform and report the results of the three steps: identification, measurement in specific units and monetary valuation (2,3). Some relevant/identified resources might not be measured for various reasons (intangible/not measurable, very small/negligible, no data available, discarded because they are the same in all options compared, etc.), but it is usually recommended to list them in order to make decision-makers aware or their existence and potential relevance (2).

## Key characteristics of costing items included in the EU HCSCD

Down below are described the costing methodologies that were used in order to calculate the cost of described items and/or cost components included in each item (in case there were available in the country the costs proceed from). This section emphasizes the need not only for cost comparison, but also for comparison of the methodologies used in the calculation of the cost of each item. At the beginning of each country, tables with commonly used sources are provided.

Typology of sources of healthcare costs of the costing items obtained from the participating countries are shown in Table 7.

**Table 7. Typology of sources of healthcare costs given the costing item and country**

| | | England | France | Germany | Italy | Poland | Portugal | Slovenia | Spain | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|
| Composite goods and services | GP visit | | | | | | | | | |
| | Specialist vist | | | | | | | | | |
| | A&E visit | | | | | | | | | |
| | Day of hospitalization at normal ward | | | | | | | | | |
| | Day of hospitalization at ICU | | | | | | | | | |
| | Ultrasound scan | | | | | | | | | |
| | Computerized tomography scan | | | | | | | | | |
| | Ferritin | | | | | | | | | |
| | Creatinine | | | | | | | | | |
| | Intensive care ambulance | | | | | | | | | |
| | Non-emergency patient transport | | | | | | | | | |
| | Colonoscopy | | | | | | | | | |
| | Haemodialysis | | | | | | | | | |
| | Oxygen therapy | | | | | | | | | |
| Complex processes & procedures | Heart failure | | | | | | | | | |
| | Hernia inguinal, femoral and umbilical | | | | | | | | | |
| | Laparoscopic cholecystectomy | | | | | | | | | |
| | Cataract extirpation | | | | | | | | | |

- production cost (based on DRG)
- production cost (based on resource use)
- production cost
- ad hoc study cost
- reimbursement price
- tariff (based on DRG)
- tariff (Social Health Insurance calculation)
- tariff (based on procedure code (PC) or treatment function code (TFC))
- tariff
- public price (based on DRG)
- public price

| | |
|---|---|
| Personnel costs | https://www.pssru.ac.uk/project-pages/unit-costs/ |
| Tariffs | https://improvement.nhs.uk/resources/national-tariff/#h2-201920-national-tariff-payment-system |
| Reference costs | https://improvement.nhs.uk/resources/reference-costs/#rc1718 |

**PRIMARY RESOURCES**

**Medicines**

The prices are updated at monthly basis and depend on category each drug belongs to(30). There are three types of categories:

• Category A includes popular generics, which are widely available. Price is based on a weighted average of list prices from wholesalers and generic manufacturers.

• Category C items based on a particular brand or manufacturer's price.

• Category M includes readily available drugs, where the Department of Health calculates the price based on information submitted by manufacturers.

**Medical devices**

List prices are not commonly used for procuring devices in the NHS. Therefore, updated prices of **drug-eluting stent (DES**) were sought from the NHS Purchasing and Supply Agency. According to the NICE guidance on DES, 'the prices for DES are driven by a number of factors including the: market conditions at the time of contracting; contract period; renewal date for the procurement arrangements (contracts are usually updated annually and the most recent contracts show significant decreases in the prices of DESs); volume commitment; period commitment; combination of period and volume commitment; product rationalisation or standardisation; retrospective threshold discounts (e.g., free set quantities of stents when agreed volumes have been exceeded); consignment stock (e.g., when a supplier provides an inventory to trust); and other added value inclusive arrangements (e.g., the provision of additional training and related equipment)'(31).

For **wearable cardioverter defibrillator (WCD)** no information was provided.

**Health products/disposables**

The cost of glucose test strips depends on the brand. NHS Business Service Authority published a list of different ex-factory prices. They are updated at a monthly basis(30).

**Personnel costs**

Personnel costs are taken from Curtis and Burns (2018)(32). They estimated the hourly wage of both primary care-based and hospital-based GPs and nurses.

Regarding primary care GPs, the cost elements taken into account in the calculation of hourly wage were the following: net remuneration (that is, the average income before tax)(33); practice expenses (such as direct care staff, administrative and clerical staff), office and general business, premises, other (advertising, promotion and entertainment) and car and travel(33,34); qualifications(35) and capital costs (premises)(36,37). Working time of 42.8 weeks per year and 41.8 hours per week was taken from the 9th National GP Worklife Survey(38). Therefore, the sum of value of all the previously mentioned cost elements was divided by the product of 42.8*41.8. This resulted in an hourly wage of 148£. This hourly wage can be modified according to the variety of cost elements added up to the annual net remuneration. In this line, the hourly wage when including direct care staff costs and excluding qualification costs is 125£, when excluding direct care staff costs but including qualification costs is 134£ and when excluding both direct care staff costs and qualification costs, the wage salary is 110£(32).

The cost elements considered in the calculation of hourly wage of primary care-based nurses and hospital-based medical and nursing staff were the following: wages/salary, salary oncosts, qualification costs, overheads such as management, administrative staff, estates staff and non-staff, capital overheads and travel. To calculate the average hourly wage, the sum of all cost elements was divided by the annual working hours taken from elsewhere(39). Moreover, the hourly wage depends on band the hospital-based nurses belong to. Duties undertaken by each band can be found elsewhere(40). In turn, hospital-based doctors are classified into foundation doctor (FY1 and FY2), registrar, associate specialist and consultant (medical, surgical and psychiatric). The average hourly wages as well as the references to costing methodology of all cost elements can be found elsewhere(32).

**COMPOSITE GOODS AND SERVICES**

Costs of complex processes & procedures and most of composite goods and services, as defined in the EU HCSCD, are based on DRGs, known in England as HRGs. There are two main sources: reference costs and national tariffs.

The English reference costs dataset contains costs and activity data collected annually from all NHS trusts and foundation trusts (not-for-profit hospitals). It contains activity data based on finished consultant episodes (FCE), defined as time spent in the care of one consultant(41). Additionally, the NHS uses these costs to set the tariffs (that are used as prices for reimbursement) for the activity in two years' time. Costs and tariffs are different because tariffs contain incentives for providers to prioritize certain types of activity or to increase efficiency, inflation, as well as other adjustments.

National tariffs for 2019/20 are modelled with costs taken from 2016/17 reference costs and activity data taken from 2016/17 Hospital Episode Statistics (HES) and 2016/17 reference costs(42). The HES activity dataset consists of total of admitted patient care spells, outpatient consultations and A&E attendances from all secondary care services' providers to the NHS. The HES data are based on spell basis (hospital spell may contain one or more FCE and is defined as 'a period

form admission to discharge or death'). For this reason, it is primarily used in the admitted patient care (APC) tariff calculation, as the APC is paid based on spells(42). Full absorption costing is undertaken, therefore, all direct costs, variable and fixed overheads (including land costs) are included(43).

**Outpatient visit**

A **GP visit** is calculated on a basis of a GP remuneration (see personnel costs). To calculate the cost of GP visit, a GP remuneration is multiplied by ratio of face-to-face time (1:0.64). The ratio excludes travel time(32). Therefore, the cost of a GP visit depends on the cost elements included in the GP's remuneration. The costs are estimated per hour of patient contact, per minute of patient contact of per surgery consultation lasting 9.22 minutes. The latter is estimated with or without cost corresponding to carbon emission (0). For further details see Curtis and Burns (2018)(32).

Regarding **specialist visits**, according to reference costs, the average unit cost per attendance varies across services. There are different costs for consultant-led and non-consultant-led attendances per service. In turn, both consultant- and non-consultant-led attendances are subdivided into multi professional or single professional, face-to-face contact or non-face-to-face contact and first attendance or follow-up attendance (e.g., cost of multi professional non-face-to-face follow-up consultant-led attendance at nephrology service is known)(44).

According to national tariff workbook, cost of specialist visits are calculated taking into account attendance type and clinic type, and are defined by treatment function code (TFC) instead of HRGs. TFC is defined as code for 'a division of clinical work based on main specialty, but incorporating approved sub-specialties and treatment interests used by lead care professionals including consultants'(45). There are separate tariffs for first and follow-up attendances as well as for single professional and multi-professional attendances for each TFC. Multi-professional attendance refers to several care professionals seeing a patient together, in the same consultation and at the same time (46). To incentivise a change in the delivery of outpatient follow-up activity, to encourage a move to more efficient models and to free up consultant capacity, first attendances are over-reimbursed and corresponding follow-up attendances are under-reimbursed. This transfer in cost is set at a TFC level and ranges from 10% to 30%, except nephrology (0%)(42).

Regarding cost of **Accident and Emergency (A&E) department visits**, reference costs distinguish between cost of admitted and non-admitted patient. Moreover, both admitted and non-admitted patient may be of 4 types. Additionally, each type is characterized by investigation category (from 1 to 3 or no investigation) and by treatment category (from 1 to 4). A separate category is patient dead on arrival, dental care and no investigation with no treatment(44).

According to national tariffs, the cost of A&E depends on department type (from 1 to 3). This, in turn, is disaggregated into investigation and treatment categories (Supplementary Table 9)(47). To support a more effective approach to resource and capacity planning for emergency care services, a blended payment for these services was introduced. It includes both a fixed and a variable element. In order to agree the amounts payable for emergency services by providers and commissioners, several rules are applied. They agree the level of planned activity, and calculate the value of this planned activity using the unit prices and expected case-mix. If the value of actual activity is more (less) than the value of planned activity, the price payable will be the fixed price plus (minus) 20% of the difference between those values.

Nonetheless, the commissioner and provider may agree amounts by which the actual activity may differ from the planned activity, but where the price payable remains at fixed price. In this case, the percentage rate will be that specified in the provision, instead of the aforementioned 20% rate (42).

## Hospitalization

Reference Costs spreadsheet uses trim points to define a threshold: days that an inpatient spends in a hospital below the trim point (inlier) and days that occur above the trim point (excess). Costs of days above the trim-point are published separately as "excess bed-days"(46). The calculation of the weighted average is described in the section Inpatient medical and surgical processes. The cost per both elective and non-elective inpatient excess bed days (those above trim point) exclude procedure cost, thus it is a good estimate of the cost per day of hospitalization. The cost per excess bed days is published for each HRG currency(44). Additionally, the Reference Cost spreadsheet includes costs per whole hospitalization period, which is discussed in the section Inpatient medical and surgical processes.

### Image diagnosis

Reference cost differs among direct access, outpatient and others. 'Direct access' means that patient was "directly referred from primary and community care to direct access service for both diagnostic assessment and treatment". 'Others' refers to those patients who were not referred by GP to the hospital to have the image diagnosis exam done. 'Outpatient' refers to image diagnosis exam performed in an outpatient clinic(45).

The unit cost of **computerized tomography scan** varies by age (5 years and under, between 6 and 18 years, 19 years and over), contrast (with contrast, without contrast, with pre- and post-contrast, with post-contrast only), and area (one, two or three areas)(44,47).

The unit cost of **ultrasound scan** varies by length of duration (less than 20 minutes, 20 minutes and over) and contrast (with or without contrast)(44,47).

### Laboratory tests

Unit cost per exam at department of haematology is calculated by dividing total costs incurred by the department by total activity. Detailed data on blood and urine tests are not available(44).

### Ambulance services

No distinction is made between intensive care and non-emergency patient transport. The costs are set for a call, and the activities 'hear and treat or refer', 'see and treat or refer' and 'see and treat and convey' (Supplementary Table 10).

Calls are measured by the number of emergency and urgent calls presented to the switchboard and answered, including hoax calls. Calls abandoned before they are answered, patient transport service requests and calls under any private or non-NHS contract are excluded.

The activity 'hear and treat or refer' is measured by the number of incidences, following emergency and urgent calls that were resolved by providing clinical advice by telephone or referral to a third party. 'See and treat or refer' is

measured by the number of incidences, following emergency or urgent calls resolved with the patient being treated and discharged from ambulance responsibility on scene. The patient is not taken anywhere. 'See and treat or convey' is measured by the number of incidents, following emergency or urgent calls, where at least one patient is conveyed by ambulance to an alternative healthcare provider.

Further description of previously mentioned activities can be found elsewhere(41).

**Diagnostic procedures**

According to reference costs, the unit cost varies across services (e.g., it depends on whether it was undertaken in urology service, colorectal surgery service, upper gastrointestinal surgery service, vascular surgery service, etc.)(44). According to national tariffs, the cost of outpatient and inpatient diagnostic colonoscopy is identical and corresponds with best practice tariff (BPT). The idea behind paying a higher price for procedures in the outpatient setting is to create a financial incentive for providers to treat patients there(47).

**Therapeutic procedures**

The unit cost of haemodialysis is based on HRGs and depends on type of haemodialysis, the age of patient (19 years and over, 18 years and under) and type of setting (hospital, satellite unit, home)(44,47).

**COMPLEX PROCESSES AND PROCEDURES**

**Inpatient medical and surgical processes**

Inpatient costs are published as reference costs and tariffs based on HRGs. Reference cost database distinguishes among cost of stay of elective inpatient, cost of excess bed day of elective inpatient, cost of non-elective long stay, cost of excess bed day of non-elective long stay and cost of non-elective short stay(44). In order to calculate a weighted average cost, 'the inlier and excess costs are summed but the excess bed day activity, which is already included in the inlier activity, is ignored'(46). In order to promote movement to day-case settings where appropriate, most elective inpatient's tariffs are calculated as combined day case/ordinary elective spell tariffs by weighting both groups according to the activity in each of them. Separate tariff for both day case and ordinary elective patient is published for some HRGs. National tariff database also reports non-elective spell tariffs and per day long stay tariffs (for days exceeding trim point)(47).

Both reference costs and tariffs of **Heart Failure and Shock** depends on the complexity score (14+, 11-13, 8-13, 4-7, 0-3). The reference cost is defined for elective inpatient, elective inpatient excess bed days, non-elective long stay, non-elective excess bed days and non-elective short stay (44). In turn, tariffs, are defined for combined day case/ordinary elective spell, non-elective spell and days exceeding trim point(47).

Both costs and tariffs **of Inguinal, Umbilical or Femoral Hernia Procedures** depends on age (1 year and under, between 2 and 18 years and 19 years and over). In turn, the cost/tariff of inpatients aged 19 years and over depends on the complexity score (6+, 3-5, 1-2, 0). The cost is defined for elective inpatient, elective inpatient excess bed days, non-elective long stay, non-elective excess bed days and non-elective short stay(44). Tariffs of all the previously mentioned

HRGs are defined for non-elective spell and days exceeding trim point. Moreover, the HRGs with CC Score 6+, 3-5, between 2 and 18 years and 1 year and under are defined for combined day case/ordinary elective spell, while the HRGs with CC Score 1-2 and 0 are defined for day case spell and ordinary elective spell per separate(47).

**Day case procedures/Outpatient surgery**

Costs of day case procedures/Outpatient surgery are published as reference costs and tariff based on HRGs. Reference costs refer to day case procedures as day case, that is defined as an admission where the patient is discharged before midnight. Outpatient surgery is a surgical procedure performed without hospital admission of the patient, therefore, it is less costly than day case procedure (46). National tariffs dataset contains day case spell tariffs and outpatient procedure tariffs, being a day case performed in a hospital and outpatient procedures in an outpatient setting. For HRGs that contain only one cost referring to both day case and outpatient procedure, the cost is independent of setting (46).

Cost/tariff of a day case **laparoscopic cholecystectomy** depends on age (19 years and over, 18 years and under) and complexity of procedure (4+, 1-3, 0) (44,47). Outpatient laparoscopic cholecystectomy is performed only on patients aged 19 years and over with a complexity score equal to 0 (44).

Cost and tariff of a day case **cataract surgery** depends on complexity of procedure (44,47). The cost of outpatient cataract surgery depends on complexity of procedure (44). Only a single tariff is defined for the outpatient cataract surgery (47).

## FRANCE

Two main portals for information on unit costs are the social health insurance site (*Securité Sociale l'Assurance Maladie;* Ameli)(48) and the hospital agency (*Agence Technique de l'Information sur l'Hospitalization*; ATIH)(49).

| | |
|---|---|
| Tariffs (SHI point of view) | https://www.ameli.fr/accueil-de-la-ccam/telechargement/index.php |
| Tariffs (SHI point of view) | https://www.atih.sante.fr/tarifs-mco-et-had |
| Costs (production point of view) | https://www.scansante.fr/applications/enc-mco |

The hospital tariffs are published by ATIH, be they inpatient or hospital day cases, from the SHI payer's point of view based on DRGs. Most DRGs have one associated tariff (*Groupe Homogène de Séjours*; GHS). For a small subset of DGRs there can be two associated GHS tariffs which is usually due to a significant difference in the care provided such as implantable devices being used that can have an impact on costs. Conversely, a baseline tariff (GHS) may be attributable to more than one DRG.

Each baseline tariff that is associated with a DRG is for a "typical" length of stay, that is, the length in days is within a range of values for the given DRG. Should the hospital stay be below the minimum or above the maximum value stated in the GHS tariff database, the baseline tariff is modified according to equations published by the ATIH(50).

Certain expensive drugs and devices, or some daily charges such as reanimation are not included in this tariff. There are two schedules for these tariffs updated once or twice per year −one for public and not for profit establishments−, and one for private establishments. These tariffs are made available in the public domain in csv and Excel formats(51). These tariffs are an indication of the amount paid to the hospital for the hospital stays based on the DRG, but it is important to note that hospitals also receive annual lump sum funding, such as for emergency care, organ retrieval and transplants and from other allocations from public utility missions, also referred to as missions for general interest and contracting (*missions d'intérêt général et d'aide à la contractualisation;* MIGAC) that serve to fund coordination of care, plus epidemiological surveillance and expertise(52).

The ATIH database ScanSanté publishes costs from the hospital production point of view aggregated at the DRG level. Therefore, the total costs include all resources used during a hospital stay for the intervention, infrastructure as well as all fixed overheads. These average national DRG production costs per stay are calculated from a voluntary sample of public and private hospitals, who provide detailed accounting system production costs annually. These production costs include expenses of clinical activities, medical-technical expenditure, logistics and general management expenses, medical logistics expenditures and direct charges, but exclude land costs(53).

Ameli provides information from the SHI payer's point of view and includes ambulatory care patient tariffs such as consultations with GPs, specialists and nurses as well as interventions, biological examinations and imaging. In general, the different tariff components of a medical visit vary greatly depending on variables such as geographic location, time of day that the care was carried out, day of the week, the type of health professionals(s) carrying out the care(54). It is

not possible to simply add the published tariffs together to ascertain what the patient is charged or that the SHI will be reimbursing. The self-employed health professionals, who provide most of the ambulatory care, who are members of the professional category Sector 1 adhere to the statutory tariffs set out in the national agreements (conventions). Those doctors in Sector 2 have a permanent right to exceed the official tariffs via extra-billing. In general, the SHI reimburses only 70% of a consultation or 80% of a medical act. In this case, private health insurance payments or out of pocket payments are made. There are exceptions such as patients suffering from long term chronic diseases for whom the reimbursement rate is 100%.

Table 8 summarizes sources of unit costs used in France.

**Table 8. Sources of unit costs (France)**

| Portal | Perspective | Type of unit value | Type of patient |
|---|---|---|---|
| ATIH | Social Health Insurance | Tariff (based on DRG) | Inpatient, Day case |
| Scansanté | production | Production cost (based on DRG) | Inpatient, Day case |
| Ameli | Social Health Insurance | Tariff | Ambulatory care, Private hospital |

*Source: Own elaboration*
*ATIH, Agence Technique de l'Information ser l'Hospitalization; DRG, Diagnosis Related Groups*

**PRIMARY RESOURCES**

**Medicines**

The cost of medicines are available for consultation on the SHI ameli site. Two different prices are accessible: ex-factory price and public price(55).

**Medical devices and Health products/Disposables**

Theoretically, the technologies are reassessed every five years based on the documents provided by the manufacturer and on systematic literature reviews. Therefore, when a device is admitted onto list of refundable products and services, they have a time limit to be on the list until they are reassessed. However, if a device is still on the list beyond this reassessment date, it can still be reimbursed.

The public price of **sirolimus-eluting stent**, **wearable-cardioverter defibrillator** and **glucose test strips** can be found in the product listing document that is also made available on the ameli site(56).

**Personnel costs**

For doctors who are salaried employees in public hospitals, for the cost from the production point of view, the salary information can be difficult to find in the public domain and the financial services or accounting services of individual hospitals have to be contacted. In the case of the Paris university hospital network (*Assistance Publique Hôpitaux de Paris*; AP-HP) in order to calculate the hourly cost of hospital staff from the production point of view, 1607 annual hours worked as per the employment contracts are currently used(57). Obviously, in terms of the real cost this approach has

limits since many medical staff work more hours than appear on their contracts. For a salaried doctor at the AP-HP in 2016, the average annual salary including employer charges and taxes was 76,414€. For a university professor and practitioner, the part time average salary in 2016 including charges was 63,351€. The cost from the point of view of the SHI is bundled in the total DRG tariff for public and private not for profit hospitals. The private hospitals function in a different way that will not be covered here.

From the production point of view, the nurse's salary will depend upon the type of nurse and the type of hospital. For a nurse with the national diploma (IDE) at the AP-HP the annual salary including charges in 2017 was 48,296€.

The personnel costs for out of hospital care are calculated from the SHI payer's point of view and the information about costs has been covered above in the tariffs communicated on the Ameli site. Doctors working in ambulatory care are mostly self-employed. For information, according to the report published by *Direction de la recherché, des études, de l'évaluation et des statistiques* (DREES), the average duration of a work week is 57 hours, with significant disparities among practitioners. However, doctor's activities are not only limited to the patient's care activities: it also includes training and management tasks such as accounting, and activities performed outside the office are often added, such as activities at retirement home, nursery, activities within a trade union, etc.(58). Overall, the average cost per hour of an ambulatory self-employed doctor is rarely used in French EEs and the proxy of the tariff for a consultation is usually used in EE as an approximation of the personnel costs from a production point of view.

Since GPs and specialists who provide ambulatory care are mainly self-employed, are paid on a fee-for-service basis (supplemented by flat payments for patients with chronic conditions and pay for performance schemes), their income depends mostly on the level and composition of their activity. The SHI will usually reimburse the patient 70% of the tariff. The other 30% is either and out of pocket expense or paid by a separate insurance(59). The coverage of patients who directly access specialists or other GPs outside of the coordinated care pathway falls to 30%(60). Nevertheless, there are special regimes that receive 100% reimbursement (e.g., pregnant women)(61). There is a basic cost per GP visit (without any additional examinations that would be charged separately) for more than 6 year old patients, home visit and complex home visit. Travel supplements and supplements for performing procedures are added to the basic tariff. The amount depends on the time of day and whether the visit takes place on a working day, Sunday or public holiday. The allowance per kilometre is calculated on the basis of the type of surface (flat land, mountain or travelling on foot or by ski)(62).

The **ambulatory specialists**, are paid per consultation, and so the same procedure applies as for GPs. Under the "preferred doctor" scheme, patients are requested to register with the doctor of their choice, whom they should see to obtain a referral to a specialist. The preferred doctor is most often a GP, but it may be a specialist of any kind working sector 1 or sector 2. The cost of ambulatory specialist depends on the type of specialty, complexity of the illness, type of visit (teleconsultation, home visit, ambulatory care)(63).

The **nurses** working in ambulatory care are paid based upon the intervention/act that they carry out, type of setting (home or in clinic), time of day it is carried out, day of the week/bank holiday, etc. For example, if a nurse travels on Sunday to see a patient under 7 years old at their home 5 km away not in a mountainous region to take only a blood

sample, the nurse will charge according to the following formula: Direct venepuncture sampling (1.5)*AMI (1.5*3.15€) + Fixed travel allowance (2.50€) + Kilometric allowance in flat land (5*0.35€) + supplement for acts performed on Sundays or public holidays (8.50€) + supplement for single act (1.35€) + young child supplement (3.15€) = 25.58€. Some weights and costs of nursing activities are summarized in Supplementary Table 11. The complete list can be found elsewhere(64,65).

**COMPOSITE GOODS AND SERVICES**

**Outpatient visits**

For the cost of a GP, nurse or specialist visit, all the information described in the above section on personnel costs may be applied.

The cost of simple A&E emergency visit (no imaging nor extra tests, no hospitalization) in public and private not-for profit establishments depends on whether the visit was performed during the day, night or weekends. Moreover, the cost to all payers for a visit to emergency whether public or private is also published(66).

**Hospitalization**

A generalised cost per day of hospitalization is not estimated. The cost and average length of stay for the whole hospitalization period from both the SHI and production point of view aggregated at DRG level is provided(51,53).

**Image diagnosis**

Tariffs of image diagnosis services are also made available on the SHI website ameli(54). Supplements may be added to the basic tariff in the following cases: procedures performed urgently on Sundays and public holidays, paediatric night urgency 12-8 am, emergency except paediatricians, patients < 5 years old, major act radiography carried out by a radiologist, a pulmonologist or a rheumatologist, etc. Type and amount of supplement depends on the type of procedure. To this tariff a technical charge is added for CT scanners and magnetic resonance imaging (MRI) scanners *(forfeit technique)* depending on the model, the age of the scanner and the region of the hospital where the scanner is located.

**Laboratory tests**

For routine biology, for accounting and resource management reasons, the tariff is expressed as a coefficient that has to be multiplied by a fixed value of the letter B (Biology). The coefficient of each routine biology test varies(67). These tariffs are available on the SHI website ameli.

**Ambulance services**

For non-emergency transport, patients can be transported in several ways to or from a health facility or of a city office (or between care structures): in ambulance, in light medical vehicle (*véhicules sanitaires légers*; VSL), by approved taxi or by any other medium (public transport, personal vehicle). The patients are transported in an ambulance if they must be lying down or half-seated or supervised under oxygen or carried or transported under aseptic conditions. The patients are transported by VSL or by approved taxi if they need help to move, they risk side effect during transport or

their health state requires strict compliance with hygienic rules. Patients who can travel alone or accompanied by somebody should use a personnel vehicle or a public transport. The payment of transport costs by the SHI funds requires the delivery of a medical prescription written before a transport(68).

From the SHI point of view, travel to and from hospital, as well as other journeys for medical consultation in certain situations, is reimbursed at a rate of 65% or 100% (depending on whether the patient's situation allows reimbursement or not) by the SHI after deduction of 2€ per trip each way that is the compulsory excess charge to patients (*franchise medical).* A patient who uses a personal vehicle, a tariff per kilometre driven is defined. Therefore, if a patient drove 50 km to go to a consultation, he will currently be reimbursed according to the following formula:

65% (100%)*tariff per one kilometre driven (€)*length of journey (km) – franchise (2€).

In case the patient uses public transport, he will be reimbursed for the cheapest ticket available. For example, for a 2$^{nd}$ class ticket that costs 50 €, the patient will be reimbursed as follows: 65% (100%)*50€ - franchise (2€) = 30.5€(69).

The pricing of transport by VSL includes:

- A flat rate depending on the location of the headquarters of the medical transport company. It is applied for transport carried out in all the municipalities other than those where the care is provided. The rate applicable to each company is that of the department where the company's head office is located. When the company carries out transport in another department, the applicable tariff remains that of the county of the company's headquarters. A flat rate includes the first 3 km travelled. Each French department falls in one of four defined zones (A, B, C, D) in order to establish the pricing to be applied by the company(70).

- A short journey valuation depending on the number of kilometres travelled. It applies, gradually, up to the 18$^{th}$ km travelled.

- A kilometric rate applicable to the distance travelled from the place of departure to the place of arrival, minus the first 3 km included in a flat rate, or from the 1$^{st}$ kilometre travelled in the case of billing for the care.

An additional charge is billable by companies located in certain municipalities in the Paris region for transport carried out within this area. The kilometres are billed from the 1$^{st}$ km travelled(70).

All these previously mentioned charges are summarized in Supplementary Table 13.

**Diagnostic procedures**

The tariffs for diagnostic services are made available on the ameli site(54).

**Therapeutic procedures**

The costs of hemodialysis and oxygen therapy are published by ScanSanté(53) and ATIH(51).

From the hospital production point of view, the cost of **hemodialysis** includes the following cost elements:

- medico-technical expenses such as anesthesia, operating room, etc. (amortization, maintenance, other staff, medical staff, nursing staff)

- direct expenses (other consumables, blood, non-billable pharmaceuticals specialties, laboratory subcontracting)
- infrastructure cost (financial cost, cost of building)

The cost of **oxygen therapy** includes the following cost elements:

- clinical expenses (other clinical staff, clinical medical staff, clinical nursing staff)
- medico-technical expenses related with hyperbaric chamber (amortization, maintenance, other staff, medical staff, nursing staff)
- logistic and general management expenses (laundry, restoration, reception and patient management, general administrative services, administrative personnel services, stretchering and patient walking, maintenance, hotel services, motorized patient transport)
- medical logistics (pharmacy, biomedical engineering)
- direct expenses (other consumables, non-billable pharmaceuticals specialties, imaging subcontracting, laboratory subcontracting)
- infrastructure cost (financial cost, cost of building)

From the SHI perspective, the cost of hemodialysis differs between the type of setting (hospital, home)(51).

**COMPLEX PROCESSES & PROCEDURES**

**Inpatient medical and surgical processes**

The costs of inpatient processes are published by *ScanSanté*(53) and ATIH(51).

From the production point of view, the DRGs' four different levels of severity take into consideration a number of elements such as the severity of disease, the different medical interventions carried out during the hospital stay and the length of stay, and also include sometimes a fifth level for very short term hospital visits for lengths of stay less than 24 hours (day cases).

The cost of **heart failure** includes the following cost elements:

- clinical expenses (clinical staff, materials, maintenance and amortization for all types of clinical care outside the operating theatre including continuous monitoring, intensive care, critical care, resuscitation)
- medico-technical expenses such as anesthesia, operating room, etc. (amortization, maintenance, other staff, medical staff, nursing staff)
- logistic and general management expenses (laundry, catering, reception and patient management, general administrative services, administrative personnel services, stretchering and patient walking, maintenance, hotel services, motorized patient transport)
- medical logistics (pharmacy, sterilization, biomedical engineering, hygiene and vigilance, other)

- direct expenses (other consumables, blood, specialties, other subcontracting, imaging subcontracting, laboratory subcontracting, transport subcontracting, fee-for-service staff, etc.)
- infrastructure cost (financial cost, cost of building)

The cost of **inguinal, femoral and umbilical hernia** includes the following cost elements:

- clinical expenses (clinical staff, materials, maintenance and amortization for all types of clinical care outside the operating theatre including continuous monitoring, intensive care, critical care, resuscitation)
- medico-technical expenses (anesthesia, operating room, amortization, maintenance, other staff, medical staff, nursing staff)
- logistic and general management expenses (laundry, restoration, reception and patient management, general administrative services, administrative personnel services, stretchering and patient walking, maintenance, hotel services, motorized patient transport)
- medical logistics (pharmacy, sterilization, biomedical engineering, hygiene and vigilance, other)
- direct expenses (other consumables, plotter list of other consumables, blood, non-billable pharmaceuticals specialties, pharmaceuticals specialties, other subcontracting, imaging subcontracting, laboratory subcontracting, transport subcontracting, fee-for-service staff, etc.)
- infrastructure cost (financial cost, cost of building)

**Day case procedures/Outpatient surgery**

The cost of day case procedures and some outpatient surgery is published by ATIH (ScanSanté production point of view)(53) and ATIH (payer's point of view)(51).

From the production point of view, the cost of **cataract extirpation** includes:

- clinical activities (caregivers, medical staff, clinical staff)
- medico-technical activities (operating room, anesthesia)
- logistics and general management (general administrative services, hotel services, staff administrative services, management information systems, maintenance, restoration)
- direct charges (other medical consumables, implantable medical device not billable in addition to hospitalization benefits, non-billable pharmaceutical products)
- medical logistic (sterilization, pharmacy, biomedical engineering)

| | |
|---|---|
| Diagnosis-Related Groups | https://www.dkgev.de/fileadmin/default/Fallpauschalenkatalog_2019_180928.pdf |
| Outpatient procedures | https://www.kbv.de/media/sp/EBM_Gesamt___Stand_1._Quartal_2019.pdf |

**PRIMARY RESOURCES**

**Medicines**

The prices are based on the selling prices of the pharmaceutical companies. They include the wholesale surcharge, the pharmacy surcharge, and a VAT rate of 19%. The reference prices are uploaded monthly(71).

Manufacturers are permitted to set whichever price they feel is appropriate for drugs falling into these classes, but the umbrella organization of health insurers (*GKV–Spitzenverband*, GKV-SV in the letters of its German acronym) establishes a limit to what individual insurers will contribute toward payment. The GKV–SV sets its payment limit for generics near the 30$^{th}$ percentile in the distribution of prices within each therapeutic class, high enough to ensure that patients have more than one choice but low enough to ensure that the payer is not responsible for paying the highest prices within the class. Most generic drugs fall into the reference pricing system. Approximately 34% of drugs, 80% of prescriptions, and 33% of drug spending in Germany is for drugs subject to reference pricing. There are different levels for reference price groups. These are used to regulate the range of coverage of a reference price group, which influences pricing:

- Drugs with the same active ingredients (level 1) → Paracetamol
- Drugs with pharmacologically-therapeutically comparable active ingredients, in particular with chemically related ingredients (level 2) → Atorvastatin
- Drugs with a comparable therapeutic effect, in particular, drug combinations (level 3)

The reimbursement of medicines in the outpatient and inpatient sectors is regulated differently. Within outpatient care, drugs are being reimbursed based either on reference prices or based on the manufacturers list price with several discounts and co-payments being applied. There is no internal reference price for Trastuzumab in Germany. All drug prices can be searched in the *"Lauer Taxe"* while prices might be lower, if the sickness fund has an individual agreement with the manufacturer. Prices in Germany are not confidential in general, but access to such a price list is needed.

If a drug is administered during a hospital stay, other reimbursement regulations apply. As a rule, a hospital does not receive separate reimbursement for dispensing a drug. Hospital services are subject to flat-rate cost regulation by DRGs. The costs of drugs dispensed are usually covered by a DRG. However, both the degree of innovation and the (high) price of a drug make it necessary to reimburse hospitals for additional costs in few exceptions. At present, this applies in particular to new cancer drugs. The list of these drugs is an annually updated annex to the DRG catalog (so-called

additional charges). For Trastuzumab there is an additional charge *("Zusatzentgelt")* for the year 2018. This also applies to 2019. The amount of the additional charge depends on the amount of active ingredient delivered(72).

**Medical devices**

In principle, there is no individual reimbursement for medical devices used during a hospital stay. Both the medical service and the product (e.g., a stent) are reimbursed at a flat rate via a DRG. In certain cases, in which a DRG is not able to reflect the high prices of consumables, additional fees are reimbursed. This applies to DES. The mentioned fees for a DES can be charged additionally to a DRG and therefore best reflects the price of this product(72). Yet, there is no information or publicly available data about the purchasing price of a hospital. Moreover, there are so many negotiations and tendering in Germany that is difficult to know the cost structure behind that, there is no cost calculation and usually a market price is used.

At this time, the statutory health insurance companies do not finance the **WCD** in the cardiology rehabilitation clinics. The German Society for the Prevention and Rehabilitation of Cardiovascular Diseases estimates the cost of the WCD therapy to be about 2,600€/month(73).

**Health products/Disposables**

Annual costs for **glucose test strips** per patient are estimated by the Federal joint committee(74). However, the maximum packing prices are agreed at the regional level and may vary slightly. Three price groups (A1, A2 and B) are formed in which basically all the market glucose test strips are classified (Supplementary Table 14). The VAT is not included. For different pack sizes, an increase or decrease in prices for the groups A1, A2 and B are agreed accordingly. The contracting parties regularly discuss the possibilities of further development of this price agreement(75).

**Personnel costs**

Agreements about what medical and nursing staff should earn are available. Salaries of medical staff at ambulatory care depend on negotiations. Some calculations are done, but they are not made public. They are done just to prepare negotiations that are taking part later on. Personnel costs are based on average salary including incentives, extra hours, on-call time and it is divided not by 365 days but without bank holidays and weekends.

Private insurance is important in Germany. An important percentage of population is insured with private companies instead of sickness funds. This results in two different fee schedules. Fee schedule for sickness fund is updated quite often (more than once a year) to bring in new services, because otherwise is not possible to pay for them. This payment is based on a relative position of a new service and finally the weight is converted in value in euros. Fee schedule for private insurance is set by the Ministry of Health and it is not updated very often. New service just take the position, which is already in there. This is an analogue position and we can take it because efforts are comparable. This is not an ideal situation and it is not based on any calculation. If it is accepted or not is based on negotiation. The basis is a micro-costing but just for a sickness funds fee schedule and is not public.

From the production point of view, the average monthly salary of **specialists** working in hospitals was calculated on the basis of over 6,500 doctors and psychotherapists. The cost elements included are medical pension plan, health and long term care insurance and income tax (Supplementary Table 15)(76).

The income of **GPs** and **specialists** working in ambulatory care is budgeted quarterly. Therefore, the GPs' income (which is based on a capitation system) and specialists' income (which is fee-for-service based) is given as a quarterly gross income or as a per capita amount. The GP's and specialist's gross income and the income per patient in the last quarter of the year 2016 according to *Kassenärztliche Bundesvereinigung* report(77) is shown in Supplementary Table 16.

Regarding **nursing staff**, the median gross monthly salary and median salary per region, sex and age categories is available elsewhere(78). According to the web page de.statista.com, the average gross monthly salary in 2018 was 3,085€. However, to access the data, the payment of a fee is required(79).

**COMPOSITE GOODS AND SERVICES**

### Outpatient visit

In order to calculate the average cost of **A&E visit**, the cost information of 612,070 cases from 55 hospitals was used. It includes all costs incurred in other areas of the hospital that have been used as part of the emergency treatment, but only of legally insured patients that are billed to the statutory health insurance associations. Investment costs (depreciation for equipment and buildings) are not taken into account(80). The results can be represented in the matrix structure that contains the cost centre groups in the rows, and the cost element groups in the columns. The cost matrix shows the origin and type of costs incurred (Supplementary Table 17).

80% of the case costs are incurred in the emergency room itself, 13% for radiological examinations and 5% for laboratory diagnostics. Costs incurred by other cost centres are rather insignificant (2%). Looking at the types of costs incurred in the emergency rooms, around a third are attributable to the medical service, one third to the nursing or functional service, 9% are medical material costs and 25% infrastructure costs. These include building management, administration, maintenance, central sterilization, etc. For 55% of outpatient emergencies, costs are incurred in diagnostic or therapeutic areas outside the emergency room. For example, in 35% of emergency treatments, radiology costs averaged 46€, in 24% of cases, laboratory costs were around 26€. Some of the hospitals provided additional optional data on the age, type of assignment and mode of transport and the specialty of the emergency patient being treated, so that the costs for the relevant subgroups could be analysed. The average cost for outpatient emergency patients is 126€. The average cost in the age group under 6 years is 89€. The treatment costs increase with increasing age and amount to 160€ for very old patients. In addition, the report shows the average costs by type of assignment, type of transport, by departmental reference and diagnostic groups. The case costs of patients assigned to the emergency services are, for example, 171€, and if the patients are also accompanied to the hospital by an emergency doctor, the case costs average 242€(80).

**Hospitalization**

To calculate a day value is not very appropriate. Total cost of DRG can be divided by the average days for that DRG, but this is not an actual cost, because on the day of the operation the cost is much higher than on the rest of the days. It is also possible to have an overall value for cost in hospital per day (take an average cost per day for a hospital case, which is around 3000 € and divide that by the average stay in the hospital, which is about 7 days).

Nonetheless, according to the report published by *Statistisches Bundesamt (Destatis)*, the average **cost per episode** is 4,695 €(81). The resources included in the cost are described in Supplementary Table 18-Supplementary Table 20.

**Image diagnosis**

It is based on negotiated fee schedules. The cost of **ultrasound scan** depends on the type and area of examination. Additionally, the cost of **CT scan** depends on whether it requires contrast(82). For inpatients, the cost of image diagnosis is included in the DRG.

**Laboratory tests**

The cost of different tests is based on the negotiated fee schedules(82). For inpatients, the cost of laboratory tests is included in the DRG.

**Ambulance services**

Years ago, the intensive ambulance care was operated by the state. However, nowadays, each county has to do a tendering in order to set a tariff. Regarding ambulance services in Ennepe-Ruhr county, a billing-relevant operation begins with the departure of a vehicle from the rescue station/location or the start of the deployment. The scale of the fee for a journey depends the type of care (emergency rescue, emergency doctor mission, non-emergency patient transport), the corresponding use of an emergency vehicle, the number of people transported and, in the case of a journey outside the district, the kilometres travelled(83).

There are two types of **intensive care ambulance**: ambulance '*Rettungswagen*' (RTW) and emergency medical vehicle '*Notarzteinsatzfahrzeuge*' (NEF). In the RTW, the patients can be professionally supplied with oxygen and the heartbeat can be monitored using an ECG. There is also a comprehensive range of medicines. The basic fee for a journey of RTW is 520€. The NEF is staffed with a driver and an emergency doctor for the treatment/care of emergency patients. Therefore, the fee includes the provision of the vehicle including the medical staff. The fee for NEF should be paid when the emergency doctor advises, examines or treats a patient. Subsequent transport in the RTW will be invoiced separately. The basic fee for NEF is 560€ per journey.

For both RTW and NEF applies that for transports, in which the rescue equipment remains at the destination until the return transport, only a basic fee is charged. If it is not possible for the vehicle to remain for imperative reasons of use and therefore another vehicle has to carry out the return transport, a further fee must be paid. For journey outside the ambulance area of the Ennepe-Ruhr district, a lump sum of 2€ is charged form the first kilometre for a distance of more than 100 kilometres, calculated from the border of the district of ambulance area per single kilometre additionally. A

surcharge of 50% is charged for each additional person being transported. The total amount will be distributed equally among the passengers(83).

The **non-emergency patient transport** (KTW, in the letters of its German acronym) has on board a stretcher and carrying chair, first aid kit and emergency backpack, a simple oxygen system and usually also an automatic external defibrillator. It takes patients who cannot drive themselves or who have to be transported lying down to the clinic, doctor or rehabilitation. A billing-relevant operation begins with the departure of a vehicle from the rescue station/location or the start of the deployment. The scale of the fee for a journey depends the type of care (emergency rescue, emergency doctor mission, patient transport), the corresponding use of an emergency vehicle, the number of people transported and, in the case of a mission outside the district, the kilometres travelled. The basic tariff for KTW is 145€(83).

Additionally, the German sickness funds also pay for taxis, if this kind of transport is necessary (which has to be certified by the doctor).

**Diagnostic procedures**

Diagnostic services are part of the fee schedule(82). For sickness funds, the fee schedule is done from time to time, but they are not based on any calculation, they are negotiated.

Regarding **colonoscopy**, obligatory procedure contents consists of:

- total colonoscopy showing the cecum,
- Patient information on colonoscopy and premedication in reasonable time before the procedure,
- education and instruction of the caregiver(s),
- information about the procedure and possible polyp(s) ablation and other therapeutic measures in the same session,
- Information on the course and duration of colon cleansing,
- Delivery of all substances for colon cleansing
- Photo / video documentation (s),
- follow-up,
- Compliance with the measures for checking the hygiene quality and provision of suitable emergency equipment both in accordance with the quality assurance agreement,

Optional service content consists of:

- position control by means of an imaging process,
- coagulation tests and small blood count,
- representation of the terminal ileum,
- trial excision(s),
- Premedication, sedation, possibly with monitoring of blood pressure and pulse oximetry(82)

**Therapeutic procedures**

The cost of hospital **hemodialysis** is based on DRG. The reference value of 3,544.97€ has to be multiplied by the corresponding multiplication fraction that can be found elsewhere(72). Ambulatory hemodialysis is part of the fee schedule(82). The tariff of **oxygen therapy** includes the following services:

- Documentation,
- Expiratory oxygen measurement and mask monitoring,
- Coordination and ensuring the care of the patient between the pressure chamber treatments by a qualified institution,

Optional service content consists of:

- Wound control and dressing change,
- Photo documentation after every 10$^{th}$ pressure chamber treatment,
- Otoscopy,
- ECG monitoring,
- Rest spirography,
- Pre- and post-examination,
- Transcutaneous measurement(s) of the oxygen partial pressure, including provocation if necessary,
- Information about preventive fire protection measures and safety instructions before starting pressure chamber treatment, once on the day of treatment(82).

**COMPLEX PROCESSES & PROCEDURES**

The reimbursement of outpatient and inpatient medical services is carried out in different ways. In both sectors, there are many elements of flat-rate reimbursement (e.g. DRGs for hospitals). In outpatient sector, however, there are also many individual service payments. For this reason, it is often not possible to determine the price of a particular service, for example a radiological examination, at the hospital. It is part of a flat rate DRG for a total hospital stay. In contrast, it is easy to approximate the costs of certain disease for hospital stays (for example, the average cost of a stroke). This, in turn, is more difficult for outpatient medical services.

For a hospital stay, the overheads are included in the DRG (except for investments). For an ambulatory care visit, overheads are also included in the honorarium, but how this has been calculated is not very transparent.

**Inpatient medical and surgical processes**

Inpatient processes are costed based on DRGs. DRG is based on very transparent micro-costing, it is known how many personnel costs and overheads they include (investment and land costs are excluded). It is updated once a year. The main sources contains DRGs relative weights only(72). They have to be multiplied by a reference value that was 3,544.97€ in 2019 (varying from country to county).

Regarding **heart failure**, there are four different costs depending on the complexity of a process and the length of hospital stay(72).

**Day case procedure/Outpatient surgery**

There are two different fee schedules (for private insurance and for sickness funds). The resources are identified at very detailed level (micro-costing). It is not possible to link a diagnosis to a certain price or fee. As an alternative, data from publications or individual contracts between physician organisations and payers are cited.

The **laparoscopic cholecystectomy** is only performed in inpatients. In the future, this should be part of fee schedules. Much more is done on the same procedure for inpatient. This makes this system quite inefficient.

The **cataract surgeries** are remunerated by a one-time flat-rate fee per case of illness and sick eye. The replacement health insurers compensate the participating ophthalmic surgeons for an outpatient surgery fee for the entire service content, including all upcoming material costs (including special lens, if applicable, as well as blue light filter lens, if the implantation of these lenses is medically indicated) in the amount of 709€ per cataract operation performed. With this surgery flat rate, all costs of the implant including procurement and storage, the visco surgical material and the material costs of the consumables for funds outside the consultation hours are covered. Any further claims against the insured are not permitted(84).

| | |
|---|---|
| Medicines | https://www.aifa.gov.it/liste-farmaci-a-h |
| Inpatient and outpatient tariffs | https://www.gazzettaufficiale.it/eli/id/2013/01/28/13A00528/sg. |

Values reported for both inpatient and outpatient care are collected in the official tariff lists published by the *Servizio di Sanitá Nazionale* (SSN)(85). More specifically, all inpatient and most of outpatient tariffs are attached to the decree *Decreto Ministeriale 18 ottobre 2012*(86). The tariffs are defined on the basis of standard production costs and standard quotas of general overheads calculated on a representative sample of public and accredited private providers(86). The previous decree does not mention what resources were included in the final cost. The general criteria for the definition of the welfare functions and for the determination of their maximum remuneration are established on the basis of organizational standards and predefined unit costs of the production factors, taking into account, when appropriate, the volume of the activity carried out(87). Regional tariffs (with minimal variations) are also available(88).

Outpatient specialist activity is categorized using procedure codes derived from the Italian version of the International Classification of Disease (ICD) ICD-9-CM. Inpatient activity is organized according to DRG (version 24).

The availability (and reliability) of cost values vary greatly across the different cost objects. Official cost values (SSN, *Agenzia Italiana del Farmaco* - AIFA) exist for selected categories only: hospital admissions, outpatients procedures (e.g., specialist visits, diagnostic and laboratory tests, therapies), prostheses (e.g., wheelchair, artificial limbs, lens) and drugs. Other items (e.g., personnel, medical devices, ambulance services) that may be used in EEs are costed using local sources or ad-hoc studies.

**PRIMARY RESOURCES**

**Medicines**

Drug prices (for drugs of class A and H that are reimbursed by SSN) result from a negotiation process between the pharmaceutical companies and *AIFA*, which evaluates the clinical and cost-effectiveness profile of the new products becoming available on the market. For Atorvastatin, the public price and reference price is available, whereas for Trastuzumab, the public price and ex-factory price is available. Paracetamol is only available in combination with Codeina or Oxicodone. Reference prices are uploaded each 6 months. The patients can choose a brand name drug instead of the generic equivalent drug, but they are asked to pay the difference between the two(89).

**Medical devices**

Unfortunately, there are not reference prices for all medical devices at national level. An ad-hoc study aimed to standardize auction prices of some medical devices (e.g., drug-eluting stent) and results were incorporated into national

laws(90). However, these prices are not updated and cannot be considered 'official' values for the Italian context. Local examples of purchase or leasing prices are extracted from ad hoc purchase documents and may change even for the same region.

The median base auction price of **DES** published by *Autorità Nazionale Anticorruzione* is set on 448,95€ (median value is 782,5€)(91). According to *Decreto 11 ottobre 2007*, the base auction price is 1486€(90). The last update of base auction price dates back to 2009.

Purchase or leasing local prices of **WCD** are extracted from ad hoc purchase documents and may also change for the same region. There is some list of medical devices reporting their auction prices(92–94).

**Health products/Disposables**

There are no national reference values for health products/disposables; thus, examples of prices based on local purchase documents are provided(95,96).

**Personnel costs**

There are three main sources of personnel costs in Italy: *Istituto Nazionale di Statistica* (ISTAT), national collective contracts and ad-hoc studies. ISTAT is an official statistics source and combines different data (social security data, registry data, etc.) aimed at evidencing the differential wages in the private sector. It reports hourly salaries by job categories (i.e., healthcare and social assistance) and job levels (e.g., intermediate technical roles). More detailed information regarding cost elements included in the concept "cost per hour of work", such as periods of on-call time, bank holidays, incentives or variations in productivity, extra hours, etc., comes from ad hoc studies/articles. Surveys/interviews with professional groups is also an alternative.

According to the national collective contract, **nurses** can work 5 day per week (7.12h/day) or 6 days per week (6h/day). Theoretically, Sunday is not included (52 days per year are mandatory days off). Also, consider 28 or 32 days of annual leave (respectively for shifts of 5 or 6 days per week) and 12 days of bank holidays. The national contract does not include incentives, night shifts, on-calls and extra-hours of work(97). Examples of incentives for nurse working in intensive care or operating room: 4.13€ per each day of work at operating ward, intensive therapy, sub-intensive therapy or nephrology service and dialysis; 5.16€ per each day of work at infectious disease service or equivalent disciplines. Regarding domiciliary assistance, the incentives are 5.16€ or 2.58€ per day of work (depending on the nurse's category)(98). There are 7 categories corresponding to different levels of remuneration. They have the same responsibility in any setting, just every 3 years a nurse passes to another level and get a salary increase(97). There can be differences in salaries across regions. The difference about wages can be explained because beside the national collective contract, there is usually an integrative contract, which is regional-based. Basically, each local healthcare practice can freely decide how much can remunerate more a health's professional. E.g., a nurse working in *Fondazione IRCCS Policlinico "San Matteo"* in Lombardia could be paid an extra annual salary of 1,533€ in 2018(98).

A nurse's salary does not depend on a health care setting (hospital, primary care, etc.).

In private sector, nurse's net monthly salary is around 1,500€. Nevertheless, considerable differences can be found from one institution to another. E.g., those who work in non-profit organizations and cooperatives can gain even just net monthly salary of 1,000€, while nurses in the emergency room and in the operating theater can gain 2,000€. Nurses holding managerial positions are paid about 3,000€ a month(99).

According to ISTAT, the hourly nurse's salary depends on the category (i.e. seniority) s/he belongs to. Part of gross annual salary consists of salary in kind (0.1%), remuneration for overtime (1.8%), compensation for thirteenth and other additional monthly payments (7.6%), remuneration for premiums and other components not payable in each pay period (1.5%)(100).

**GPs'** salaries are based on a capitation system. A GP can have a maximum of 1,500 patients and receive a fix capitation for each patient that is irrespective of the number of visits. According to the national collective contract, GPs are paid an annual flat-rate fee per patient of 38.62€. This quota is raised by an extra quota resulting from the multiplication of the total number of patients in charge by the tabular value determined by the intersection between the seniority of the GP and the band determined by the number of patients assisted (Supplementary Table 21). GPs are additionally compensated for each patient that has completed 75 years of age by 15.49€. There are many other incentives added to the basic quota of 38.62€ per patient per year(101).

According to an ad hoc study that combines data from ISTAT, *Conto Annuale* and local data from ENPAM, a GP earns per patient per year around 66.42€ and his hourly retribution is of 60.71€(102).

According to the national collective contract, a yearly salary of a **specialist** with permanent contract is based on 13 payments and 38 working hours per week. A yearly salary of a specialist with fixed-term contract is based on 13 payments and 28 working hours per week. The salary does not include any incentives. The retribution per extra hour of day shift is fixed at 26.61€, 30.08€ is paid for one extra hour of night shift or one extra hour of day shift on public holidays and 34.70€ is paid for one extra hour of night shift on public holidays. The annual incentives for specialists who do not practice in private sector are determined as well(103). In order to calculate the hourly wage of a specialist with permanent contract, it should be considered that Sunday is not included (52 days per year are mandatory days off) and that 28 or 32 days of annual leave (for shifts of 5 or 6 days per week, respectively) and 12 days of bank holidays should be subtracted.

According to the previously mentioned ad hoc study, a specialist earns per patient per year 192.89 euros in hospital and 13.58 euros in ambulatory care(102).

## COMPOSITE GOODS AND SERVICES

### Outpatient visits

There are no official tariffs for **GP visit**.

Tariffs of a **specialist visit** are constant across specialties(86).

Regarding the cost of **A&E visits**, the cost comes from a three-year period (2000-2003) and is based on an ad hoc study performed in 6 hospitals in the Region of Lazio(104). In order to estimate costs, the top-down method could not be used because allocative statistics for A&E department is currently not available neither at local nor national level. Additionally, the application of the bottom-up method requires detailed information on resources consumed per individual patient. However, the hospital accounting systems do not have this information. Therefore, the study used the methodology of relative weights. The cost of all individuals treated at A&E department, admitted or not to the hospital (with the exception of programmed hospitalizations) who accessed A&E according to the following classification criteria were considered:

- Accessed without reference to any classification system
- Accessed classified according to the triage system
- Accessed classified according to the International-Refined DRG (IR-DRG) system tested in the framework of the study

The study considered the following costs:

Direct cost of A&E department:

A. Fixed cost related to the productive factors (e.g., personnel, equipment) and variable costs (e.g., drugs, health products, disposables) both used directly by A&E department, except for Radiology and Laboratory.
B. Costs determined by services not provided directly by the accident and emergency department. This refers to cost of Radiology department and Laboratory. Therefore, all costs related to activity provided by radiology and laboratory departments to the patients treated at A&E department are imputed to A&E department.

Indirect costs of A&E department:

C. Costs of the production factors attributed to accident and emergency department, but not directly used in the production of the single service. This is the case of variable overheads such as cleaning or laundry. General operating costs of the structure to which the accident and emergency department belongs, to be attributed to the accident and emergency department itself. This is the case of fixed overheads such as cost of building or amortization of building.

Supplementary Table 22 shows the information provided by the hospitals. On average, fixed costs represent over 75% of the total costs of the A&E department. The incidence of fixed costs, however, varies between the structures from a minimum of 67% to a maximum of 95%. The main cause seems to be related to the way in which the costs of the medical personnel on duty who work both for A&E and for the department to which they belong have been determined. Some structures have attributed the cost entirely to the emergency room, while others have imputed it (but with variable proportions) partly to the emergency room and partly to the department to which they belong. A&E department is a final cost object. Supplementary Table 23 shows the average cost per each of the six hospitals included in the study. The standardized average cost per hospital, that is, the result of multiplying the previously defined average cost (Supplementary Table 23) by the corresponding weight is shown in Supplementary Table 24.

**Hospitalization**

Regarding cost of a **day of hospitalization at normal ward** and the cost of a **day of hospitalization at ICU**, the average cost of the whole hospitalization period is available only. It comes from an ad hoc study based on a sample of 23 hospitals and it was estimated using the activity-based costing. Hospital tariffs are associated to DRGs. The cost of a recovery period at normal ward includes cost related to the production factors such as the personnel cost (doctor, nurse, other personnel such as biologists, technicians, administrative staff, etc. related to diagnosis and treatment units, managers and directors), cost of medicines and overheads (depreciation, cleaning, laundry, wardrobe, catering, and other costs assigned to diagnosis and treatment units). All the previously mentioned costs were collected from hospitalization at normal ward, reanimation unit, operating room (operating room, delivery room, hemodynamic, electrophysiology) as well as from services from other units such as consultancy, blood transfusion, gastroenterology, etc.(105).

**Image diagnosis**

The cost of an **ultrasound scan** is based on a costing studies of some services performed in a sample of hospitals from 3 Italian regions: Toscana (2003-2004), Veneto (2008) and Friuli Venezia Giulia (2006)(106).

The cost of a **CT scan** is based on a costing studies of some services performed in a sample of hospitals from 4 Italian regions: Tuscany (2003-2004), Veneto (2008), Piedmont (2008) and Friuli (2007)(106).

The costs are published by the SSN in an official tariff list(86).

**Laboratory tests**

The cost data come from the following studies: costing studies of all laboratory services performed with the method “Costilab” in the Regions of Umbria in 2007, and Tuscany in 2004; a study using ABC methodology that was carried out by the Local Health Authority (ASL) of Cuneo in Piedmont in 2008, and a costing study of all laboratory services (except those carried out by the immuno-blotting service and pathological anatomy) done in a sample of public and private settings in Veneto using a step-down costing methodology and conducted by Bocconi University in 2007(106). The costs are published by the SSN in an official tariff list(86).

**Ambulance services**

Cost values reported for an **intensive care ambulance** journey come from an ad hoc study using costing data of 5 local healthcare companies (*Azienda Sanitaria Locale*, ASL) from Region of Liguria. An ASL is a public body of the Italian public administration responsible for providing health services. The data was being obtained during 3 consecutive years (2003-2005). The triage system was used to estimate the cost of intervention according to the patient’s complexity. The number of personnel per intervention was estimated on the basis of the hours worked monthly by the staff dedicated to the activities related to an ambulance intervention taken from the published results of the European Emergency Medical Services (EMS) project (see Supplementary Table 25 for the variables used). The cost components were deduced from the analytical accounting data from each of the 5 ASL. Each individual case has been broken down into three main activities: receiving emergency calls, assessment of the severity of the event and the complexity of the intervention and activation of the intervention. Cost of receiving emergency calls was determined by cost of assistants/technical operators, administrative workers and overheads. Cost of sending a vehicle is determined by cost of personnel (medical

and nursing staff), services (rentals) and others (depreciation). Among costs related to the intervention at the rescue site are costs of pharmaceutical and blood products, diagnostic reagents, medical devices and other health materials and acquisition of non-health products).

Regarding cost of ambulance services, even if there is no intervention, everyone must be prepared to be ready to intervene when needed. Therefore, most costs should be considered as fixed costs. Even it is obvious that there are some variable costs such as drugs, equipment, fuel, etc., they are very low compared to the others and therefore can be safely overlooked.

The fact that data were obtained from 5 ASL constitutes a too limited number for a methodologically correct cost estimation(104).

The cost of **non-emergency patient transport** are not available.

**Diagnostic procedures**

Based on the official tariff list published by the SSN. Two different treatments of **colonoscopy** were identified: Colonoscopy with flexible endoscope and Colonoscopy - retrograde ileoscopy(86).

**Therapeutic procedures**

The tariff of **haemodialysis** is based on a study on the characteristics of assistance to patients with chronic renal failure dating from 2008(106) and is published by the SSN in the official tariff list. The tariff depends on the type of haemodialysis and on the type of setting it is delivered (hospital vs. home)(86).

The cost of **oxygen therapy** was not found in the official tariff list(86).

**COMPLEX PROCESSES & PROCEDURES**

**Inpatient medical and surgical processes**

In order to derive acute inpatient tariffs, a sample of 41 healthcare providers, either public or private (but accredited with the SSN), were selected according to the criteria of efficiency, efficacy, quality and appropriateness of care, plus the availability of robust cost data. Moreover, they were distributed in three dimensional classes (i.e. 121-350, 351-600, >600 beds), proportionally with respect to the national picture, and located in the following regions: Lombardy, Veneto, Emilia-Romagna, Liguria, Umbria, Puglia and Sicily(106).

The tariffs for hospitalizations lasting more than 1 day are determined on the basis of the full costs (DRGs). Exceptions are some DRGs, such as those relating to transplants (for which it was agreed to refer to the values of the conventional single tariff), and those relating to the paediatric area (in consideration of the recognized descriptive limits of the DRG system compared to paediatric cases). The tariffs include A&E department costs of those patients who were admitted to the hospital directly from the A&E department. The last costing exercise for hospital tariffs dates back to 2009(106).

Several tariffs associated to the inpatient medical and surgical processes are defined:

- tariff of ordinary hospitalizations with duration superior to 1 day and within the value threshold (tariff per episode of admission)
- tariff of ordinary hospitalizations with duration between 0 and 1 day, transferred or deceased (tariff per day of hospitalization)
- tariff of ordinary hospitalizations with duration between 0 and 1 day. Day case (tariff per episode of admission in case of surgical DRG, tariff per day of hospitalization in case of medical DRG).
- Tariff of days over value threshold (tariff per day of hospitalization)(106)

The tariff of **hernia inguinal, femoral, umbilical** depends on whether the process includes complications or not.

**Day case procedures/Outpatient surgery**

The tariffs of day case procedures were determined on the basis of the composition of the costs by macro-item and the average length of stay specific to DRG, but excluding the cost items not compatible with daytime hospitalizations (e.g. costs of intensive care and emergency room). In particular:

-The tariffs for day case procedures attributed to surgical DRGs were determined on the basis of the average cost per day, increased by the cost components relating to the surgical intervention and to the pre and post intervention services, specific to DRG.

- The tariffs of day case procedures attributed to medical DRGs were determined on the basis of the average cost per day, specific to DRG(106).

Tariffs associated to the **laparoscopic cholecystectomy** depend on whether it entails complications or not.

The tariff per day case **cataract surgery** is published only.

| | |
|---|---|
| Medicines | https://www.gov.pl/web/zdrowie/obwieszczenie-ministra-zdrowia-z-dnia-30-kwietnia-2019-r-w-sprawie-wykazu-refundowanych-lekow-srodkow-spozywczych-specjalnego-przeznaczenia-zywieniowego-oraz-wyrobow-medycznych-na-1-maja-2019-r |
| Inpatient DRG | http://www.nfz.gov.pl/zarzadzenia-prezesa/zarzadzenia-prezesa-nfz/zarzadzenie-nr-382019dsoz,6906.html |
| Outpatient DRG | http://www.nfz.gov.pl/zarzadzenia-prezesa/zarzadzenia-prezesa-nfz/zarzadzenie-nr-222018dsoz-tekst-ujednolicony,6924.html |

**PRIMARY RESOURCES**

**Medicines**

The official prices of reimbursed drugs are updated on a regular basis every 2 months. The reimbursement list can be found elsewhere(107). Medicines with paracetamol are commonly used in Poland, but most of them is in the over-the-counter and is not reimbursed. Therefore, the reimbursement list contains paracetamol in combination with tramadol, because it needs to be prescribed by a physician.

**Medical devices**

There's no list of hospitals with the cost of medical devices. Each hospital buys them by tender. According to the hospital data, the average price of DES was around 1,000 zł in 2007. Distributors provided a similar average price in 2006. According to detailed information on costs of each treated patient in two Polish hospitals, the cost of a DES can be found in Table 9. However, these prices are not publicly available. In Poland, stents are not costed separately, the cost of DES is included in the DRG referring to the whole process of implanting a DES.

**Table 9. Cost of a drug-eluting stent in 2018 (Poland)**

| Mean | Min | Max | Median |
|---|---|---|---|
| 1,179.55 zł | 464.40 zł | 3,888.00 zł | 972.00 zł |

*Source: Communication with the Polish partners.*

The **WCD** is currently not reimbursed in Poland.

**Health products/Disposables**

The official prices of reimbursed health products are updated on a regular basis every 2 months(107).

**Personnel costs**

An hourly wage of GP, nurse and specialist is not defined. Instead, lump sum for a year of care of 1 patient is defined, being of 159 zł for a GP and of 40.80 zł for a nurse in 2019(108).

**COMPOSITE GOODS AND SERVICES**

**Outpatient visits**

Cost of a **GP visit** is not available in Poland.

The cost of a **specialist visit** is equal across all specialties. However, cost varies depending on a severity of patient's illness. Not all specialties have the same types of severities (e.g., in cardiology, there are 8 types of patient's illness severity – 1, 2, 3, 4, 5, 7, 8 and 9). Moreover, cost of a post-hospitalization visit, visit related to a prescription only, several types of visits after cardiovascular event, etc. are defined as well(108).

Regarding cost of **A&E visit**, each hospital receives individually set lump sum for the year. This is set by National Health Fund(109) and consist of two parts: one covers the cost of infrastructure and in 2020 is 4,521 zł per day and the second depends on patients profile in a determined period of time. Therefore, the cost of the second part of A&E visit is set according to the following formula, taking into account the number of patients within the appropriate category of patient's health, based on the medical procedures performed and the weights of individual categories:

$$R_f = \frac{a}{l_d} \times \sum_{i=1}^{6} P_i \times W_i$$

Where,

a: value of point (in the hospital emergency department the value is 1 zł),

$l_d$: the number of days in the period adopted for the calculation (the calculation includes the period containing reporting data from the full 12 months, and in the absence of which, reporting data from a minimum of 3 consecutive months are used in the calculation),

$P_i$: the number of patients in each category of patient's state of health. The component includes:

1) patients qualified for categories V and VI who were suddenly admitted as a result of being transferred by a medical rescue team;

2) patients for whom the A&E service did not end in hospitalization in the same institution;

3) traumatic patients or traumatic paediatric patients for whom the benefit in the trauma centre ended up in hospitalization in the same institution and for the settlement indicated the benefit from the group T specified in the characteristics of the group from the catalogue of groups,

$W_i$: weight of the relevant category. The weights can be found in as specified in Supplementary Table 26.

**Hospitalization**

The cost of a **day of hospitalization at ICU** is set by the National Health Fund and it depends on the patient's severity of illness (measured on TISS-28 scale) and level of care (1st, 2nd or 3rd). The cost varies from 749,01 zł to 4906,14 zł for children, from 850,68 zł to 4380,48 zł in case of adults and from 952,89 zł to 4906,14 zł in case of adults of level II severity

of illness. The service provider is obliged to compile in the statistical report all the detailed activities performed in patient care for each day of the patient's stay in the ward(110).

**Image diagnosis**

**Ultrasound scan** is not financed separately. Cost of **CT scan** differs among imaging area and it depends on whether the exam is done with or without contrast as well. The head examination covers all intracranial structures. In addition, as part of this procedure, depending on medical indication, the following examinations can be performed: CT of the maxillofacial region, CT scan of the temporomandibular joints, CT scan of the temporal bone, CT scan of the saddle or posterior cavity, CT of the base of the skull and CT of eye sockets. The cost of CT exams are provided on an outpatient basis and are implemented in appropriate diagnostic institutions or clinics, which are the subject of separate contracting by the National Health Fund(111).

**Laboratory tests**

There are no separate tariffs of blood tests. They are included in ambulatory or hospital DRGs. Nevertheless, according the Polish project partners, the commercial price of **ferritin** is 40 zł and of **creatinine** 13 zł, approximately. The same partners obtained costs from the AOTMiT's cooperating hospitals for 2018 year (Table 10).

**Table 10. Average cost of selected laboratory costs (Poland)**

| | Mean | Min | Max |
|---|---|---|---|
| Ferritin | 18.51 zł | 14 zł | 23.08 zł |
| Creatinine | 4.65 zł | 1.9 zł | 10 zł |

*Source: Communication with the Polish project partners*

**Ambulance services**

Capitation system is used in order to finance a **non-emergency patient** short distance **transport** in primary care. Provision of "distant" sanitary transport in primary care, that is, a long distance transport (there and back) of 121 – 400 km is paid by a constant tariff per journey. Provision of transport longer than 400 km is paid by the previous tariff for the first 400 km plus the tariff set per each km above 400 km. The costs of the previously mentioned transport services performed from Monday to Friday, excluding public holiday can be found elsewhere(108).

**Diagnostic procedures**

The costs of **colonoscopy** are provided on an outpatient basis and are implemented in appropriate diagnostic institutions or clinics, which are the subject of separate contracting by the National Health Fund(111).

**Therapeutic procedures**

The tariff of one session of haemodialysis includes:

1) transporting the patient to a dialysis station prior to haemodialysis;

2) preparing the dialysis station, setting the apparatus, pre-rinsing, venting the system, flushing the system in case of reutilization;

3) medical examination and preparation of the patient (weighing, washing the fistula area, appointing dialysis orders, filling in the dialysis card);

4) administration of erythropoiesis stimulating agent - in the case of medical indications;

5) puncture needle insertion or connection to a dialysis catheter;

6) connecting the patient to an artificial kidney apparatus;

7) haemodialysis and control of the patient's dialysis and vital signs;

8) laboratory tests and consultations, bacteriological and biochemical tests;

9) monitoring and treatment of anaemia - erythropoiesis stimulants, administered in a dose that ensures obtaining and maintaining a haemoglobin concentration in the range of 10-12 g/dl in at least 65% of those on permanent dialysis at the dialysis station;

10) termination of the procedure (bringing in blood, stopping bleeding, determining vital signs after haemodialysis, changing the dressing around the catheter, weighing, administering drugs);

11) after dialysis: disinfection (thermal, chemical) and decalcification of the artificial kidney apparatus, waste utilization, possible reutilization of dialysers and assessment of their efficiency after this procedure;

12) preparing the position for the next patient;

13) transport of the patient after the procedure to home or to the place of stay;

14) patient's or caregiver's education in self-care.

Personnel included in one session of haemodialysis:

1) physicians - the total working time corresponding to the working time of the dialysis station:

a) a specialist doctor in the field of nephrology or during a specialization in the field of nephrology - at least one full-time equivalent, and in the case of services provided only to children when the dialysis station's working time is shorter than the one-time doctor's working time - a specialist doctor in the field of children's nephrology or during specialization in the field of paediatric nephrology - working hours equal to the working time of the dialysis station and

(b) a specialist in internal medicine or

c) a specialist in paediatrics (for the treatment of children);

2) nurses who have been confirmed by appropriate certification of training at a dialysis station or nurses after a specialist course in dialysis, or nurses after a qualifying course in the field of nephrology nursing with dialysis, or nurses holding the title of specialist in the field of nephrology nursing or internist nursing - in the total working time corresponding to the working time of the dialysis station.

Medical equipment and apparatus at the place of providing benefits:

1) haemodialysis apparatus with automatic ultrafiltration control;

2) water treatment apparatus;

3) Electrocardiogram;

4) resuscitation equipment(111)

A tariff of **oxygen therapy** can be found elsewhere(112).

**COMPLEX PROCESSES & PROCEDURES**

Some inpatient processes and day case procedures cost the same (e.g., cataract extirpation).

**Inpatient medical and surgical processes**

In general, cost per hospitalization period is set for almost all DRGs. However, some DRGs have three different costs: cost of a not planned hospitalization, cost of a planned hospitalization and cost of a day case surgery(110). The cost of **heart failure** depends on the severity of the process. The cost of **abdominal hernia** surgery depends on whether is with or without implant(110).

**Day case procedure/Outpatient surgery**

Outpatient DRGs are used in order to set tariffs for day case procedures/outpatient surgery(111). Tariff associated to **laparoscopic cholecystectomy** was not found among outpatient DRGs(111). Tariff associated to cataract surgery is defined as tariff of outpatient cataract surgery.

| | |
|---|---|
| Medicines | http://app10.infarmed.pt/genericos/genericos_II/menu.html |
| Inpatient and outpatient | http://www.acss.min-saude.pt/category/acss_pt/tabelas-e-impressos/ |

The main source regarding unit costs used in EE is the official report published by the Portuguese NHS (*Serviço Nacional da Saúde, SNS*). It sets Portuguese DRG prices for inpatient and ambulatory care(113). DRGs make use of production costs taken from the Portuguese hospital cost database –which considers annual public hospitals cost information- and of Maryland weights. Most of the information available is partially used for setting a prospective global budget and a case payment prices for third parties.

Further information on indicative prices is commonly extracted from the guidelines for contracting between public providers (e.g. hospitals, primary care centres) and the Ministry of Health.

**PRIMARY RESOURCES**

**Medicines**

Cost for generic drugs are published by HTA agency – INFARMED(114). Costs of some high cost drugs are collected in the centralised purchasing database(115).

**Medical devices and Health products/Disposables**

The cost was taken from the public bid contract and it refers to purchasing price for one specific hospital. The cost does not include VAT(116,117).

**Personnel costs**

Public sector monthly salaries are reflected in the salary table that is published by the Ministry of Health. Nevertheless, the **nurse**s' hourly wage is calculated by labour trade union for normal daytime working hours on working days taking into account 35 working hours by week. This calculation is based on legal terms and will address only the purposes of calculating supplements. For example, for the salary category 30, the hourly salary for day of work on working days was set on 13.35€/h. There is a supplement of 3.34€/h for day work on Saturdays after 13 pm, Sundays and bank holidays and of 6.68€/h for night work on Saturdays after 20 pm, Sundays and bank holidays. Regarding extra work, the first hour of work on working days costs 15,85€(118) (Supplementary Table 27).

In general, the salary is the main payment system for primary care GPs. However, there are three types of primary care public organizations in Portugal. In two of them, the GPs are paid by salary, while in the remaining organization, the GPs salary depends on a base salary and on the achievement of performance indicators.

Cost per hour of work of **GP and specialist** included in the EU HCSCD is taken from contract between doctors and labour trade unions. It is based on 14 annual payments. It does not include any incentives nor extra pays. Nonetheless, it depends on doctor's seniority and category, on the weekly working hours (35 or 42), on working or not in the public sector with exclusivity and on whether the contract was celebrated before or after January 1st, 2013. Any supplements (such as meal, holiday and Christmas allowances, supplement for night, weekends or holidays, extra time, supplements according to settings or incentives) are not included in the basic monthly salary. Extra hours are paid according to Supplementary Table 29.

Regarding GPs' salary, an additional supplement is added to the monthly salary and it depends on the municipality a GP belongs to and on the number of patients subscribed to each GP (Supplementary Table 28)(119).

**COMPOSITE GOODS AND SERVICES**

**Outpatient visit**

The production cost of a **GP consultation** is calculated by the National Auditing Body, and it is based on information collected on all units operating at national level in 2011 and 2012 in five regional health administrations (North, Centre, Lisbon and Tagus Valley, Alentejo and Algarve). It includes all costs related with personnel, exams, drugs and infrastructure. The cost of GP visit depends on the level of team's organizational maturation and contractual level of performance(120).

The cost of a **specialist visit** varies across hospital groups. Six groups were defined, each of them is compounded of different number of hospitals (4 hospitals in group A, 9 hospitals in group B, 14 hospitals in groups C, 7 hospitals in group D, 6 hospitals in group E and 3 hospitals in group F). Group F refers to oncology department. A separate group of psychiatric hospitals were compounded of 2 hospitals. The cost of each group includes all costs related with personnel and infrastructure. In some cases, drug costs are included as well(121).
The payment to **emergency care** entails 3 components: a fixed value according to the type of service (it covers the efficient costs related to the installed capacity of the emergency service); a performance component corresponding to 5% of the fixed value (it depends on several indicators); and a variable component for extra activity paid at a marginal price. The price has been obtained by dividing the fixed payment amount by the number of expected attendances. Three different costs of A&E visit were defined: basic emergency, medical chirurgical emergency and polyvalent emergency service(121).

**Hospitalization**

The average cost per **day of hospitalization at "normal" ward** was calculated as the average of a cost of a day of hospitalization of all medical DRGs(122).

The cost of a **day of hospitalization at intensive care unit** was calculated as the average of average costs that were already available for four regions instead of using each hospital information. The cost of personnel, consumptions, contracts, supply and external services and other costs are included(123).

**Image diagnosis**

Tariffs are set for payments to third parties. They are highly detailed (e.g., cost are reported for different parts of body). However, there is no info on detailed resources consumed during the exam(113).

**Laboratory tests**

Tariffs are set for payments to third parties. They are highly detailed (e.g., costs of particular blood tests are reported). However, there is no info on how prices are computed(113).

**Ambulance services**

Most of the **emergency transportation** is done by National Institute for Medical Emergency (INEM, in the letters of Portuguese acronyms). However, the information about how the cost are computed is lacking. In case the vehicle is not owned by INEM, the cost is fixed per km intervals and can be found elsewhere(124).

Regarding **non-emergency patient transport**, the contracted price between the Ministry of Health and private individuals, natural or legal persons, whose purpose is to provide care for health can be found elsewhere(125).

**Diagnostic procedures**

The tariff of diagnostic procedures is published by SNS. No rationale for setting the tariff was provided(113).

**Therapeutic procedures**

The tariff of **haemodialysis** is set out in the contract between the Ministry of Health via General Directorate for Health or the Regional Health Administrations and private individuals, natural or legal persons, whose purpose is to provide care for health as part of the national health care network. The tariff refers to a comprehensive price, which: (i) integrates the provision of several services (e.g., dialysis sessions, medications, MCDT, vascular hemodialysis); (ii) defines results and quality control parameters of the health services to be provided; (iii) establishes a mechanism for monitoring, monitoring and evaluation. Includes 3% reduction in price due to hemodialysis spending above 230 million euros(126).

The tariff is used for sub-contracting, therefore, it includes all cost concepts (resources used). The cost is set per patient/week for comprehensive care package of hemodialysis with and without vascular access and it is independent of the setting (home or hospital). The cost of one session of hemodialysis is set as well without any specification regarding a type of setting(126).

**COMPLEX PROCESSES & PROCEDURES**

**Inpatient medical and surgical processes**

The inpatient tariffs vary according to severity(113). Regarding **heart failure** and **hernia inguinal, femoral and umbilical**, four different tariffs are defined (severity 1 - 4).

**Day case procedures/outpatient surgery**

The outpatient tariffs vary according to severity. Three different tariffs associated to DRGs describing the severity of **laparoscopic cholecystectomy** and **cataract extirpation** are defined (severity 1 - 3). No difference between a day case surgery tariff and inpatient tariff was found. Similarly, no difference between inpatient and day case tariff was found regarding cataract extirpation(113).

| | |
|---|---|
| Medicines | https://www.jazmp.si/fileadmin/datoteke/seznami/SFE/Cene/cene_2007hist.html |
| Standardized production costs | http://www.zzzs.si/Zzzs/info/egradiva.nsf/o/37D1B2F27B0EC343C12583B7002DAF04?OpenDocument |
| Diagnosis-Related Groups | https://partner.zzzs.si/wps/portal/portali/aizv/zdravstvene_storitve/plan_in_realizacija/podatki_o_planu_in_realizaciji_zdrav_storitve |

The officially used source of all the prices in health care (except for DRGs and medicines) and basis for all the contracts with the providers is General Agreement(127), which is a tripartite agreement, concluded among Ministry of Health, Health Insurance Institute of Slovenia (HIIS) and health care providers. It includes all data on quantity, type and prices of service that will be provided in a year. Therefore, the unit costs in General Agreement are based on standardized or production costs. However, updating of costs is not regular – the process is planned and HIIS does it accordingly to the needs. If for example they feel that price is not adequate, they would nominate a team to reflect on the prices and prepare a new pricelist for a procedure. Then the prices would remain valid until something happens, then HIIS would work in this specialty again.

The basis of all DRGs is the General Agreement. A 'standard DRG' (that is, valued of weight "1") includes all health care resources incurred in the carrying out an intervention (all direct costs, variable and fixed overheads)(127). This value needs to be multiplied by the weight of DRG whose cost is wanted to be known (each DRG has different weight). The data on realization of the yearly DRG cases along with the weight of the DRG, number of cases as well as total value are published elsewhere(128). Cost elements included in a DRG weight of value 1 are the following: 21.09 medical and nursing staff, 3.22 administrative technical workers, variable overheads, material cost, depreciation, premium for additional pension insurance, additional funding for informatization, other extra pays for anniversaries of the personnel, such as 10 years of work in the company, 20 year of work, 50 years of age, once-per-year add-on wage for holidays, sometimes it includes financing of holiday facilities, etc.(127).

**PRIMARY RESOURCES**

**Medicines**

The Agency for Drugs determines maximum prices based on external reference pricing with Germany, France and Austria as the reference countries. Maximum prices are formed based on the manufacturer's price plus wholesale margin (1.1% on ex-factory price plus 0.5€ fixed mark-up). The maximum prices are calculated in three different procedures, depending on the type of the medicinal product (generic, originals, biosimilar). The reference prices (maximum allowed prices) of medicines are listed elsewhere(129). The VAT is excluded.

**Medical devices**

The cost of all **DES** that were bought in Slovenia by hospitals can be found on the portal of public tenders(130).

**Health products/Disposables**

Standard unit price can be found elsewhere(131).

**Personnel costs**

According to the legislation, medical and nursing staff work 2,088 hours per year. The annual amount is compounded of 12 payments. To obtain cost per hour of work, the annual wages are divided by 2088 hours. The annual wages can be found elsewhere(127). Cost elements included in 8-hour work per day includes annual leave, incentives, endangered positions (such as RTG), loyalty payment, food, transport, break time, etc. Extra time is excluded(132).

**COMPOSITE GOODS AND SERVICES**

**Outpatient visit**

There are various types of **GP visits** in Slovenia, all of them with different number of "weights". The most basic visit is a "short visit". The cases of a short visit are shown in Supplementary Table 30. All direct costs, variable and fixed overheads are included. The price of the visit is composed of a fee for service (which is 1.5 weights for a short visit)(133) and capitation. Capitation depends on the age of a patient and is, for example, 0 years (weight 1), 1-3 years (weight 0.75), 4-18 years (weight 0.5), 65-74 years (weight 1), 75+ (weight 2), disabled people with a disability of more than 70% (weight 2)(134). In order to get a value of short visit for an x-year old, the weights of fee-for-service and capitation must be summed and the final weight must be multiplied by the value of the weight that can be found elsewhere(127). Generally speaking, eighty per cent of a total price of the visit is paid by compulsory health insurance and twenty per cent by complementary voluntary health insurance as defined by Act on Health Care and Health Insurance. However, in some cases (e.g., diabetes mellitus) one hundred per cent is covered from compulsory health insurance.

The size of the budget for each **specialist** team differs depending on the specialty (e.g., cardiology, neurology or orthopaedics) because of differences in labour, material and infrastructure costs and is mostly based on historic cost data. However, the budget is the same for all teams within a given specialty in the country. The price of specialist attendance varies across specialties. It depends on the length of visit as well. The cost is set out in the General Agreement for the contracting year 2019 and it includes all direct costs, variable and fixed overheads. The total resource consumption is taken from hospital accounting. Outpatient clinic service is contracted at a yearly budget set beforehand for full team and is paid if a certain number of points is achieved. Dividing a yearly budget by a number of points needed to achieve gives a value of one point of each outpatient clinic(127). The points for each service provided are defined elsewhere(135). The number of points depends on the duration of the consultation, personal staff involved and health care resources spent. Regarding type of institution where the specialist visit take place, most of the visits can be located separately, as ambulatory outpatient care, but can also be located in the hospital.

The distinction between **A&E visits** in primary care or hospital need to be made. In primary care, there is annual cost per team only. Unit costs are not planned and the explanation is that the emergency primary care needs to be in preparation all the time – so they need to be paid regardless whether something happens or not. There are 6 different price standards for emergency care. The difference between them is due to the cost elements included. The difference is the area where these teams serve – so, if the area is bigger and Health Insurance Institute of Slovenia feels that more staff is needed, they would add more staff. In case the area is smaller and only one physician is enough, they would only take one into account. That's why there are more standards for the same thing. Total cost include all staff involved, overheads, depreciation, material costs and are taken from hospital accounting(127). The difference in cost across emergency care is due to historical organization of these services among the regions and the payment mechanisms just simply tried to adapt in order to cover all the situations.

The cost of A&E visits in hospital setting depends on emergency department (e.g., neurology, infectious disease, etc.) and on the length of visit. The A&E service is contracted at a yearly budget set beforehand for full team and is paid if a certain number of points is achieved. All direct costs, variable and fixed overheads are included. Dividing a yearly budget by a number of points needed to achieve gives a value of one point of each A&E service(127). The points for each service provided are defined elsewhere(135). The number of points depends on the duration of the consultation, personal staff involved and health care resources spent.

**Hospitalization**

The cost per day of hospitalization is not available. Instead, cost of the whole hospitalization period for each DRGs is calculated, depending on the diagnosis and procedures.

**Image diagnosis**

The cost is set out in the General Agreement for the contracting year 2019 and includes all direct costs, variable overheads and fixed overheads, e.g., personnel staff (a doctor specialist, nurse and administrative technical worker), fixed overheads (e.g., heating, water, cleaning, etc.), additional pension insurance, material costs, depreciation and additional funding for computerization. To obtain the unit cost of an image exam, the total annual cost is divided by the total annual points needed to achieve. The cost of a **CT** varies according to the body area, which is further divided into more detailed CT exam (with or without contrast)(127).

**Laboratory tests**

There are no costs of individual tests. The cost of laboratory services is set out in the General Agreement and it is included in ambulatory services(127). The list of all hematologic services is available only for evidential purposes, but not for pricing(136). The price list of individual tests of one of the self-pay laboratories can be found elsewhere(137).

**Ambulance services**

The cost is set out in the General Agreement(127).

The cost of **intensive care ambulance** is defined per urgent mobile unit per year. It includes a nurse, driver, administrative technical worker.

The cost of **non-emergency patient transport** is set per kilometre. Three different types of non-emergency patient transport are defined: patient transport with escort (includes cost of rescue worker, health care technician and administrative technical worker), patient transport for dialysis (includes cost of driver and administrative technical worker) and other non-emergency patient transport (includes cost of driver and administrative technical worker).

Moreover, both intensive care ambulance and non-emergency patient transport include also cost of fixed overheads, additional pension cost, material cost, depreciation and additional funding for computerization. In conclusion, all direct costs, variable and fixed overheads are included(127).

**Diagnostic procedures**

The cost is set out in the General Agreement. It includes cost of health care staff (specialist, nurse and administrative technical worker), variable overheads, premium for additional pension insurance, material cost, depreciation and additional funding for computerization(127).

**Therapeutic procedures**

Cost of haemodialysis is set out in the General Agreement and includes personnel costs (specialist, health care technician and administrative technical worker), variable overheads, additional pension funding, material cost, depreciation and additional funding for computerization(127).

The cost of oxygen therapy is also set out in the General Agreement. However, the cost elements are not specified(127).

**COMPLEX PROCESSES & PROCEDURES**

**Inpatient medical and surgical processes**

Prices of inpatient medical and surgical processes are set out in the General Agreement for the contracting year 2019(127). A 'standard DRG' is multiplied by a corresponding DRG weight(128).

**Day case procedures/Outpatient surgery**

The cost of day case procedures/outpatient surgery is set out in the General Agreement for the contracting year 2019(127).

The **cholecystectomy** in day care (laparoscopic) is paid the same amount than the classic one in the hospital – the reason for this is incentivizing providers to change from classic to laparoscopic surgery.

The cost of **cataract extirpation** includes 1.1 specialist doctor (he includes 0.1 anaesthesiologist), 1 nurse, 1 health care technician and 0.47 administrative technical worker, variable overheads, premium for additional pension insurance, material, depreciation and additional funding for computerization. Additionally, two outpatient examinations (one before and the other after surgery) are also included(127).

| | |
|---|---|
| Medicines | https://botplusweb.portalfarma.com/botplus.aspx |
| Inpatient and outpatient GRD | https://www.mscbs.gob.es/estadEstudios/estadisticas/inforRecopilaciones/anaDesarrolloGDR.htm |

The National Health System publishes production costs of inpatient processes and outpatient procedures taking into account all 17 autonomous regions (AR) and two autonomous cities (Ceuta and Melilla). They are based on DRGs. The cost of inpatient episodes are categorized into four levels of complexity.

However, each AR, as well as Ceuta and Melilla publish their own list with tariffs or public prices (prices, from now on). Their common feature is that the inpatient and outpatient procedures are based on GRD. However, the system or rule ARs use in order to assign prices to each GRD is unknown. They depend on the number and type of both hospital and resource use, etc. In order to homogenize hospital costs, a methodological document with several recommendations was published by the NHS(138). The authors of this document conclude that, in order to homogenize hospital costs among AR, the inpatient costs of the hospital accounting systems should include the cost of A&E of those patients admitted to the hospital directly from the A&E department, the cost of all diagnostic and therapeutic procedures performed on inpatient during his hospital stay, the cost of organ transplant and the cost of all day case procedures that require further hospitalization. Additionally, the hospital accounting system should exclude the cost of day case procedures that do not require further hospitalization, the cost of home hospitalization and cost of outpatient drug dispensing. The authors conclude that teaching and research costs should be apportioned to a specific cost centre(138).

**PRIMARY RESOURCES**

**Medicines and Health products/Disposables**

The cost of medicines and health products/disposables that are reimbursed and dispensed at community pharmacy can be found in Bot Plus, a community pharmacy database (139).

**Personnel costs**

Andalusian Health Service publishes the annual salary of statutory medical and nursing staff in Andalusia region. It is based on 14 payments and includes the basic salary, a three-year supplement, a destination supplement corresponding with the different levels of jobs and a specific supplement associated with a position held(140). The hourly cost of medical and nursing staff is not calculated. In order to calculate the cost per hour worked, 1,642 annual working hours should be considered(141). Annual salary of medical and nursing staff is shown in Supplementary Table 31.

**COMPOSITE GOODS AND SERVICES**

The costs of composite goods and services are published by each AR. In Aragon, there is a detailed list of cost elements included in the calculation of each item(142). In Madrid, the calculation of public prices is unknown(143).

**Outpatient visit**

In occasions, GP and specialist visits are subdivided into first and follow-up visits(142,144) that can be further subdivided into visits with or without complementary tests(145) or into face-to-face visits, telephone visits, home visits and telemedicine service(144).

In Aragon, the **specialist visit** includes medical staff, nursing staff, auxiliary nursing staff, routine diagnostic and therapeutic procedures indicated for each specialty, cures, consumable material and medication (if needed), and a detailed medical report at discharge(142). In Galicia and Andalusia, the cost of specialist visit depends on first or follow-up visit. However, the cost elements taking into account in the calculation of cost are not specified(145,146). In País Vasco, the specialist visit is divided into face-to-face visit, telephone visit and telemedicine service. Each of them can be further divided into first and follow-up visit. Their cost depends on whether the visits is led by a doctor or a nurse. Moreover, the cost of basic laboratory tests, electrocardiogram, audiometry, spirometry and all image diagnosis mentioned in *'Anexo IV'* are not included in the cost of the visit(144).

The cost of **A&E visit** may differ across different types of visit such as paediatric A&E visit, general A&E visit, traumatology A&E visit, etc.(143) and settings (primary care vs. hospital)(147). In Aragon, the cost of A&E visit is calculated as a proportion of a standard hospitalization tariff based on DRG. The weight associated to A&E visit was 0.05 in2015. It includes medical staff, nursing staff, auxiliary nursing staff, medicines needed during the A&E visit, blood test, cures, consumable material, diagnostic and therapeutic procedures specific for each specialty and detailed medical report at discharge(142). In Galicia, the cost of A&E visit includes all medical and/or surgical examinations and tests performed, except some special services and/or procedures(145). In País Vasco, the cost of A&E visit includes basic laboratory tests, electrocardiogram, audiometry, spirometry and all image diagnosis mentioned in '*Anexo IV*'. All additional examinations are billed separately(144).

**Hospitalization**

The cost of **a day of hospitalization at** both **normal ward** and **ICU** is published in the tariff list of each AR. More often than not is to publish a tariff of a day of hospitalization calculated as an average across all hospital specialties(144,145). However, in Andalusia region, a tariff of a day of hospitalization differs across hospital specialties(148).

In Aragon, this tariff includes medical staff, nursing staff and auxiliary nursing staff; routine diagnostic and therapeutic procedures specific for each specialty and complex diagnostic and therapeutic procedures in case of UCI; pharmacological treatment required during a hospital stay as well as blood tests and blood products; cures; food (including parenteral and enteral nutrition); consumable material; hospitalization in a shared or single room and issuance of medical report at discharge(142).

In Galicia, all costs incurred during a hospital stay are included, except those defined as specialized procedures, services and tests, epidural anaesthesia used during a delivery process and some material such as surgical prosthesis, pacemaker or other implanted material. In case an operation rooms is used during a hospital stay, there is a supplement of 1,030.13€ for the first use. From the second and each time the operating room is used for the same process that led to the stay, a 40% increase (412.05€) will be applied(145). The cost of A&E of patients that were admitted to the hospital directly from the A&E department are excluded(149).

In País Vasco, the cost of hospitalization includes food, medication, medical and nursing staff(144).

**Image diagnosis**

In Aragon, the set of benefits derived from the strict fulfillment of the minimum requirements demanded for each of the image diagnosis techniques is included, including hospital admission in those techniques that are required. The material or medicines that are required for the preparation of the organ to be explored, which is not expressly specified in the list of maximum tariffs is also included, as well as the issuance of medical report(142).

In Galicia, the image diagnosis are billed at cost prices. There is a standard cost of an **ultrasound scan** and more costly ultrasound scans are determined as well. The cost of a **CT scan** is the same regardless whether includes contrast(145). In País Vasco, the cost of different image diagnosis is calculated by multiplying the number of RVUs by the cost of the unit. The cost varies among parts of the body examined(144).

**Laboratory test**

The public prices used in Madrid can be found elsewhere(143).

In País Vasco, the cost of each laboratory test is determined by multiplying the number of RVUs by the cost of the unit. However, the cost of extraction (6€) and the cost of processing the request (5€) are not included in the RVU. In turn, there is a distinction between the normal and urgent analysis, as the later uses more resources. In turn, the cost of CT depends on whether is done with or without contrast(144).

**Ambulance services**

In Galicia, the cost of a **non-emergency patient transport** depends on whether the service is urban or interurban which in turn depends on the number of inhabitants (more than 200,000 vs. less than 200,000). Additionally, both urban and interurban service is divided into planned and not planned. The cost is set per kilometre. The cost of a waiting time will be considered when the person driving the ambulance is warned of the need for the return of the sick person in case of interurban transfers over 40 kilometres away. The established fee will be paid after the 2$^{nd}$ hour of waiting and up to a maximum of 3 hours, regardless of whether the service is planned or not(145). In Madrid, the cost of urban service is set per journey and the cost of interurban service is set per journey and per km. Additionally, the cost of waiting hour is defined(143).

Regarding **intensive care ambulance**, the cost differs between basic and advanced life support. In the case of basic life support, in Galicia, the cost per urban service, the cost per kilometre of interurban service and the cost of waiting hour is determined. In País Vasco, the cost of a journey depends on whether a nurse accompanies the vehicle or not(144).

In the case of advanced life support, in Galicia, the cost of personnel (doctor, driver), vehicle, requested medical report and the copy of clinical history is determined(145). In País Vasco, the tariff is set per return journey of up to 100 km. For journeys longer than 100 km, an additional cost per each km above 100 km is set. No additional information on the cost elements included in the tariff(144).

In Madrid, there are three types of intensive care ambulance: non-assisted ambulance, rapid intervention ambulance (transferring the patient is not possible, a medical professional, a nurse and an emergency technician is included) and mobile emergency ambulance (transferring the patient is possible, a medical professional, a nurse and an emergency technician is included). The cost of non-assisted ambulance is set per journey, kilometre and waiting hour. The cost of both rapid intervention ambulance and mobile emergency ambulance is set per journey and kilometre(143).

**Diagnostic procedures**

In Aragon, the set of benefits derived from the strict fulfillment of the minimum requirements demanded for each of the diagnostic techniques is included, including hospital admission in those techniques that are required. The material or medicines that are required for the preparation of the organ to be explored, which is not expressly specified in the list of maximum tariffs is also included, as well as the issuance of medical report(142).

In País Vasco, the cost of diagnostic procedures can be added to the cost of a day of hospitalization and specialist and A&E visit(144).

**Therapeutic procedures**

In Aragon, the tariff of **haemodialysis** includes haemodialysis material, dialysis fluid, dialysis monitors, own cardiopulmonary resuscitation material(142).

In Galicia, the public price of haemodialysis includes routine analytical test and transfusion. The price is set per session and is the same for both outpatient and inpatient(145).

In País Vasco, these is the cost of a day case haemodialysis and the cost of haemodialysis that can be added to the cost of a day of hospitalization, and specialist and A&E visit(144).

In Aragon, the tariff of home **oxygen therapy** includes installation of the bottle and equipment necessary for the administration of oxygen in the patient's home; nasal goggles or masks for oxygen administration will be new at each facility and will be changed monthly; reception and notices 24 hours a day. Repair of breakdowns or replacement of the equipment within 24 business hours of the notice, through a technical assistance service, comprehensive review of the concentrator and liquid oxygen equipment at least annually in specialized workshops(142).

**COMPLEX PROCESSES & PROCEDURES**

**Inpatient medical and surgical processes**

In Aragon, a standard cost of a hospitalization period is based on DRG with American weights. This tariff includes valuation and treatment planning consultation; pre-anaesthesia consultation including the preoperative study,

pharmacological treatment (including pre, peri and postoperative medication); cures; food (including parenteral and enteral nutrition); medical staff, nursing staff and auxiliary nursing staff; the use of an operating room and anaesthesia (if necessary); consumable material; possible complications that may occur throughout the entire care process; the re-interventions to be performed on the patient (provided they are related to the provision of the service and/or the procedure performed; hospitalization in a shared or single room; carrying out an anatomy-pathological study of the excused surgical pieces (if necessary)(142).

In Madrid, a public price of inpatient processes is based on DRG and it varies depending on the complexity of a process (from 1 to 4)(143). The public prices are based on GRDs. However, there is not a standard cost of a relative weight '1' as in the DRG calculation. Therefore, the public prices vary differently in each DRG(150).

In País Vasco, the cost of inpatient process is based on DRG and includes all costs incurred during the hospital stay. In the interventions where the Da Vinci robot is used, the cost of DRG will be increased by 3,302€(144).

**Day case procedures/Outpatient surgery**

In Aragon, the cost of day case procedures/outpatient surgery includes the procedure itself; the consultation of assessment and treatment planning; pre-anaesthesia consultation including the pre-operative study; pharmacological treatment required during the care; pre-, peri- and postoperative medication; cures; food (including enteral and parenteral nutrition); medical staff, nursing staff and auxiliary health personnel; use of an operating room and anaesthesia if necessary; consumable material; an anatomy-pathological study of the excised surgical pieces if required; possible complications that may occur throughout the entire care process; re-interventions to be performed on the patient if and only if they are related to the provision of the service and / or the procedure performed(142).

In Madrid, the calculation of public prices is unknown. Additionally, the laparoscopic cholecystectomy is performed on inpatients only(143).

In Galicia, the public prices includes the cost of first consultation, two follow-up consultations, the cost of the main procedure and all necessary additional diagnostic procedures(145).

In País Vasco, the cost of each day case procedure is calculated by multiplying the number of RVUs by the cost of a unit. The cost of those day case procedures that are not specifically mentioned is 448€ (medical day case procedures) or 1,195€ (surgical day case procedures). For all types of outpatient surgeries there is a unique cost 180€(144).

## SWEDEN

| | |
|---|---|
| Medicines | https://www.tlv.se/beslut/sok-i-databasen.html |
| Inpatient and outpatient | https://sodrasjukvardsregionen.se/download/regionala-priser-och-ersattningar-for-sodra-sjukvardsregionen-2020/ |
| | https://plus.rjl.se/infopage.jsf?childId=24272&nodeId=44878 |

There are several counties in Sweden, each of them has its own price list. This report contains price lists of two counties: *Södra* (Southern medical region) and *Sydöstra* (Southeast medical region).

The southern medical region is formed by 4 counties: Skåne, Blekinge, Kronoberg and Halland. Some items refer to tariffs based on DRGs (items related to inpatients and outpatients), others are tariffs based on a hospital resource use (outpatient) and some items are charged at fixed prices.

Regarding DRGs, there are two different tariffs, the one charged at the University hospital of Skåne, and the other one charged at other hospitals (Blekinge, Kronoberg and Halland). In case the patients attended at the University hospital of Skåne do not belong to the southern medical region, a tariff from the price list plus the supplement of 3.85% is charged. Other hospitals charge a supplement of 2.85% for attending patients that do not belong to the southern medical region. When DRG prices are not specified, either patient-specific prices or other pricing are applied according to the regulations. For example, 2019 prices are updated to 2020 prices using index 2020 (1.029).

The southeast medical region is formed by 3 counties: Jönköpings län, Kalmar län and Östergötland. The tariffs of all procedures performed at the University Hospital in Linköping are slightly higher than the tariffs of the procedures performed at other hospitals. The University Hospital in Linköping applies prices that are either based on DRG or according to a self-developed classification system (PBE, in the letters of its Swedish acronym). For those clinics that are reimbursed under the DRG, clinic prices with weight list according to NORD-DRG CC version 2020 (based on clinical care cases) are applied. In addition, the University Hospital in Linköping has a number of products that are charged at actual cost.

At the region's county and county hospitals, charges are primarily applied with an agreed DRG price and weight list, NORD-DRG CC version 2020 (based on clinic cases). The price per point in 2020 is 59,520 kr. For psychiatry, child psychiatry and legal psychiatry, day care allowance applies. Physician visits, other contacts in primary care and some additional care services are charged according to a special price list.

Various DRG prices should, as a rule, cover all costs. In some cases, it is obvious that drug costs are not included. There is a one-year time lag between cost calculation and its application.

**PRIMARY RESOURCES**

**Medicines**

Current pharmacy selling prices for the medicines can be found elsewhere(151). For all medicines, two different prices are available (purchase price and public price).

**Medical devices and Health products/Disposables**

No official price list for medical devices exists in Sweden. Each health care region sets out their price. In turn, a **WCD** is not financed in Sweden. A commercial price of **glucose test strips**, when purchasing at least 100 units, was 3.24 kr(152).

**Personnel costs**

The average monthly salary includes the labour cost, vacation, sick pay, overheads and social fees. Therefore, the hourly rates are obtained by dividing the total sum by 165 hours(153). There are different charging principles for **specialist** and **GPs** regarding daytime and on-call time (Supplementary Table 32).

**COMPOSITE GOODS AND SERVICES**

**Outpatient visit**

The cost of a **GP visit** depends on type of visit (face-to-face, web-based). A service is charged according to a special price list(154).

The cost of a **specialist visit** depends on the complexity of the visit (complex, not complex) and specialty (liver/bile duct, circulatory tract, endocrine metabolism, etc.). In hospital setting, the tariffs are based on DRGs(154,155).

The cost of **A&E visit** is available for the Southern health care region(155).

**Hospitalization**

The cost of **day of hospitalization at normal ward** and **at ICU** with and without physician resources used per patient hospitalization day can be found elsewhere(155).

**Image diagnosis**

The cost of image diagnosis can be found elsewhere(154,155). In turn, the cost of **CT scan** depends on part of body and on whether the CT is done with or without contrast(155).

**Laboratory tests**

Acute analysis has 50% supplement. Acute analysis from the specialist range (which is not normally performed urgently) can be ordered by special agreement with the laboratory for an additional cost 2,120 kr(156).

**Ambulance services**

There is no distinction between **intensive care ambulance** and **non-emergency patient transport**. *'Ambulans'* is only used when it is an emergency patient transport. The cost is set per kilometre. The care county council may bill the home county council the kilometre price for the entire ambulance mission, thus also the distance of travel. If the mileage is shorter than 10 km, compensation of 1,010 kr is still payable. Hourly rate of accompanying doctor and nurse is 800 kr and 425 kr, respectively. This cost is identical in Southeast medical region(154). In Southern medical region, the compensation is paid for the entire ambulance mission, that is, the return journey. The lowest compensation for ambulance transport amounts to kilometre compensation 90 kr x 20 km = 1800 kr(155).

**Diagnostic and therapeutic procedures**

The cost of **colonoscopy** is available elsewhere(154,155). The cost of acute and chronic **haemodialysis** is reimbursed per session(155). The cost of **oxygen therapy** was not provided.

**COMPLEX PROCESSES & PROCEDURES**

**Inpatient medical and surgical processes**

Regarding Southern healthcare region, the costs are slightly higher in the University Hospital of Skåne than in the Blekinge, Kronober and Halland regions(155).

The cost of **heart failure** depends on complexity (very complex, complex and not complex)(154,155).

Additionally, the cost of **hernia inguinal, femoral and umbilical** depends on complexity (complex and not complex) and age (<18, >17)(154,155).

**Day case procedures/Outpatient surgery**

The cost of **laparoscopic cholecystectomy** is only defined for inpatient and it depends on complexity (very complex, complex, not complex). The cost of not complex inpatient laparoscopic cholecystectomy may be used as an approximation of cost of the outpatient laparoscopic cholecystectomy, since after the laparoscopic cholecystectomy it is not needed to spend a night at the hospital(154,155).

The cost of cataract surgery depends on whether the surgery is bilateral or unilateral (154,155).

Further information on countries' costing methodologies can be found in Supplementary Table 5, Supplementary Table 6 and Countries where remuneration of general practitioners is mostly based on a salary: cost elements included in the contract.

# CHAPTER 3. KEY ISSUES OF COSTING METHODOLOGIES

## Part 1. Conversion of prices and costs through time

### Introduction

Costs included in an EE are often collected at different points in time and need to be adjusted to the same year (known as the "price-year") in order to make fair analysis. Prices of specific items can increase or decrease over time and omitting this adjustment can distort the final result.

We can imagine the following hypothetical scenario. The price-year chosen for the analysis is 2018 and we are interested in the costs of certain medical items. However, we do not have data for all items in 2018, but we have similar data for some previous years. A stylised representation of the problem is portrayed in Table 11, for six potential items of interest.

**Table 11. Numerical hypothetical example**

| Item or resource | 2010 | 2012 | 2014 | 2016 | 2018 |
|---|---|---|---|---|---|
| **Complex processes and interventions**: | | | | | |
| - Heart Surgery | 50 | 50 | 50 | . | 50 |
| -Appendicitis procedure | 70 | 80 | . | 90 | . |
| **Composite goods and services**: | | | | | |
| - Day of hospitalization | . | . | . | 180 | 200 |
| - Laboratory test | . | 30 | . | . | . |
| **Primary resources:** | . | | | | |
| - GP wage | 2,000 | 2,000 | 2,200 | 2,200 | 2,300 |
| Hand sanitizer | 1,300 | . | . | . | 1,300 |

*Notes: Values expressed in euros (€)*

The question is how we can infer the unobserved cost of a specific item, based on a known cost for that item at a previous moment in time. To make this adjustment, we need an appropriate price index to proxy for the (unobserved) price changes for that resource. The most common indices used in the literature to estimate the inflation rate overall in the economy or in the health sector are: (1) Consumer price index (**CPI**); (2) Gross Domestic Product (**GDP) deflator**; (3) **Specific indices of prices in the healthcare sector** (157). It should be stressed that the change in any price index is at best only a proxy or approximation for the actual price change in the specific item. By using a price index to make this adjustment, we are assuming that the (unobserved) change in the price in that specific resource is the same (in percentage terms) as the average weighted change in price for all the items included in that index. Hence we need to choose a price index that is likely to move in the same direction and with the same magnitude as the price of the

resource item we are interested in. In what follows, we will look each index in turn to understand *(a)* the main assumptions underlying each index, *(b)* how they are built/computed and *(c)* their respective advantages and disadvantages for the implementation in the cost database for each category of healthcare resource.

## Inflation Indices

### (1) CPI

The consumer price index (CPI) is an indicator of the average level of prices of goods **purchased by households** and can be used to calculate the rate at which the cost of living for households rises or falls. In the United Kingdom, the Consumer Price Index, which includes occupant homeowners' housing costs (CPIH), is considered the most comprehensive measure of inflation of goods and services purchased by households, and is used as the basis for adjustment over time of many kinds of contracts, such as regulated prices of energy, and as the basis for salary negotiations in several sectors of the economy.

The index is generally calculated monthly as a weighted average of sub-indices for different components of consumer spending, such as food, housing, footwear, clothing, medicines, where the weight is given by the participation of each consumer good in the basket of goods. It is important to emphasize that the weights are fixed, that is, the weight of each good in the index is the participation of said good in the consumption basket in the "base" year. This type of index is called the **Laspeyres index** (158). Consequently, this index does not consider potential substitution effects. To see this, suppose, for example, that in the basket of the everyday consumed goods used to calculate the CPI is included *hand sanitizer*. If, due to extreme circumstances, the availability of this good in the market drops suddenly, this will imply that (1) the price of the hand sanitizer may grow significantly, and (2) consumers may replace hand sanitizer with other similar products. However, since the weights to build the CPI are fixed to the base year, (at least for several years) this index will only reflect the increase in the price of hand sanitizer, but not the fact that consumers are substituting the good with similar products. Thus, it is likely that this index will **overestimate** the impact of the change in the prices of hand sanitizer in consumer welfare (see Appendix). This inaccuracy is sometimes referred to as *substitution bias*. The CPI consumption basket is changed periodically, but not annually.

As well as the CPI for household cost of living, there are available a number of other indices of producer and retail prices, constructed using a **Laspeyres** methodology, such as the Producer Price Index (PPI) and the Services Producer Price Index (SPPI), and the Retail Prices Index (RPI).

### (2) GDP Deflator

The GDP deflator (also called the implicit price deflator for GDP) is a measure of the average price level of all the goods and services produced domestically (that is, GDP) in an economy. It does not include imported goods. GDP is often expressed as the sum of the value of four macroeconomic expenditure aggregates:

- **C:** the consumption of *final* goods and services produced in an economy;

• **G:** goods and services provided by the government (includes wages of public workers, such as doctors and nurses, various types of health care expenses, such as the purchase of equipment and medicines, and any other goods or services produced by a government);

• **I:** business and equipment investments.

• **NE:** (net exports) the goods and services produced in the economy for being exported in other countries, less the imports.

Hence, the GDP deflator is, conceptually, the average price level of these four aggregates.

There are two main differences between the CPI and the GDP deflator. The first difference is in the items included. The CPI measures the prices of all goods and services purchased by consumers in the country with their after-tax incomes, while the GDP deflator measures the prices of all domestically produced goods and services. So the CPI includes the prices of domestically produced and imported consumer goods, but does not include the prices of capital goods, or goods provided free or subsidised by the government, or goods for export, while the GDP deflator does include the prices of domestically produced consumer goods, capital goods, government expenditure, and prices of exported goods, but does not include the prices of imported goods.

The second difference is in the methodology or the formulas used to construct the weights used in each index (see Appendix). The CPI uses weights based on the pattern of consumption in a base year. The GDP deflator allows the weights to vary from year to year with the consumption and investment patterns. This type of index is called the **Paasche index** (158). Therefore, it allows substitution effects within the economy each year which are not accounted for in the CPI. As before, let us take as example the increase in price of hand sanitizer. Since the weights of the GDP deflator can change freely from year to year, the GDP deflator will not suffer a substitution bias and will detect that people are switching consumption from one good to others. However, it is worth mentioning that this measure potentially underestimates inflation as it does not consider the potential loss of consumer welfare that occurs because consumers are "induced" to give up their originally preferred good because of the higher price.

## (3) Specific indexes on health expenditure

In the HCSCD database, we are specifically interested in changes in prices of healthcare goods and services, and not interested directly in changes in the prices of other goods and services. Hence, to estimate changes in prices of some kinds of healthcare resources, there may be reasons to prefer a healthcare specific price index, rather than a general price index such as the CPI or GDP deflator.

In this case, two potential measures are available: (3.1) a specific index for the inputs to the domestic health sector and (3.2) the health component of the CPI. Below, we describe each measure in detail.

**(3.1) A specific price index for the inputs to the domestic health sector**

The United Kingdom is an example of a country which regularly publishes such an index, along with the supporting methodology. As reported by Curtis and Burns (2019) (159), until 2016/2017, the National Health System (NHS) estimated and used an index called Hospital & Community Health Services (HCHS). It was produced by the Department of Health to provide a measure of inflation specific to the input costs faced by the NHS as the health component of the GDP deflator. This index was a weighted average of two separate inflation indices: (1) the pay index, calculated using the NHS annual wage increase, and (2) the health service cost index, which measured the change of price for each of the 40 sub-indices of goods and services. These were weighted according to the proportion of expenditure on wages and prices to give the overall HCHS wage and price index.

However, in 2016, this index was discontinued and has now been replaced by the NHS Inflation Index (NHSCII) created by the Department of Health and Social Care, in conjunction with the Office of National Statistics that has worked with the NHS and the University York. The NHSCII identifies an appropriate inflation measure for each item of expenditure in six broad categories: NHS providers, general practice, prescription, dentistry, ophthalmology, and residual, to create a general inflation measure for the NHS. Similarly to the GDP deflator, the NHSCII is calculated according to the formula of the **Paasche index**.

It is worth noting that the NHSCII methodology uses a range of different sources of information about the prices of NHS inputs to construct the price index (Table 12).

**Table 12. Data sources for the NHSCII**

| Resource | Data source |
|---|---|
| Clinical supplies, drug costs and parts of depreciation costs | The relevant sub-components of the Producer Price Index (PPI) |
| Parts of general supplies and services | The relevant sub-components of the Services Producer Price Index (SPPI) |
| Parts of premises costs | The housing sub-component of the Consumer Prices Index (CPI) |
| Parts of premises costs and parts of depreciation costs | The relevant sub-components of the Construction Output Price Indices |
| Non-employee staffing costs, such as research and development, and consultancy costs | The Average Weekly Earnings index |
| Private finance initiative costs | Retail Prices Index |

*Source: Office for National Statistics (ONS), 2020* (160)

### (3.2) The health component of CPI

Another healthcare prices index is the health component of the CPI, which captures the household spending on the sub-category of health-related goods and services. It is important to note that this only includes the prices of healthcare goods and services purchased by the household. The expenditure on goods and services that are provided by the

government and, hence, free or subsidised for the household at the point of use (i.e. *social transfers in kind*) will not be included in the CPI-Health sub- index.

The methodology for calculating the CPI-Health and its sub components is reasonably harmonised across countries. As reported by the International Labour Organisation (ILO) guidelines (2014), the CPI-Health sub-index consists of three main specific elements:

(1) Medical devices and equipment:
(2) Outpatient services:
(3) Hospitalization services, excluding the services of retirement homes for elderly persons, institutions for disabled persons and rehabilitation centres providing primarily long-term support.

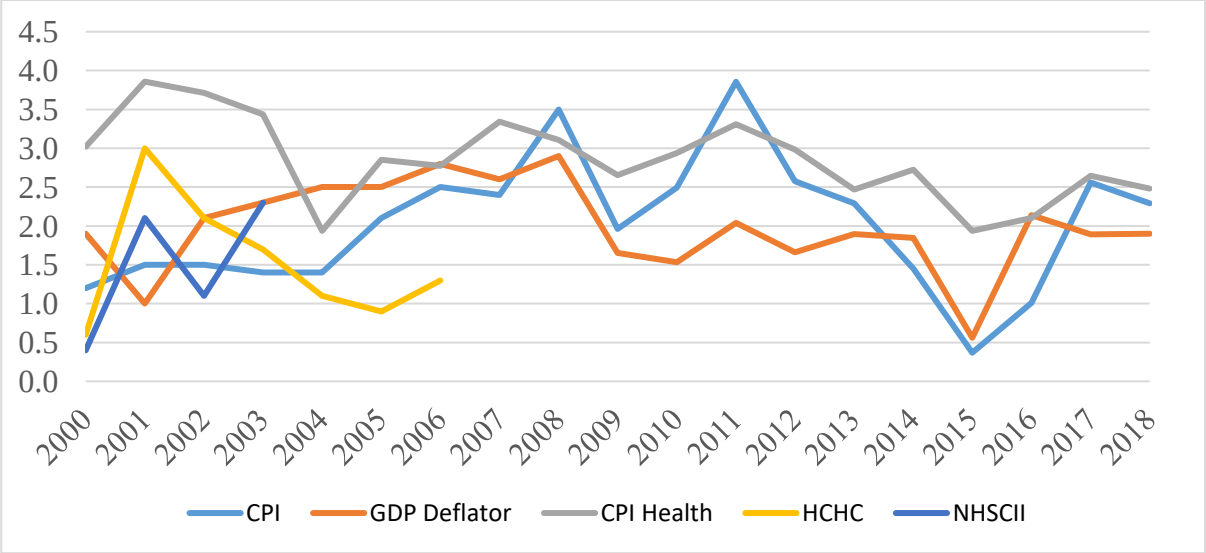
## Comparison of annual estimated rate of inflation calculated from each price index

It is worthwhile examining the extent to which different indices more in the same general trend, and the degree of volatility in these time series. Table 13 and Figure 1 and Figure 2 present a comparison of the inflation rates calculated from the indices explained above.

**Table 13. Annual estimated rate of inflation calculated from each price index, UK.**

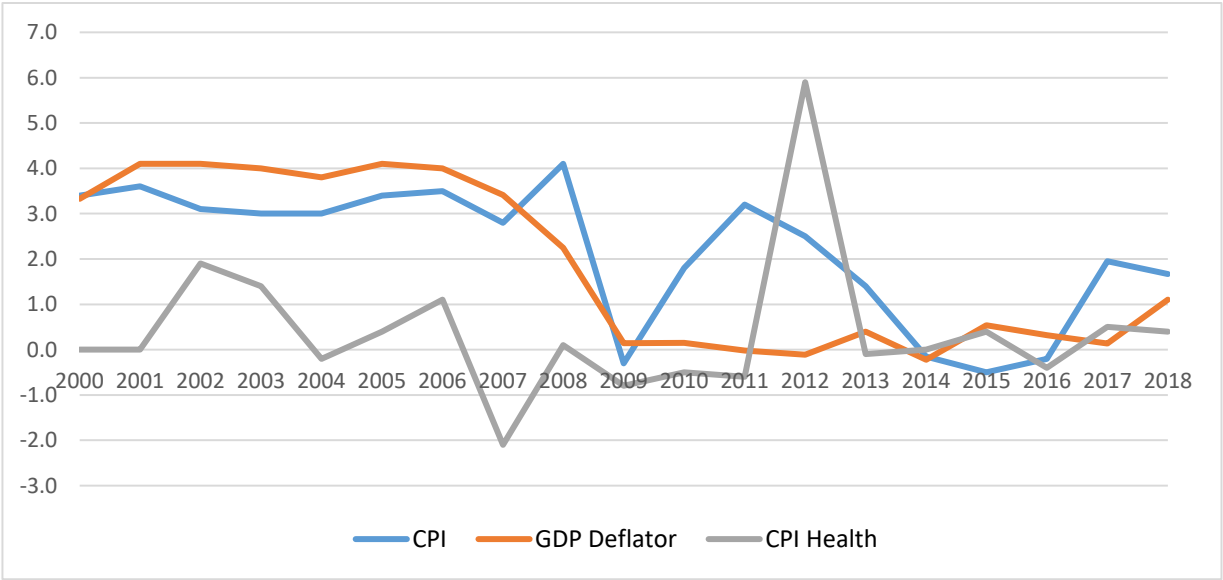
| Year | CPI | GDP Deflator | CPI Health | HCHC | NHSCII |
|---|---|---|---|---|---|
| 2000 | 1.2 | 1.9 | 3.0 | | |
| 2001 | 1.5 | 1.0 | 3.9 | | |
| 2002 | 1.5 | 2.1 | 3.7 | | |
| 2003 | 1.4 | 2.3 | 3.4 | | |
| 2004 | 1.4 | 2.5 | 1.9 | | |
| 2005 | 2.1 | 2.5 | 2.9 | | |
| 2006 | 2.5 | 2.8 | 2.8 | | |
| 2007 | 2.4 | 2.6 | 3.3 | | |
| 2008 | 3.5 | 2.9 | 3.1 | | |
| 2009 | 2.0 | 1.7 | 2.7 | 0.6 | |
| 2010 | 2.5 | 1.5 | 2.9 | 3.0 | |
| 2011 | 3.9 | 2.0 | 3.3 | 2.1 | |
| 2012 | 2.6 | 1.7 | 3.0 | 1.7 | |
| 2013 | 2.3 | 1.9 | 2.5 | 1.1 | |
| 2014 | 1.5 | 1.8 | 2.7 | 0.9 | |
| 2015 | 0.4 | 0.6 | 1.9 | 1.3 | 0.4 |
| 2016 | 1.0 | 2.1 | 2.1 | | 2.1 |
| 2017 | 2.6 | 1.9 | 2.6 | | 1.1 |
| 2018 | 2.3 | 1.9 | 2.5 | | 2.3 |

**Figure 1. Inflation indices over time, UK.**




*Notes: The figure compares inflation rates calculated from various price indices in the UK over the period 2000-2018. Specifically, it is included the Consumer Price Index (CPI), the Gross Domestic Product (GDP) deflator, the health component of the CPI (CPI Health), the Hospital & Community Health Services (HCHS), and the NHS cost of inflation index (NHSCII).*

**Figure 2. Inflation indices for Spain**




*Notes: The figure compares inflation rates calculated from various price indices in Spain over the period 2000-2018. Specifically, it is included the Consumer Price Index (CPI), the Gross Domestic Product (GDP) deflator, the health component of the CPI (CPI Health).*

Due to the method of construction noted above, Laspeyres indices, such as the CPI, will tend to over-estimate inflation, while Paasche indices, such as the GDP deflator, will tend to under-estimate inflation, though this should not be interpreted to mean that the CPI will always be greater than the GDP deflator, as they measure prices of different items. Our data for UK and Spain (figure 1 and 2) also seem to indicate that the CPI is possibly more volatile than the GDP

deflator. Furthermore, as a general rule, sub-components of indices are likely to be more volatile than the full price index, as there are fewer items in their construction (so a large price change in one item will have a greater influence on the sub-component index than the overall index). This can be seen, for example, in Figure 2 where the CPI health for Spain spiked in 2012, reaching 5.9%, as a consequence of an introduction of a new pharmaceutical co-payment, which forced millions of users of the public health system to pay more out of pocket for medicines (161). Figure 2 shows that this spike in the price paid by consumers for medicines did not increase the overall inflation rates as measured by CPI and GDP deflator.

See Appendix for further information.

## Recommendations in the literature

In 2003, the WHO-CHOICE guide to cost-effectiveness analysis noted:

*"The most appropriate inflationary measure for adjusting costs for CEA is the one which reflects most closely the general price level of the **resources used to produce health interventions**. This would probably be the health component of the GDP deflator, but this is available in only a few countries. Therefore, we recommend using the GDP deflator. If no GDP deflator is available for a country, the CPI can be used as the second best alternative."*

Kumaranayake (2000) is the main reference of the WHO recommendation (162). In this paper, Kumaranayake presents step-by-step tutorial on how to (and how not to) deflate or inflate. In the paper, he references the World Bank report (1999) (163), which also suggest to use the GDP deflator, as opposed to the CPI that exclusively focuses on privately purchased consumption goods. The GDP deflator is the broadest measure of inflation as accounts for private consumption, for government spending, and investment in private and public capital goods.

It should be noted that the construction of the GDP deflator for healthcare (and for government services in general) is not straightforward, as it requires an estimate to be made of the productivity of healthcare (that is, the real output as a function of inputs). Measuring nominal expenditure on healthcare is relatively uncomplicated, but disentangling price changes can only be approximately disentangled from activity changes and changes in the effectiveness of healthcare interventions (164).

The Canadian Guidelines on Costing stated, in the chapter related to inflation, that "As price levels change over time, it is necessary to adjust all prices to a given time period". There are two price indexes that have been used — the general consumer price index (CPI) for health and personal care products and the general CPI for all goods and services. The use of general CPI for all items is recommended, as the CPI for health and personal services is confined to marketed pharmaceuticals and health products (toothpaste, shampoo). There is no health care CPI that incorporates physician and hospital services. 46 We therefore suggest using the general CPI as a deflator. This data by province or at the national level is available from the Statistics Canada website (www.statcan.ca) or nationally from the Bank of Canada website (http://www.bankofcanada.ca/rates/related/inflation-calculator/).

In the Australian Guidelines for Economic Evaluation stated that "If using historical estimates of costs, detail the information sources and the methods used to estimate them. Justify the use of the historical cost source as relevant and the best estimate available. Use the most relevant Australian price index (e.g. total health and health industry–specific price indexes published by the Australian Institute of Health and Welfare) to adjust for inflation and estimate current prices. Value future costs at current prices (e.g. do not allow for future inflation in the calculations), consistent with using constant prices in the economic evaluation".

## Discussion and recommendations

The objective that of this study is to examine appropriate indices to impute a price or cost for a specific healthcare resource in a specific price-year, where data on that price or cost are unavailable or unobserved for that specific moment in time, but instead price or cost data are available for an earlier moment in time. In this case, it seems reasonable to state that the general rule should be to use a proxy index which most closely reflects the expected change in the price or cost in that specific type of resource.

The WHO guide to cost-effectiveness analysis (2003) recommendation to use the health component of the GDP deflator seems reasonable for updating the costs of composite healthcare services (such as hospital procedures) that are a combined use of healthcare staff, capital goods, consumables and so on (165). Such an index has two advantages: first, it reflects the costs of the same types of resources as are used to provide hospital procedures (including investment goods), and second, it is constructed as a **Paasche index,** which might be important in an innovative, capital intensive sector where technology is frequently updated. In the UK, the NHSCII is an example of a price index with these properties.

The health component of the GDP deflator is itself a composite index, constructed as a weighted average of prices of pay and non-pay items, for example following the NHSCII methodology set out in Table 12. Therefore, if such data are available, analysts could consider using the sub-components of the health component of the GDP deflator to adjust the prices or costs of specific HCSCD database items. For example, for clinical supplies, the appropriate index could be the relevant sub-component of the Producer Price Index, or for services provided to the NHS, the appropriate index could be the relevant sub-component of the Services Producer Price Index, and so on.

It may be that not all countries publish the health component of the GDP deflator, or the sub-components. The WHO-CHOICE guide recommended the overall GDP deflator in this case. Whether this general macro-economic price index adequately tracks the trend in specific healthcare costs and prices is an empirical question that may be specific to each country, sector and possibly the economic cycle.

The CPI is designed as an index of prices for goods and services consumed by households. Although it is not as generally appropriate for updating prices or costs of public-sector provided healthcare as the health component of the GDP deflator, there may exist certain categories of healthcare goods and services whose prices are likely to move in the same trend as those of goods and services consumed by households. One example might be over-the-counter medicines available in community pharmacies. Another example may be the salaries of certain grades of public sector workers, if these are contractually linked to the CPI either formally by collective bargaining, or implicitly by market forces.

The CPI health sub-index may have limited usefulness for updating the prices of items in EE of interventions provided in the public healthcare system. An example where it might be useful is to estimate the update the prices of specific resources in markets where the NHS buys goods and services at approximately the same prices as private consumers. Examples might be specific categories of orthopaedic equipment or devices.

# Part 2. Unit cost database vs. Standard cost list

## Introduction

The EU HCSCD is likely to have several positive effects on the cross-border collaboration and on the efficiency of EE in the EU. The main advantage is simply providing data on unit costs for EE (even if conducted for 1 country). Additional, analysts will find it easier to undertake multi-country studies and to transfer studies done in a certain country to other EU countries and may promote development of costing methodology and exchange of best practice between countries.

The reason for that is that the EU HCSCD 1) promotes the standardisation of health care resources concepts and terms in all countries, and 2) provides a repository of monetary values for each resource.

A first version of the EU HCSCD is already available: the structure is functional and operative, although it could certainly be refined and improved, specially when analysts start using it and give feedback, identify potential bugs and suggest improvements.

The amount of information included in the database is, however, still limited, in relation to the potential needs of HEE analyses, to existing information that could be mined, and to other existing databases. The database might grow in two dimensions: 1) the number of resource items, and 2) the number of registered observations for each item in each country or jurisdiction.

A limited set of relevant resource items was agreed in consensus with the other members of the project team in order to set up the first, present version of the database and it will probably be enlarged, if the database is continued in the future.

## Examples of Standard (unit) Costs Lists for HEE.

A number of countries have developed standard cost lists to help standardize their EEs. The first countries that applied HEE analysis in the early 1990's to inform reimbursement decisions of pharmaceuticals and other health technologies were Australia and Canada. These two countries were also the first to formally establish methodological guidelines for HEE (Australia in 1993 and Canada in 1994) that had to be followed by parties submitting requests for reimbursement of new pharmaceuticals by the public health system.

Jacobs et al. (166) tried "to categorise the current recommendations for the analysis of costs within an economic evaluation, and to use these categories to assess variations in guidelines." They defined five categories: General design items, Resource identification and classification, Resource measurement, Resource valuation and Overall reporting.

Resource valuation –also called, unit costs estimation– addresses the issue of how to assign monetary values to the units of resources required or used by in an intervention. This category of procedures take the form of costing rules or

cost accounting norms aimed at assigning the monetary value of a process to units of resources, outputs and outcomes. The guideline setting body can either stop at this point and let each analysts calculate; a second –sometimes complementary– option is to produce an actual Costs Lists that present standard or average values, i.e. representative costs for a given jurisdiction.

Australia and Canada were also the first countries to establish Standard Costs Lists: Australia developed a single national list, whereas Canada issued several provincial lists. In the EU, only three countries have a Standard Costs Lists, or similar documents: the UK, the Netherlands and Germany. Finally, the WHO-CHOICE program developed some unit cost information to support CEA mainly aimed at identifying priorities and to estimate the global cost of publicly financed health benefits packages for middle and low-income countries.

With regard to valuation of resources (Unit Costs) most guidelines recommended from a conceptual point of view "opportunity costs", and five guidelines (Australian, Canadian, Dutch, Scottish and NICE) recommended the use of standard costs. Standard cost list were provided in conjunction with the Dutch and Australian guidelines. Some guidelines reviewed and recommended costing methods and data sources that analysts should turn to, such as physician tariffs and hospital financial data.

**Australia**

As from 1993 the Commonwealth Department of Health, Housing and Community Services (DHHCS) requires submissions to the Pharmaceutical Benefits Advisory Committee (PBAC) for the listing of a new Drug on the Pharmaceuticals Benefits Scheme (PBS) to incorporate a clinical as well as an EE, which must follow the available guidelines.

In August 1992 a Manual of Resource Items and their Associated Costs for use in submissions to the PBAC involving economic analyses (167) was later developed as a complement of the Guidelines, in order to ensure consistency and comparability. The Manual included definitions and descriptions and some methodological recommendations, as well as several sub-lists of resource items with their monetary values attached. The largest list – Appendix 1. Hospital Services, Inpatient Services Cost per DRG – included 471 items. For some other categories of items – Visits to out-patient clinics (9 items), Nursing home accommodation per week (6 levels) and Consultation of by allied health professional (8 types) – dollar costs were also provided.

The Manual has been updated several times. The most recent Version 5.0 was published in 2016 (168) This version does not include an explicit list of resource items with their respective unit values, but it redirects the user to the originals sources by means of hyperlinks to the various categories of resources.

**Canada**

The Guidelines were first published in 1994 and, as stated in the foreword: "The fourth edition of the Guidelines for the Economic Evaluation of Health Technologies: Canada follows publications in November 1994 (first edition), October 1997 (second edition), and March 2006 (third edition)(169). The fourth edition reflects the experience gained through using the previous editions, and takes into account the methodological advancements that have occurred in the EE of

health technologies since 2006 (170). The Canadian EE Guidelines tried to be rather flexible from the beginning in order not to restrict the creativity and innovation of the analysts.

The first document with specific guidance for costing appeared in 1996 (171) and has been recently updated in 2015 (172). The present version contains only detailed information, and methodological advice, as well as links to the adequate sources of cost information at provincial level, a normal feature in a federal state. In the past, however, standard cost list were produced for some Canadian provinces (173,174).

The Alberta cost list states "There is a need for a list of standard costs for health care services, for use in EE studies in Alberta". Its use serves to reduce to reduce the variability in study results which are due to differences in unit prices and costs used by investigators (174).

The Manitoba cost list also describes how the information can be used: "When the cost list is used in conjunction with such utilization data, investigators can conduct studies for the general population and for particular groups (such as individuals with specific diseases). The cost list can also be used to allow investigators to compare the costs of specific interventions. Since the scope of this list is province-wide, the estimates that are made using this cost list will add to the generalizability of the studies, more so than if the costs were obtained for a single facility. The use of this cost list is not appropriate in areas such as funding, budgeting, or comparing facilities. For some evaluations, a detailed 'micro-costing' technique may be more appropriate. However, where standard or average costs are needed, this cost list permits investigators to conduct studies that have realistic, generalizable results" (173).

The resources in the two list were not standardised, therefore the cost were not comparable. Later a new publication was set up, that tried to attain a global provincial view (175). Jacobs and Roos (1999) discussed this topic as well in an academic publication (176).

Other relevant documents related to costing and standard unit costs are the Guidance Document for the Costing of Health Care Resources in the Canadian Setting (177) and the Canadian Patient Cost Database Technical Document MIS Patient Costing Methodology (178).

**United Kingdom**

The reference source for unit costs for EE in health and social care is a project led by the Personal and Social Services Research Unit (PSSRU), University of Kent that started in 1992. It is basically funded by the Department of Health and Social Care, with a minor contribution from the Department of Education. The flagship piece of work of the project is the annual report. The most recent issue is Unit Costs of Health and Social Care 2018 (32). Annual reports can be downloaded as pdf from the website since 2003.

Its main function is to generate a source of unit costs. Unit cost is defined as the cost of an unit of output and the basic approach is to estimate it as long-run marginal opportunity cost, based on existing studies and on new studies that carry out internally or that they commission to external researchers. They work in close collaboration to the NICE, among other institutions. The project has a website and has recently developed a repository of studies among other web-based

resources, such as data spreadsheets. The website contains a very useful introductory video presentation[1]**The Netherlands**

In 2000, the first "Dutch Manual for Costing: Methods and Reference Prices for Economic Evaluations in Healthcare" was published, followed by an updated version in 2004. The purpose of the Manual is to facilitate the implementation and assessment of costing studies in EEs.

A new and revised version was published in 2010, according to the guidelines on pharmacoeconomic evaluation issued by the Dutch Health Insurance Board and approved by the Ministry of Health, Welfare, and Sport (179).

An IQWiG report notes that preferred methods predominantly depend on a country's specific context, and in the Netherlands, for example, "hospital costs (cost per inpatient day, differentiated between general and teaching hospitals), visits to general practitioners and specialists (costs per visit), valuation of medical staff time, costs of paid work (including friction period), costs of housework and travel costs are set and used throughout all health EEs."(11).

The Dutch Manual is very comprehensive and recommendations are based on theoretical reasons, but it also has a practical approach, as it provides standard costs that can easily be applied to EEs. It categorises costs in various groups:

Direct health care costs: Hospital stays, Out-patient visits, Daily costs of medical treatments, Lab tests, Diagnostic imaging, Surgical interventions, Haematological products, Medicines, Specialist visit, PHC visit, Residential services for the elderly, Home visits, Mental health care, Physiotherapy and rehabilitation.

Direct non-health care costs: Ambulance, Transportation, Time cost of patients, Other costs.

Indirect non-health care costs: Lost production, Unpaid work, Other costs

**Germany**

In Germany, the document of reference regarding costing methodology for EE in health care is Institute for Quality and Efficiency in Health Care (IQWiG) Working Paper Cost Estimation Version 1.0 – 19/11/2009 (11). This report discusses the justification and potential use of a Standard Cost List: "From a societal perspective, it is possible to calculate standard costs in resource valuation particularly for inpatient costs and outpatient consultations. Inpatient costs include running costs (financed by SHI or private health insurance) and capital user costs (financed by the federal states). Capital user costs are modelled based on investment costs for new hospitals, assumptions about life span and utilization rates of equipment/buildings as well as assumptions about the appropriate interest rate. Costs per outpatient consultation are a weighted average of SHI and private insurance costs (with higher reimbursement in private health insurance). The calculation is based on the assumption that, on average, a physician earns a fair income (compared to other professions)".

[1] https://youtu.be/rrUMj3_ZN8Q

Although the IQWiG Working Paper does not provide unit costs, it refers readers to the consensus proposal which addresses a set of methodological issues on costing health care resources and provides as well a set of standard costs figures for the most relevant health services and resources (82 items) (180).

**Thailand**

Thailand is one of the few middle-income countries for which there is evidence that it has developed a Standard Costs List for HEE. HEE is a standard tool regularly used in Thailand for decisions regarding the inclusion of a new drug on the national list of essential drugs and a new treatment regimen on the national health insurance benefit package. In 2008, the Health Intervention and Technology Assessment Program (HITAP) of the Ministry of Public Health developed National HTA Guidelines (181), which included a chapter on measurement of costs also published as a journal article (182).

The author summarised the process for developing the guidelines in the article: "Analysis was undertaken to generate a set of standard costs for medical services and those incurred by patient receiving treatment, for use in health EEs. Medical service unit cost data were derived from a survey of 3,091 hospital medical services in five hospitals, disaggregated by type of hospital (district or provincial/regional) and analysed using the relative value unit method. Patient-borne ambulatory cost values were derived from data gathered through 905 patient interviews that took place in six health centers, three district hospitals, and three provincial/regional hospitals. The survey gathered data on costs rising from the distance travelled to access the medical service, the time spent in the healthcare facility, as well as travel and meal costs. The analysis generated a set of standard cost data for Thailand that will make conducting EEs more accurate, faster and more convenient, as well as allowing better comparability between studies. This is the first standard cost menu that has been developed specifically for Thailand, and as such should be revised and refined in the future." A very detailed description and justification of the process, methodology and results of the project is provided in the article (182).

## WHO-CHOICE project

WHO-CHOICE is a WHO program aiming at promoting cost-effectiveness analysis and strategic planning, mainly focused on setting priorities for public financing of universal coverage benefit packages for in low and middle-income countries. The program has produced methodological analysis and guidance in cost-effectiveness analysis (165) and has supported policy country studies. As part of its work it generated a repository of information on estimated regional costs and prices, which can be accessed at its website: Tables of Costs and Prices used in WHO-CHOICE Analysis https://www.who.int/choice/costs/en/ which leads to tables listing prices and other relevant information for cost analysis:

*Country-specific unit costs:* Unit cost values for primary and secondary health care services in each member state, expressed both in international dollars and local currency units, have been estimated and updated to the years 2007 and 2008.

*Prices of programme cost inputs:* Tables listing the ingredients and prices for local (non-traded) goods used in estimating programme costs. Prices are listed for each of the 14 GBD regions.

Besides the former data repositories the menu displays some methodological and supplementary information:

*Assumptions on Resource Consumption:* Tables listing the standardised list of assumptions on resource use for programme costs of health interventions.

*Price Multiplier for Different Coverage Levels:* A table listing the costs of shipping and handling for traded goods for different levels of population coverage.

*Prices for Traded Items:* Tables listing the prices used for tradable goods. These items are used in estimating programme costs.

*Useful Life*: Tables listing the useful lives of capital items. These items are used in estimating programme costs.

*Purchasing Power Parity:* A table listing the purchasing power parity exchange rate for member states of WHO

*Cost-effectiveness threshold values:* A table showing the values in each WHO sub-region that are used to denote whether an intervention is highly cost-effective, cost-effective or not cost-effective.

The work on data collection and econometric analysis to provide cost data estimates has been made available in peer reviewed publications (183–185).

## Other useful sources of information, experiences and projects on unit costs for HEE:

ISPOR (International Society for Pharmacoeconomics and Outcomes Research) maintains in its website a repository of "Pharmacoeconomic Guidelines Around The World" (186) which provides hyperlinks to unit cost related documents in 44 countries. It also provides a comparative table of 33 guideline key features. Two features directly relate to our topic: 16) costs to be included, and 17) source of costs, which might updated references to national Standard Costs Lists and similar tools.

Base de Datos de Costes Sanitarios (BDCS) Soikos[2] was a private database that operated between 1998 and 2005. It contained 19,900 observations (values/unit costs) of over 2,000 resource items for Spain, obtained from multiple sources, 558 in the 2004 version.

The EC DGXII funded NEVALAT project (2001-2004) promoted the use of analytical tools for improving the use of HEE in Latin American countries; this included national unit costs databases. Two of the LA participating teams, Argentina and Cuba, started in this context their own national databases.

[2] Gisbert R, Brosa M. Costes sanitarios y evaluación económica. Barcelona: SOIKOS, S.L., 1998

Hutton (2001) reports a private project "Unit Costs for Multi-Country Economic Evaluations" launched in 1998, which tried to collect and collate cost data from public accessible sources from seven countries US, UK, France, Germany, Italy, Spain and Sweden and five broad disease areas (Oncology, Cardiovascular, Infectious diseases, Psychiatric diseases and Neurology). The initiative was funded by MEDTAP and a group of pharmaceutical companies. "The aim was to produce data suitable for micro-costing exercises (based on trials or models) that adopted the "bottom-up" approach of aggregating observed or estimated resource use. Costs based on procedures, episodes of care or case-mix groups are rarely sufficiently disaggregated for this purpose. Consequently, many of the official costs lists produced by European governments and health financing agencies do not meet the need." (187).

Finally, some papers published in peer-reviewed journals as well as quotations and documents in the grey literature suggest that additional standard costs lists and similar tools might exist, but it is difficult to identify their existence and how to access them and to assess its quality and the level of actual utilisation.

## Discussion

The main justification of setting up Standard Costs Lists for HEE according to IQWiG (2009) is "To improve comparability of health EEs, standardization of costing methods is recommended, including the development of standard cost lists that supplement guidelines for health EE. Standard cost lists present average valuations for commonly used services and resources." (11)

During the present IMPACT-HTA project, the WP3 database has evolved from a proof-of-concept to an operational stage. Therefore, it was not considered a priority to identify and collect observations a large volume of data (i.e. monetary costs/values) from multiple institutions or settings. It was considered sufficient at that stage to concentrate in the methodological aspects and to identify at least one observation for each item and country, in order to understand and clarify how the figure concerned had been computed.

However, it seems obvious that a single observation for each resource item, taken at a concrete institution, might not be representative of the respective country or jurisdiction. In fact, costs and prices of goods and services normally vary continuously across markets and along time and records of monetary magnitudes are usually an aggregate of observations made at different sites of a certain jurisdiction, during a defined time period. Several well-known medicine prices databases (Brazil, WHO-Geneva, CHOICE, among others) do follow that logic. The users of the databases based on this approach are sometimes able to decide by themselves how to compute the aggregate figures from the data, or might be able to take a standard value offered by the database program, which is semi-automatically computed by an algorithm incorporated in the database.

From an academic researcher perspective it might seem more desirable to let the user/analyst have access to all available observations of all the resource items required to cost an intervention being evaluated, and allow him/her select the observations, remove outliers, and compute according to his/her technical judgement some parameters as representative values of the data distribution: mean, median, standard deviation, etc.

Two drawbacks of the former approach are: a) the process might be very time consuming for the analyst, compared with having a the representative single values per resource item more readily available; b) there is a risk of analyst bias in selecting and computing the representative values for a resource item. For instance, if the analyst is "interested" in "ending" with a favourable ICER for a new technology evaluated, s/he might be nudged to select the observations and representative values that leads to a high cost for the alternative, the comparator intervention. The problem is worsened by the fact that HEE analyses often have important financial implications: according to the results, a new technology can receive a higher price or be included in the list of benefits of a health insurer: Large amounts of money and profits might be at stake. The resulting implications and associated conflicts of interest provide a potential incentive for intentional biases. Of course, this is not a problem right now for the EU HCCD, because the database does not include yet multiple observations per resource item, but it is likely to be so in the future.

It would be therefore advisable to include this type of considerations and capacities in the database program development and user manual. For instance, when searching for the unit cost of a certain resource item, the database might, by default, provide the standard cost, computed as the median, and the number of observations. On demand, the program could display a larger set of parameters: the mean, the standard deviation, and the outliers (defined, for instance, as values beyond two standard deviations).

The analyst might be expected to use the median as the standard value for the base case and be allowed to introduce other options in the sensitivity analysis or in secondary analyses. Of course, in some jurisdictions, the authorities may want to define their own methodological norms on the issues discussed above, for instance, whether to use the mean or the median, when computing the standard value for each resource item.

The standard cost list must not necessarily be the same for the whole country. In federal or decentralised states, the regions or relevant jurisdictions might be responsible for managing the health system and, by extension to calculate their own Standard Costs Lists based on local costs.

# Part 3. Transferring economic evaluation models across countries and jurisdictions

## Introduction

The main purpose of the **European health care and social costs database** is to facilitate the design and implementation of multi-country health EE analyses, as well as the transference of HEE analyses originally carried out in a given EU Member State (EUMS) to other EUMS. EE analyses are time consuming exercises and require human resources of high technical skills, which may not be available in some settings (188). The expected benefits of transferring HEE analysis are a more efficient use of expert capacity and a quicker availability of HEE results across EU countries, because transferring analysis will reduce the cost of fully carrying out the analysis in each country that might need it for decision making (189).

EE analyses, like other forms of HTA, must be contextualised, which means that it has to take into account the conditions of the country, jurisdiction or setting where the technology must be applied. However, the underlying assumption that allows to transfer EE analyses is that some components of the EE can be applicable to multiple settings (190). For instance, the evidence of efficacy and effectiveness derived from clinical trials and other types of research, is normally assumed to be applicable to real practice (external validity), even if some adjustments may be required (191). It is usually assumed as well, that the results of clinical experiments carried out in a certain jurisdiction are in principle valid for populations in other settings. This is indeed the implicit assumption of many national Drug Regulatory Agencies (DRA) when they grant market authorisation to new technologies on the basis of clinical trials carried out elsewhere.

The core component of an EE analysis often is a mathematical model that represents the relevant course of a disease under two or more health interventions. It seems therefore acceptable that the health outcomes and sometimes the health resource utilisation of the interventions assessed might be validly computed in different settings by a single (the same) epidemiologic-clinical model. These assumptions can anyway not be taken for granted, and the models and assumptions should be ideally validated.

As far as costs are concerned, transferability requires analysing separately units of resources and unit monetary values (price or cost) of the resource (191). The amount of units of each health care resource used in interventions carried out in two or more setting will be equivalent mainly depending on whether medical technologies and practices are the same or not so in each setting. When an EE analyses a new technology, the intervention is likely to follow a standardised protocol across EU countries and hence to use the same units of resources. The relevant comparator is however less likely to be the same across countries, which would strongly reduce the feasibility of transferring the original core analysis to other countries(192). Moreover, the units of resources used across settings, might easily differ. In the original study country, the comparator (usual care) may consist in one PHC visit, while in the target country; usual care may mean three visits. Therefore, number of resource units is something that must be customized to the target setting when transferring an EE study.

However, even in the case that the most favourable conditions of resource use comparability between study settings hold, the likelihood that unit prices of health care resources are equivalent or similar between settings might not hold. In that situation – equal or similarly enough health intervention processes between countries – the unit costs/prices of the original study should be replaced by the respective unit costs/prices in the local setting where the core of the original study is to be applied (191).

The objective of this chapter is to review the problem of transferability in EE of health technologies, focusing on the transferability of the resource use and cost in EE.

## Methodology

A narrative literature review was performed to identify studies that addressed the topic of transferability in EE of health technologies, focusing on the transferability of the resource use and cost in EE. The search was conducted in February 2020 in MedLine Web of science database and Google scholar. In addition, selected sources of gray literature were searched. To execute the review, the following terms were used: “transferability”, “generalizability” combined with terms about health care cost and economic evaluation (“economic evaluation” “cost-effectiveness analysis”,” cost-benefit analysis” “health care cost” “cost analysis”) and other terms about tools and guidelines (“tools”, “toolkit” “guidelines”, check lists”). Additionally, citation tracking in Google Scholar was used as well as a manual search of the reference lists of included studies. The search was restricted to the last 15 years and for studies published in Spanish and English.

Studies have been selected that specifically address the transferability in the EE of health technologies, and especially the articles that address the transferability of costs. In addition, studies that have analyzed / assessed the transferability of costs in EE in specific procedures. All manuscripts identified and included in this review have been assessed by two of the authors of this report, for evaluation and extraction of the information to be included in the review.

## Results

### How is transferability defined in the literature?

In our review of the literature we found some confusion in the use of some terms that relate to the (re)utilization of an empirical study or analysis in a different setting or context of the original one where the study was carried out or where the results were intended to apply.

In the context of clinical research, there is a clear distinction between “internal validity” and “external validity”. The efficacy of a technology or intervention refers to the effects on a target variable, measured in an experimental setting, whereas effectiveness refers to the effects of the same technology or intervention in real medical practice. Efficacy is generally assumed to be larger than effectiveness because the former takes place in a controlled, ideal environment and under highly favorable conditions for the technology to achieve the intended effects. However, in actual practice

patients cannot be accurately selected according to the criteria of the experiment protocols; additionally, they might not be equally well diagnosed and followed; therefore adherence and compliance with the intended treatment tends to be lower in comparison to the experimental setting, where patients are followed and controlled to comply with the criteria of the protocol. Manuals and Guidelines for HEE usually recommend that efficacy data from clinical trials must be appropriately adjusted to real practice conditions in order to not overstate the effectiveness of an intervention, the relevant concept for a decision maker in assigning resources (193).

A similar problem arises when one considers whether the results or implications of a healthcare study intended for a given setting or jurisdiction, may apply or be used at a different setting or jurisdiction. Authors refer to this problem as a question as a matter of "transferability" and "generalizability". These terms used by many authors as synonymous or equivalent and related to external validity (194–196). Other authors, however, assign different meaning to the said terms.

For instance, according to Walker et al. (197), transferability is "the ability *to extrapolate results obtained from one setting or context to another", but* differentiates between the potential (or generic) transferability of a study and its actual (or specific) transferability to another policy or practice decision context at another time and place. Potential transferability hinges especially on how fully the intervention has been described, how comprehensively the implementation context is described and which patient or participant groups were selected for exposure to the intervention. This allows practitioners or policy makers elsewhere to assess whether the choice of options they face, and their target populations and organisational contexts, are similar. The important thing to note is that this type of transferability is a property of the particular study, what it has evaluated and how fully it has been described. In contrast, actual transferability assesses the same phenomena described above, but in relation to a particular decision or policy choice in a particular jurisdiction, population and health system. In that sense, it is a property of the original program, study and setting, and the population, setting and potential constraints on program design and funding in the place where the same program may be applied. Therefore, it cannot be a property of an individual study and evaluated program, but will change depending on where you want to transfer the evidence to and when.

Generalizability of results is defined as being 'similar to external validity in that it refers to the extent to which information (both clinical and economic) can be extrapolated to either a patient group with different characteristics or to a similar patient group treated in a different geographic, political or time structure'. A similar position is held by Sculpher et al. (192), who defines generalizability as 'the degree to which the results of an observation hold true in other settings'. In the clinical evaluation literature, issues of generalizability focus mainly on the characteristics of patients in a given study and how representative they are of a broader population.

Boulenguer et al. (195) states that some clarification in the terms transferability and generability can be attained by considering that there are (at least) two ways in which EEs can be used by decision makers in different settings: (a) by applying the conclusions directly because the results are either assumed or assessed to be relevant to the new setting (for example, assuming that since the use of drug A for disease B has proven to be cost-effective in country C, it will also be a cost-effective treatment in country D) and (b) by stating that a given study is transferable if (a) potential user(s) can assess their applicability to their setting and they are applicable to that setting.

Therefore, transferability is a broader concept than generalizability. If researchers desire to make the results of their studies transferable to other contexts, they must keep a detailed account of salient points surrounding their research, and include a rich description of the study.

Barbieri et al. (190) states that studies may be considered generalizable if they can be applied to a range of jurisdictions without any adjustment needed for interpretation. Some studies may be transferable if they can be adapted to apply to other settings, while other may be so specific to a given jurisdiction that they are simply not transferable to any other jurisdiction. This is almost identical to the Task Force's working definitions: Generalizability, applying the results of a study to a number of countries without needing to adjust for interpretation, and transferability, adapting the results of a study to other countries) are other challenges that have been identified in the literature (198).

For the purposes of our analysis and the usefulness of the European health care and social costs database (EU HCSCD), we will share the definitions of generalizability and transferability by Drummond et al. (198) and by Barbieri et al. (190). Some comments should nevertheless be done:

The term "external validity" is relevant in the context of EE methodology in several ways. As it has been mentioned above, EE results are assumed to inform resource allocation decisions in real life. Therefore, efficacy data obtained in controlled, experimental situations must be somehow adjusted to reflect real world situations. The same criterion applies to resource use: it is usually noted in EE guidelines that resource use derived from experimental settings, such as clinical trials, are often protocol driven and justified by research purposes, but might not occur later in real practice. Similarly, the unit costs of resources in the institutions where an experiment takes place (e.g. a university hospital), might not be representative of the settings where the technology will be used (e.g. PHC centers).

It might be assumed that generalizability of results of an EE study -applying the results to a number of countries without needing to adjust for differences- is only valid in very few instances, i.e. is limited to countries and jurisdictions that are very identical or very similar -to the original study country- in all characteristics/variables that determine the results of the study (costs, effectiveness, ICER, etc.).

The term "countries" can be misleading. In this report "setting", "jurisdiction" and "country" are often used interchangeably, because the problems of transference applies to all of them in a similar way. The EU HCCD includes unit costs that mainly refer to countries/nations, but it might be extended to costs represent regions or smaller areas and settings, if they are relevant jurisdiction for decision making and unit cost data are available and can be collected." If there are regions or jurisdictions within a country characterized by large differences in costs, assessing the cost-effectiveness of a decision should ideally be based on the differential costs at each region/jurisdiction/ setting. That is, a certain intervention that reduces hospital length of stay after a surgical procedure might be cost effective for a high-level hospital with a high cost per day and not be cost-effective for a local hospital in the neighborhood where the cost of a day of hospitalization is much lower. However, although a locally contextualized analysis is the logic optimizing approach for a decision maker locally deciding on whether to use or reimburse a given technology, a national decision making body might have to use average conditions for calculating an ICER for making P&R decisions at central level.

In fact, Canada, one of the first countries to regularly apply HEE analysis to P&R (pricing and reimbursement) decisions in health technology, enforced province-specific pharmacoeconomic methodological guidelines and unit costs lists, e.g. for Ontario, Alberta, etc. (173)(199).

Although different settings might have highly similar characteristics that allow a HEE study done in one of them to be valid and hence applicable to the others "without needing to adjust for interpretation", this is a rather unlikely situation. In most cases, analyses will need to be adjusted or adapted in order to customize or properly contextualize the results of an original study to a different country.

In order to make the process of adaptation feasible, the original analysis must ideally be totally transparent and reproducible. In that case, the analyst considering the transference of the study to a new setting would be able to identify the key parameters and assumptions and assess whether they apply to the target country conditions. It is important to mention that the equality or high similarity between jurisdictions refers not only to objective variables, such as the characteristics of the population and the health system, the health technologies applied – especially, the potential comparators - but also to more intangible factors, such as any methodological guidelines in force in the target jurisdiction.

Let us now turn to health care costs, which can be calculated as the product of number of units of the resource by its unit cost. Regarding the amount of units of each resource, the analyst must first ensure that the figures registered in the original EE study for all cost components, including, for instance, the number of units of each disposable goods used (lab tests, medicines, and other consumables), the time spent by all categories health care personnel, the time use of fixed equipment, etc. are either generalizable to the target setting, or have been appropriately adjusted to match the conditions in the target country. The analyst should then focus on appropriate and valid unit costs of the resources in the target country. This is likely to be a painful, boring and time consuming activity, because the data might not be available at all or difficult to locate and validate.

Once some local (target country) unit costs are identified, in order to ensure the validity of the transference of the unit cost, it is essential that the resources, which monetary values are going to be interchanged or substituted, are precisely defined and described in detail in the two settings. For instance, if one of the units cost to transfer is that of a PHC doctor's first visit, it is necessary to verify that the said resource includes the same components in the two settings and that the costing procedures and cost accounting procedures of the two settings are equivalent. These type of verifications are seldom explained in detail in the EE reports and consequently, the unit cost adaptation carried out when transferring EE analyses is often a "black box" procedure which validity cannot be properly assessed.

The main purpose of the European health care and social costs database (EU HCSCD) is to develop a tool that allows this part of the transference of HEE studies across EU countries to be carried out quickly and with a high level of transparency and validity. This tool can be used in a similar efficient way when multi-country studies are carried out, as long as the relevant resource items and the countries involved are available in the European health care and social costs database (EU HCSCD).

## Main results of the studies found in the literature on transferability and generalizability of HTA

The literature dealing with transferability and generalizability of HTA, including EE, is quite large. Some of the main findings identified are presented below.

***Critical factors for transferring EE of health technology and the costs***

There are several factors affecting that the results of an EE may vary between jurisdictions, and therefore results cannot simply be transferred from one location to another. The main factor most frequently cited in the literature as generating variability in economic results between locations is the unit costs associated with particular resources, e.g. the absolute or relative prices of resources (192,200). However, in addition to costs, there are several other factors responsible for the fact that the results of a study cannot be generalized (directly) to other places and therefore require an adequate adjustment or adaptation before transferring the original analysis to the new destination setting.

The identification of the factors of variability and their regrouping into homogeneous categories (i.e. areas of variability) has already been studied in the literature. For example, the review of the literature carried out by Sculpher et al. (192) shows that four groups are generally retained as the area of variability: the characteristics of the patients, the clinical parameters, the healthcare systems, and the socio-economic aspects.

Welte et al. (201) grouped 14 factors in three large categories: population, healthcare system and methodological characteristics (Table 14). Eight of these factors affect both costs and results, and 5 exclusively affect the costs of the EE (three at direct costs and two at indirect costs).

**Table 14. Transferability factors identified from Welte et al (201)**

| Categories | Transferability factors | Direct Influence on: |
|---|---|---|
| Methodological characteristics | Perspective; | Costs and effects |
| | discount rate; | Costs and effects |
| | medical cost approach (charges, fees, prices); | Direct medical cost |
| | Productivity cost approach (friction cost method, human capital approach, QALYs) | Productivity cost |
| Healthcare system characteristics | Absolute and relative prices in healthcare | Direct medical cost |
| | Practice variation (staff characteristics, characteristics and learning effects of physicians; nurses and hospitals; liability of physicians; type of healthcare facility; organizational characteristics | Costs and effects |
| | Technology availability (range of licensed products; availability of generics; competition; market form of suppliers; payment of suppliers; incentives to suppliers; supplier-induced demand; healthcare delivery structure; waiting lists; referral patterns; healthcare before and after intervention; quality of care; capacity utilization; economies of scale | Direct Costs |
| Population characteristics | Disease incidence/prevalence; | Costs and effects |
| | Case-mix (age; sex; race; education; socioeconomic; disease severity; co-morbidity; medical history; concurrent medications; susceptibility) | Costs and effects |
| | Life expectancy (progression of disease; natural history of the disease; lifestyle; risk factors; environmental factors; genetic factors) | Costs and effects |
| | Health-status preferences factors (methods to measure health-status valuation) | Effects |
| | Acceptance, compliance, incentives to patients (technology acceptance; compliance; incentives to patients; insurance level; co-payments; moral hazard) | Costs and effects |
| | Productivity and work-loss time (friction time; income level and distribution) | Productivity cost |
| | Disease spread patients (population density; immigration; emigration; travelling; ethical standards) | Costs and effects |

*Source: Welte et al* (201)

Moreover, Goeree et al. (202) identified, from a literature review, a total of 77 factors that can potentially affect the transferability of EE, grouped into five categories: patient characteristics, disease characteristics , provider, healthcare system and methodology used in the analysis. This classification model was mainly based on the categories described by Welte et al. (201). The factors included in healthcare system are possibly the most influential on costs. These factors refers to differences in clinical practice, guidelines, or norms across countries. Also, differences in unit prices across jurisdictions, absolute and relative unit costs, the types and magnitude of resources, programs, or services that are available, or the availability of treatment. Countries will also differ in terms of the mix of inputs used in health care

delivery, the organization and structure of the health care system, the level of technological innovation used in the country, and the level of technical efficiency in production.

***What do national economic evaluation guidelines say about cost transferability?***

Barbieri et al. (190) assessed the positions of national pharmacoeconomic guidelines on the transferability (or lack of transferability) of clinical and economic data (key data relating to baseline risk, treatment effect, health state utilities, resource use, and unit costs) and to review the methods suggested in the guidelines for addressing issues of transferability. Their main findings were that most guidelines recommend presenting quantities of resources use separately from unit costs in order to increase the transparency of the analysis. However, But six out of these 22 guidelines did not provide any explicit information on the degree of transferability of resource use. The majority of the remaining guidelines recommend obtaining resource use from the local setting, arguing that estimates from elsewhere have a questionable transferability. Differences in clinical practices, payment systems, incentives, and the opportunity to redeploy resources are often mentioned as the main reasons for variability in resource use between settings. These guidelines suggest that it is fundamental to use local data for resource consumption and estimates obtained from other locations are often not considered as an appropriate and valid source. However, small countries appear to be more flexible in accepting key data from other settings and in six cases, estimates of resource use are seen as having high transferability. According to the author, the level of flexibility in accepting data from other jurisdictions seems to depend on the year of publication and on the level of methodological development of the guidelines. In addition, some guidelines provide sources for unit costs (e.g., an official list).

Van Dongen et al. (203) reviewed which recommendations are currently given by national pharmacoeconomic guidelines on the statistical analysis of trial-based EEs. The majority of guidelines did not provide recommendations on how to deal with baseline imbalances, skewed costs, correlated costs and effects, the clustering of data, the longitudinal nature of data, and missing data in trial-based EEs.

The revision of methodological guidelines in HEE presented in chapter 1 shows that some guidelines explicitly mention the issue of transferability.

For instance, the Austrian Guidelines (204,205) state that the adaptation of studies can take place in different ways and levels, ranging from relatively simple methods to account for inflation and currency adjustment, to the substitution of data on resources or costs, or even of whole model structures. Indeed, the feasibility of transferring data and using them for decision-making in Austria will be conditioned by the availability and level of detail of the data and of the effort invested in the adaptation. For instance, if the original studies present only total costs, but not quantity of resources and individual (unit) costs separately, it will not be possible to adapt costs to the Austrian setting. Moreover, the guidelines suggests converting prices by means of the use of PPP, recommended for currency conversion, since exchange rates lead to distorted results. If both inflation and currency adjustments are carried out, consistency should in any case be the same reference system for purchasing power parities and price indices (e.g. GDP deflator price index and GDP-PPP). The adaptation process is precisely defined. It starts with the currency adjustment, followed by the inflation adjustment. Step three is the adaptation of the discount rate, followed by the conversion of the program costs as well as the cost savings and productivity losses.

The Irish Guidelines indicate that when costs are applied from other countries, the assumptions necessary to transfer this data must be explicitly reported, with all costs converted to their Irish equivalent in euro using Purchasing Power Parity indices. If transferring costs from another country, the inflation should be calculated using the Consumer Price Index for the local currency prior to conversion to the Irish equivalent in Euro using PPP indexes.

The German Guidelines (11,206) address the main problems of transferability by referring to the study of Welte et al. (201), and recommends modeling adjustments when there are large differences between study and target country in (1) incidence/prevalence, (2) practice variation, or (3) relative prices. Adjustments may concern the structure of the decision model (to adapt to different health care processes) or the resource utilization. Adjustments of valuation (unit prices) should always be carried out. Furthermore, adjustments should be made for inflation and different currencies. For currency conversion, purchasing power parities are recommended.

The French guidelines (207) also mention that an EE is rarely generalizable to a different context to the one in which it was conducted, and states that “The use of an EE in another context can however be considered if the interventions being compared are relevant and if the methodology of the study is of good quality.” ”... adjustments to the structure or the parameters are always necessary, because of the specific characteristics of the population (incidence/prevalence, life expectancy, preferences, etc.), the healthcare system (organization, professional practices, unit costs, etc.) or methods (time horizons, perspective, discount rates, etc.) which can lead to differences in the evaluation of the costs or health effects. EEs can be transferred to another context using these adjustments only under certain conditions. The evaluation of the degree of transferability of studies can be used to select studies that meet the necessary explanatory and transparency conditions. The task of transferring a study is then complex; it is necessary to have the full report containing details of all the work and to contact the authors to discuss the conditions for the internal and external validity of their model. Finally, whether transferring a model developed in another context or constructing a model from scratch, the use of foreign data to rate a model's parameters is often unavoidable. The degree of acceptability of foreign data varies according to the nature of the parameter for which information is provided. A distinction can thus be made between the following: i) variables for which French data are essential (e.g., calculating the costs of interventions); ii) variables for which French data are preferable, while accepting the use of foreign data under certain conditions (e.g.: evaluation of quality of life, compliance); and iii) variables for which the use of foreign data are generally accepted (e.g., evaluation of the relative risks). The author of the evaluation justifies the balance struck between the value of using foreign data and their validity for a French evaluation.”

The Spanish Guidelines also addresses the issue of transferability and recommends maximum transparency in reporting in order to help decision-makers in generalizing and transferring the various components of an EE to a different setting from the original ones they were intended for. It is strongly recommended that when a study is carried out the authors should be aware and someone else might be willing to use the same study in the future to take decisions in a different setting. It would be convenient to keep this in mind and in order to facilitate this adaptation of the original studies with the minimum amount of additional effort. Generalizability and transferability can be also enhanced by carrying out sensitivity analyses on the appropriate parameters.

***Tools and method to assess the transferability in Economic Evaluations.***

Several tools have been developed to assist with the challenges of adapting studies or data from other jurisdictions. Some of them are checklists for evaluating the generalizability of EE, such as the checklist from Drummond et al. (191), Boulenguer et al. (195), Turner et al. (208) and Nixon et al. (209). Other studies propose a sequenced flow-chart-type approach to help decide if a study can be validly transferred (for instance, Welte's transferability decision chart (201), Drummond's application algorithm (198)). Other proposals refer to check-lists that are summarized as Heyland's generalizability criteria indexes (210), Späth's transferability indicators (211) and Antonanzas' transferability index (212). This topic has been recently reviewed by Goeree et al. (196) .

Moreover, The European Network for Health Technology Assessment (EUnetHTA) has developed a toolkit (213) to support HTA agencies in adapting HTA reports from other countries, regions or settings for their specific use . One of its limitations is that it does not manage the adaptation of HTA reports that are considered as primary research. This tool was developed as part of the EUnetHTA HTA Adaptation Toolkit, and focuses on three distinct elements for adaptation: relevance, reliability and transferability. The transferability domain consists of three questions.

(i) How generalizable and relevant are the results and validity of the data and model to the relevant jurisdictions and populations?

(ii) Are there any differences in the following parameters: perspective, preferences, relative costs, indirect costs, discount rate, technological context, personnel characteristics, epidemiological context, factors that influence incidence and prevalence, demographic context, life expectancy, reproduction, pre- and post-intervention care, integration of technology into the healthcare system and incentives?

(iii) Does the evaluation violate the national guidelines for CEA? The tool is a qualitative instrument and no quantitative score for transferability is produced.

***Examples of studies that address transferability of cost in practice***

Table 15 summarizes studies that address the transferability of EE analyses from the original to a target country by adjusting the unit costs. All studies highlight the difficulty of the intended adjustment of cost data due to the poor quality and lack of transparence of the results reported. Elgaard Jensen et al. (214) and Knies et al. (215) use the Welter model as a method of evaluating the transferability of EEs, and both conclude that the model make adequate predictions on the ability to transfer costs between different jurisdictions.

Essers et al. (216) proposes three steps in the process of transferring cost-effectiveness studies:

Step 1. Collect available information with regard to the original model, and assess transferability using existing checklists.

Step 2: Adapt generalisability limiting factors.

Step 3: Obtain a country-specific estimate of cost–effectiveness.

The article analyzes an example of adaptation of a cost–effectiveness study of trastuzumab for the adjuvant treatment of HER2-positive early breast cancer from the UK to The Netherlands. They concludes that the model is transferable to the Netherlands, but is still a challenge the availability of health care resource data. More attention should be given to a reliable registration of resource consumption related to the different health states of diseases like, for example, breast cancer.

Fukuda et al. (217) establish a methodology to deal with cost transferability in EE. The authors describe four levels of transparency in the reporting of items included in the estimations of cost:

- Level A: all components of costs were described and data for both quantity and unit price of resources were reported for each component;

- Level B: all components of costs were described and data for costs in each component were reported. This included studies that used graphical presentations of the aforementioned data;

- Level C: all components of costs were described, but data for costs in each component were not reported;

- Level D: only the scope of costing was described, but the components of costs were not described.

For example, studies that only reported terms such as ‘‘hospital stay’’ or ‘‘direct costs’’ without further exposition were evaluated at Level D.

Additionally, the methodology used to calculate unit cost was also taken into account, categorized according to quality criteria in:

1. micro-costing or quasi micro-costing,
2. use of relative values units,
3. use of ratio of cost to charges,
4. unmodified charge data, and
5. unknown.

Finally, the authors also assessed the post-publication number of citations per year for each paper categorized by these evaluation axes of transferability and they found that only 8 out of 79 publication scored a high level of transferability in costs. The most frequent method use to estimate cost was the use of charges as proxy of cost, and there was no significant difference in citation frequency between studies with high transferability and low transferability.

The methodology of Fukuda et al. (217) for evaluating cost transferability described above was used by Zwolsman et al. (218) in order to provide an overview of the variability in cost estimates for the process of stress urinary incontinence, and explored the factors causing this variation. The authors found high heterogeneity in reporting cost estimates, and great variability owing to differences in interventions and health care services among countries, and the sources to derive costs and the way in which units are defined. With similar results, Ruggeri et al. (9), Gorry et al. (200) and Mandrik

et al. (219) highlighted poor reporting of costs that makes transferability difficult. Moreover, Ruggery et al. (9) reveals the utility of standardizing procedures and to have official and independent sources of information to be used for the conduction of EEs.

Steuten et al. (220) provide an overview of critical factors that affect the transferability of EE in medical devices, and describe the results from a decision-analytic model, developed to assess the cost implications of the use of a fibrin sealant in orthopedic surgery in the UK, were successfully remodeled for France, Germany and Italy. As conclusion authors comments that economic modeling methods can help transfer data across countries, but empirical research is needed to determine the relative impact of different transferability factors and to what extent their impact varies by type of disease, intervention or geographic location.

Finally, Gao et al. (221) explores the transferability of direct medical cost data across countries for some procedures such as schizophrenia, epilepsy and type 2 diabetes mellitus. The authors found that converting the raw data into percentage of GDP/per capita of the corresponding individual country can be a feasible approach to transfer the direct medical cost across countries.

**Table 15. Summary of studies that address the transferability of EE analyses by adjusting unit cost between sites**

| Author, Year | Objective | Methods | Main results about cost transferability in EE | Conclusions |
|---|---|---|---|---|
| Gao et al. (221) | To systematically review cost of illness studies for schizophrenia, epilepsy and type 2 diabetes mellitus and explore the transferability of direct medical cost across countries. | A comprehensive literature search was performed to yield studies that estimated direct medical costs. A generalized linear model (GLM) with gamma distribution and log link was utilized to explore the variation in costs that accounted by the included factors. Both parametric (Random-effects model) and non-parametric (Boot-strapping) meta-analyses were performed to pool the converted raw cost data (expressed as percentage of GDP/capita of the country where the study was conducted). | Converting the raw cost data into percentage of GDP/capita of individual country was demonstrated to be a feasible approach to transfer the direct medical cost across countries. | Pooling the converted raw cost data can be of help to construct a reference range for other countries without such data. The mean percentage of GDP/capita estimate can be converted back to the monetary value of the jurisdiction of the decision maker. When combined with the size of patient population in a jurisdiction, it can provide a quick check on the economic burden of a particular disease. |
| Knies et al. (215) | To asses if Welte's model is a valid method to assess the transferability of economic evaluations | Systematic review were conducted to identify foreign studies to be transferred to The Netherlands and then compared with a Dutch reference study. In the case study, the cost-effectiveness of physiotherapy was compared with a multidisciplinary treatment. Based on these foreign studies, two different predictions were produced for The Netherlands. In the "all studies prediction," all foreign studies were used. In the "Welte's model prediction," only the foreign studies were used, which passed the general and specific knockout criteria. Both predictions were compared with the Dutch reference case. | The predictions yielded different results and the "Welte's model prediction" proved better on costs than the "all studies prediction." | The application of Welte's model does influence cost and effects estimates when transferring economic data between countries.<br>However, more cases should be subjected to the Welte transferability model before a final conclusion can be drawn |

| Author, Year | Objective | Methods | Main results about cost transferability in EE | Conclusions |
|---|---|---|---|---|
| Fukuda et al. (217) | to conduct a systematic review of published studies that have produced quantification of the cost of Hospital-acquired infections (COHAI) estimates from 1980 to 2006 and to evaluate the quality of these estimates from the perspective of transferability | Criteria for evaluating transferability divided into two axes: 1º assesses the clarification of the scope of costing, i.e., the level of transparency on the reporting of items included in the estimates and how the estimates were calculated (rating from level A to D). 2º evaluation to identify costing methodologies. The optimal choice of costing methods is the use of micro-costing or quasi-micro-costing, i.e., activity-based costing. The second involves the use of relative value units (RVUs). The next costing method uses charge data based on the ratio of costs to charges (RCCs). The fourth costing method involves the use of unmodified charge data. The final category includes studies that offer no information to readers about the methodology used. They also evaluate the transferability for the times that the article has been referenced by other authors. | From a total of 79 publications, only 8 papers (9.0%) had a high level of transferability in which all components of costs were described, data for costs in each component were reported, and unit costs were estimated with actual costing.<br>Only 1 article graded at level A (All components of costs were described and data for both quantity and unit price of resources were reported for each component). Most frequent method was the use of charges as proxy of cost and 31.7% of the studies do not specify method of costing.<br>There are very large variations observed in the cost estimates among the publications that can be attributed to differences in the items included in costing, clinical practice patterns for HAIs, unit costs, difference between actual costs and charges, and cost estimation methods | (1) there is a large degree of variation in COHAI estimates among publications, (2) there is a large degree of variation in the transferability of these COHAI estimates among publications, and (3) there is no significant difference in citation frequency between COHAI estimates with high transferability and COHAI estimates with low transferability |
| Zwolsman et al. (218) | To provide an overview of cost estimates for different components in the diagnosis, treatment, and follow-up of SUI (stress urinary incontinence). Furthermore, we aimed to assess variation in cost estimates | A systematic search was conducted. They extracted unit cost estimates, assessed variability and methodology, and determined transferability. Transferability of costs was determined using the criteria of Fukuda et al. | 37 studies were included. Most included articles score an A-I level on transferability and methodology. This means that micro- or quasi-micro costing was applied and that all components of costs were described. Standardized unit costs per day of | Heterogeneity was observed in cost estimates for all units at all levels of health care. Reported costs are not commonly listed in detail. The study provides evidence that variability in cost estimates results from differences in interventions and |

| Author, Year | Objective | Methods | Main results about cost transferability in EE | Conclusions |
|---|---|---|---|---|
| | for SUI, and explore factors causing this variation. | | hospital stay varied considerably within and between countries. Different units to express the costs of hospital stay were identified, including average cost per day | health care services among countries, sources used to derive costs and the way in which units are defined.<br><br>CEAs of SUI interventions cannot be interpreted without bias when the base of these analyses—namely costs—cannot be compared and generalized. |
| Ruggeri et al. (9) | To assess the methodological quality of Italian health economic evaluations and their generalizability or transferability to different settings | A literature search was performed to find non-experimental prospective studies or model-based full economic evaluations carried out in Italy from 1995 to 2013. The studies identified were randomly assigned to four reviewers who applied the check list developed by Augustovski et al. To better distinguish generalizable from transferable studies, they focused on some items of the checklist specifically relevant to ascertaining the generalizability of HEEs. These were identified on the basis of recommendations for the generalizability of economic evaluations previously published by Drummond et al | 151 economic evaluations eventually met the inclusion criteria. The reporting of costs data was generally poor, typically reported in aggregate format without a clear indication of both unitary costs and the amount of resource consumption. 42 studies (48%) did not report unitary costs and resources use separately. Only 38 studies reported unit costs and resource use for specific cost items separately. In the three multinational studies included in the analysis, a unique set of unitary costs was applied to all the centers participating in the study; more n- detail costs computed within the Italian setting were extended to the other centers involved. Sources of cost data were explicitly reported in only half of the studies in this group (54%). Cost estimates were often based on DRG charges for hospital stay, on public | Overtime, we observed an increasing transparency in methods and a greater generalizability of results, along with a wider and more representative sample in trials and a larger adoption of transition-Markov models. However, often context-specific economic evaluations are carried out and not enough effort is made to ensure the transferability of their results to other contexts.<br><br>Despite a quite positive temporal trend, generalizability of results still appears as an unsolved question, even if some indication of improvement within Italian studies has been observed.<br><br>Data collection procedures could be standardized to produce data sets to be handled by different |

| Author, Year | Objective | Methods | Main results about cost transferability in EE | Conclusions |
|---|---|---|---|---|
| | | | charges for outpatient's assistance, and on market prices for drug administration. In 7 studies, costs were estimated through the Activity-Based Costing method. | researchers, thus providing an "official" and independent source of information to be used for the conduction of HTA-HEEs in Italy. |
| Mandrik et al. (219) | To analyze the quality and transferability issues reported in published peer-reviewed English-language economic evaluations based in healthcare settings of the Central and Eastern European (CEE) and former Soviet countries. | Systematic search of economic evaluations of healthcare interventions. The included studies were assessed according to their characteristics, quality (using Drummond's checklist), use of local data, and the transferability of inputs and results, if addressed. | The least frequently and transparently addressed parameters were the items' stated perspectives, relevant costs included, accurately measured costs in appropriate units, outcomes and costs credibly valued, and uncertainties addressed. Local data were often used to assess unit costs, baseline risk, and resource usage, while jurisdiction-specific utilities were included in only one study. Only 32 percent of relevant studies discussed the limitations of using foreign data, and 36 percent of studies discussed the transferability of their own study results to other jurisdictions. | Transferability of economic evaluations, conducted in healthcare settings of CEE and former Soviet countries is limited by a low number of English language peer-reviewed studies especially in chronic diseases, underreporting of methodology in publications, and limited discussion on inputs and results transferability.<br>To improve the transferability of published studies to other jurisdictions, uncertainty, the impact of influential parameters, and data transferability should be comprehensively addressed when reporting studies. Additionally, the transparency of study reporting, especially study perspective, model details, and costing methodology, should be improved significantly. |
| Essers et al. (216) | To provide a real world example of transferring a cost–effectiveness study of trastuzumab for the adjuvant treatment of HER2-positive | Three successive steps were taken. Step 1: Collect available information with regard to the original model, and assess transferability using existing checklists. | UK cost effectiveness model is transferable to The Netherland, but a challenge regarding the transferability of economic evaluations is the | Transferability of a model-based UK-study in three steps proved to be an efficient method to provide an early indication of the |

| Author, Year | Objective | Methods | Main results about cost transferability in EE | Conclusions |
|---|---|---|---|---|
| | early breast cancer from the UK to The Netherlands. | Step 2: Adapt transferability limiting factors. Step 3: Obtain a country-specific estimate of cost–effectiveness. | availability of healthcare resource data. More attention should be given to a reliable registration of resource consumption related to the different health states of diseases like, for example, breast cancer. | cost–effectiveness of trastuzumab and has led to the provisional reimbursement of the treatment. |
| Gorry et al. (200) | To assess the generic and specific transferability of published CEAs of systemic treatments for advanced melanoma to the Irish setting. | CEAs of treatments for melanoma were identified by systematic review. Transferability to the Irish setting was assessed using the EUnetHTA transferability tool for Economic Evaluation. They present a narrative discussion comparing the differences in key parameter inputs and the likely impact of these differences on the model outcomes and the reimbursement recommendation. Transferability is considered within the context of the Irish cost-effectiveness threshold, using the net monetary benefit (NMB) framework. | Assessment of transferability was difficult due to poor quality reporting. Unsurprisingly, none of the identified CEAs demonstrated complete generic transferability to the Irish setting as none were aligned with the national reference case for CEA. The parameters considered most likely to cause variation include the discount rate, time horizon and relative costs. | They shows for this case study that while parameter inputs may not be exactly aligned with the requirements for the national reference case, the conclusions may be comparable across jurisdictions |
| Elgaard Jensen et al. (214) | To identify, summarize and quality assess the available literature on the cost effectiveness of implementing low back pain guidelines in primary care, and to assess the transferability of the results to determine whether the identified studies can be included in a comparison with a Danish implementation study to establish which strategy procures most value for money | Systematic Review of literature to identify studies. Transferability was asses by the decision chart of Welte et al | Three studies were of moderate methodological quality while use of Welte's model showed that cost results from two studies could, with adjustments, be transferable to a Danish setting, whereas it was questionable whether the effectiveness results could be transferred as well. | This reviews showed that transferring the results from the identified studies is not straightforward and underlines the importance of transparent reporting. Future research should focus on transferability of effects, for example, development of a supplement to Welte's model |

| Author, Year | Objective | Methods | Main results about cost transferability in EE | Conclusions |
|---|---|---|---|---|
| Steuten et al. (220) | This article highlights those factors and methodologies that are of particular relevance to transferring medical technology assessments (medical device). | The article provide an overview of factors that are previously identified in the literature as affecting transferability of economic evaluation, as well as methods for transferring results in scientifically sound way. | In relation to transferring the cost implications of using fibrin sealant in orthopedic surgery, empirical studies that actually aim to transfer results of economic evaluation data of medical technologies across jurisdictions are still scarce, but recently the results from a decision-analytic model, developed to assess the cost implications of the use of a fibrin sealant in orthopedic surgery in the UK, were successfully remodeled for France, Germany and Italy. | Additional empirical research is needed to determine the relative impact of different transferability factors and to what extent their impact varies by type of disease, intervention or geographic location. Although economic modeling methods can help transfer data across countries, the medical technology field should aim to conduct rigorous empirical research to establish a firm evidence base for their products in at least one country. |

## Conclusions

EE is an important analytical tool to inform and facilitate an efficient decision-making in the allocation of resources in the health sector, mainly in financing and pricing technologies. However, EE are costly and time consuming exercises. Ideally, all resource allocation decisions could benefit from a formal EE analysis, which should in fact be adjusted and updated each time one of the factors and parameters that define the results change. However, this would not be feasible, nor efficient, because EE detracts resources from other activities, such as providing care to patients in need.

One approach to reducing costs and improving the efficiency of EE is to reuse existing analyses, by generalizing the results of an EE, if it is feasible – or by transferring the analyses originally done for one setting to other settings. It might also be efficient to carry out multi-country studies, which can share a single model, methodology and set of information and require less resources than independently carrying out a study for each country. However, few countries that regularly apply HEE for decision-making enforce transparent criteria and costing methodologies and procedures for HEE analyses. This situation reduces the validity, reproducibility and credibility of the analyses. It also makes very time consuming to generalize and transfer study results across countries and jurisdictions.

There are many factors in an EE that may need to be customized or adjusted in order to make it valid for other settings. There is some consensus on the assumption that health outcomes are more generalizable than resource and cost consequences of interventions (198). Hence, one of the main factors that must be adjusted in almost all cases are the unit (individual) costs of the resources. However, in order to make such an adjustment valid, the resource items must be clearly and homogeneously defined both in the original and in the target country. i.e. it must be clear which amount of primary resources are included in each cost item that has a single monetary value assigned. This is often not the case, so far.

There is often a lack of access to electronic copies of the models/algorithms. In some cases the studies do not report units of resources and individual (unit) cost separately.

Differing methodological requirements and decision-making criteria by jurisdictions are recognized barriers to the generalizability of HEE across jurisdictions, but they do not prevent transferability, although they make it more difficult and time-consuming. Several revisions have highlighted the poor quality and lack of transparency of cost data reported in EE (200,217,218). Moreover, few jurisdictions indicate in their HEE guidelines, detailed procedures and methodologies for costing resources. It is still more unusual for jurisdictions to provide a list of single standard unit cost per resource item, an option that would facilitate the calculations and prevent intentional biases in calculating unit costs.

The European Health Care and Social Costs Database (EU HCSCD) provides a potential tool to facilitate the transference and generalisability of EE across EU Member States.

The HCSCD facilitates exchange of best practice in health service costing methodology between countries at national level. Countries (such as France and England) that publish the most detailed and comprehensive estimates of the unit costs of national health services have invested a great deal of human, financial and technological capital over many years in this enterprise, and have rigorously documented, audited, verified and updated the costing process at local and national level to ensure accuracy, precision and reproducibility. In these cases, the motivation for such investment was to estimate detailed DRG-based tariffs to enable reimbursement of providers for their activity and incentivize performance. However, a spin-off benefit is that it provides high-quality data for EE, and hence facilitates effective planning and investment in future healthcare programs.

## Recommendations

- EE should be enhanced by collaboration among EU Member States.
- In order to give more credibility and to facilitate and promote the use of HEE in decision making in health policy and decision-making it is important to ensure the validity and credibility of the analyses and to reduce its cost.

- International standardization of the methodology across jurisdictions is one way to make HEE comparable and to ensure HEE a higher respectability among decision makers (222). Standardization should include the methodology for costing health care resources and other cost of HEE.

- In the long term, comparability of costs in HEE could be easily attained if all countries/institutions used the same accounting methodology. In the meantime, it would make sense to promote the joint work and collaboration of HEE analysts and users, by building appropriate tools, such as the European Health Care Costs Database (EU HCCD), that allows transference and adaptation of studies in the EU.

- There is a need to ensure the continuity and growth of the EU HCCD in terms of:

    - Number of resource items included

    - Number of observations per item

    - Countries, regions, and other relevant jurisdictions

    - Inclusion of additional information to allow the adjustment and comparability of costs

- In order to ensure the continuity of the EU HCCD an open, collaborative project should be designed that institutionalises the initiative beyond the end of the HAT Impact project.

# DISCUSSION/CONCLUSIONS/RECOMMENDATIONS

## Discussion

EE and, more generally, economic analysis is increasingly being used in most countries as a tool to inform priority setting and resource allocation decisions in the health sector.

In order to assess the efficiency of health interventions, EE analysis considers both the health outcomes and the resource cost effects of the options compared.

Quantifying the costs of health interventions is not an obvious exercise: costs are not tangible nor objective entities. The same material or tangible effect can be perceived as a big cost by one individual and as a small cost by a second individual, or even as a benefit by a third one. There is no such a thing as a real or actual cost, and the acceptance of different perspectives of analysis, each one associated to different sets of relevant costs, acknowledges the subjectivity of this term. There is no scientific consensus either on the appropriate methods and criteria to select, name, classify, measure and value the resources used in health interventions, usually termed "direct health care costs".

In order to make the results of an EE generalizable, i.e. valid in jurisdictions or countries other than the one for which the original analysis was carried out, both the effects on health and the resource costs of interventions assessed should be the same in all sites. This situation is very unusual in strict terms, but analysts often try to overcome this problem to a potential application of a study to multiple sites, by substituting the parameters of the analysis that differ between countries by the relevant local parameters. This type of adjustment is often used to allow the transferability of an EE analysis (model, algorithm) and to ensure some degree of external validity to the results of the analysis. While there is a general acceptance that the health effects of an intervention are likely to be similar irrespective of the country or jurisdiction of application, it is similarly accepted that unit costs are one of the main type of parameters that usually require and adjustment to local conditions, in practice, a substitution of the original country unit-cost values by local target-country values.

This type of transference of an original EE –actually, of part of it– to a different setting certainly has several limitations; and the specific applications may have flaws and inaccuracies. The pros and cons of this approach should be compared and balanced with those of the other feasible options, mainly:

1) To make a decision with no formal estimate of the relative efficiency of the competing interventions.

2) Taking as a reference the results of the original analysis carried out with data from the original country.

3) Doing a new EE analysis from scratch.

4) Proposed option, i.e. customizing the original study or model by substituting original unit cost (and other parameters values) by available local values.

We let the reader make its own context-dependent analysis of the likely merits and limitations of the four options.

The attractiveness of our proposed option (4) would probably increase if the analyst learns that the cost figures in the countries involved in the "transference" derive from an equivalent or similar cost accounting methodology. Also, having a detailed description of the costing/accounting methodologies will allow the analyst to judge to what extent the cost concepts in the various countries is similar and decide, perhaps, how to adjust the original model to the new setting. Finally, the knowledge of national costing and accounting methodologies and the existing similarities and differences between EU countries could set the foundations for a future process of standardization at EU level, as well as an evolution of the unit cost database towards a harmonized one, a similar process to the one that lead from the historic national, methodologically heterogeneous, consumer price indexes (CPIs) to the present, methodologically harmonized national CPIs.

## CONCLUSION

The EU HCSCD is the **first European database of healthcare unit costs**. It is publicly available (https://www.easp.es/Impact-Hta/). Accompanied by User's Manual, the EU HCSCD results to be very amiable and intuitive. It saves researchers' time and effort in searching costs; it allows cross-country comparisons and understanding the variation in costs within and across countries. Additionally, all the costs are automatically converted into euros and updated to 2020 using both Gross Domestic Product deflator and Consumer Price Index.

The present study of national unit cost data sources has shown, especially for the sample of project-partner countries, directly involved as WP3-collaborators in the collection of information on unit costs and on costing and cost accounting methodologies at national level, that there is a

considerable degree of heterogeneity and differences across −as well as within− EU Member States.

There is a great variability in costing methodologies across countries that is reflected in mainly all items included in the EU HCSCD, as well as in updating costs and type of cost elements included in each item. In many countries that are supposed to regularly use EEs in health decision-making, it was not possible to find generally used and agreed sources of unit costs of health resources and services; it was still more difficult to identify the costing/accounting methodologies behind the available unit cost data found.

These results cast many doubts on the comparability of unit costs across EU countries. It also suggest that validly transferring EE analyses across countries by substituting unit costs is not going to be a simple, straightforward procedure in the short term.

The lack of transparency is also an issue. In general, the information on cost elements included in each item is available only for few items and differs a lot among countries that offer this kind of information. In order to enhance the transferability and comparison of unit healthcare costs across countries, it would be necessary to provide a more detailed information of the type and amount of resources included in the total cost of each costing item. Nonetheless, in some countries does not exist this kind of information, or at least it is not publicly available.

The year of publication of costing items was obtained. Nonetheless, publishing the year of collection of cost elements included in the costing items is recommended as well. In order to assess the precision of unit costs, we recommend publishing the number of observation the cost of each item is based on.

The results of chapter 2 suggest that accounting methodologies vary substantially across and within countries and so do, consequently, unit cost estimates. The way to overcome this problem is that Methodological Guidelines do not only provide norms for costing, but also include a list of standard unit costs for the country or jurisdiction concerned. This project pretends to go beyond that and set up a multi-country list of standard unit costs, which facilitates the transference from the results of one study to other settings.

The products developed by WP3 (and WP4) are intended to overcome these limitations by setting the methodological foundations and a pilot practical tool, the unit cost database, which should ideally be continued and expanded in terms of resources items, countries and regions, updating of observations and methods, etc.

For the sake of transferability of analysis, the most important condition is the standardization of resource cost concepts. The use of a single standard unit cost list is essential at the level of jurisdiction, but less so at international level, as budgets, resources and decision makers work at national or regional level.

International comparability is however relevant if the purpose of estimating unit cost is not EE, but trying to assess differences in health care costs and the factors that may explain these differences.

It is important to continue the effort of collecting the costing data, expanding number of costing items and updating them each time new updates in original databases are made. This is the only way the EU HCSCD can prove value for money. Expanding the database to more European countries should be also considered. Policy implications highlighted by this whole issue suggest the urgent necessity of transparent and publicly available costing methodological documents.

The database could be undertaken by a future international consortium open to all participants in HTA Impact, but also to other interested parties, such as the Pecunia project and to already existing national organizations involved in health care costing in the EU and elsewhere.

The database could be the source for national standard costs list, that might further facilitate the transferability of economic evaluations and the opportunities for cross-border research. This is the only database with these characteristic in Europe and can help expert on economic evaluations to make analysis and health technology assessments.

## Recommendations

- Set up a stable consortium responsible for improving, updating and ensuring the continuity of the EU cost database, mainly for EE analyses. It should also progressively increase the list of cost items and the number of participating countries.
- Set up an EU Task Force to periodically revise, improve, harmonise, standardise the costing methodologies in health-care at EU level, and apply them to the generation of unit cost data for the EU database.
- Develop a procedure to regularly issue standard country unit costs lists, to be used as the preferred option (or base case) in EEs for P&R decisions.

- The database could be the source for national standard costs list, that might further facilitate the transferability of economic evaluations and the opportunities for cross-border research.
- The former tasks could be undertaken by a future international consortium open to all participants in HTA Impact, but also to other interested parties, such as the Pecunia project and to already existing national organisations involved in health care costing in the EU and elsewhere.

# LIST OF SOURCES

Following are lists of sources of unit costs that were found in each country.

**ENGLAND**

British National Formulary:

- https://www.nice.org.uk/bnf-uk-only

National Institute for Clinical Excellence (NICE):

- https://www.nice.org.uk/guidance/ta152/resources/drugeluting-stents-for-the-treatment-of-coronary-artery-disease-pdf-82598311384261

NHS Business Service Authority:

- https://www.nhsbsa.nhs.uk/sites/default/files/2020-03/Drug%20Tariff%20April%202020.pdf

Unit Costs of Health and Social Care 2018:

- https://www.pssru.ac.uk/project-pages/unit-costs/unit-costs-2018/

National Schedule of Reference Costs:

- https://improvement.nhs.uk/resources/reference-costs/

2019/20 National Tariff payment System:

- https://improvement.nhs.uk/resources/national-tariff-1719/

**FRANCE**

Ministry of Solidarity and Heath (*Ministère des Solidarités et de la Santé*):

- http://base-donnees-publique.medicaments.gouv.fr/

Social Security Health Insurance (*Securité Sociale l'Assurance Maladie*):

- https://www.roche.fr/fr/pharma/traitements-medicaux-innovants/nos_produits/herceptin/herceptin-iv.html &
- https://www.ameli.fr/sites/default/files/Documents/615994/document/lpp_2_janvier_2020_assurance_maladie.pdf
- https://www.ameli.fr/sites/default/files/Documents/697570/document/lpp_27072020.pdf
- https://www.ameli.fr/sites/default/files/Documents/376153/document/convention_medicale_2016_-_1er_avril_2018_-metropole.pdf
- https://www.ameli.fr/medecin/exercice-liberal/remuneration/tarifs-generalistes/tarifs-metropole
- https://www.ameli.fr/medecin/exercice-liberal/remuneration/tarifs-specialistes/metropole
- https://www.ameli.fr/accueil-de-la-ccam/index.php
- http://www.codage.ext.cnamts.fr/

Court of Accounts (*Cour de Comptes*):

- https://www.ccomptes.fr/system/files/2019-02/08-urgences-hospitalieres-Tome-2.pdf

- https://www.ccomptes.fr/system/files/2019-10/RALFSS-2019-06-transports-programmes-secteurs-sanitaire-medicosocial.pdf

Technical Agency on Information about Hospitalization (*Agence Technique de l'information sur l'hospitalization*, ATIH):

- https://www.atih.sante.fr/unites-communes-de-dispensation-prises-en-charge-en-sus
- https://www.atih.sante.fr/tarifs-mco-et-had

ScanSanté:

- https://www.scansante.fr/applications/enc-mco

**GERMANY**

German Institute for Medical Documentation and Information (*Deutsches Institut für Medizinische Dokumentation und Information*):

- https://www.dimdi.de/dynamic/.downloads/arzneimittel/festbetraege/2020/festbetraege-20200901.pdf

Institute for the Hospital Remuneration System (*Institut für das Entgeltsystem im Krankenhaus*, InEK):

- https://www.g-drg.de/content/download/7388/55411/version/1/file/Fallpauschalen_Katalog_2018_171124.xlsx
- https://www.g-drg.de/G-DRG-System_2019/Fallpauschalen-Katalog/Fallpauschalen-Katalog_2019
- https://www.g-drg.de/G-DRG-System_2020/Fallpauschalen-Katalog/Fallpauschalen-Katalog_2020

Association of Statutory Health Insurance Physicians (*Kassenärztliche Vereinigung*):

- https://www.kvwl.de/arzt/verordnung/arzneimittel/info/invo/blutzuckertest_preisliste_invo.pdf

Zi-Praxis-Panel:

- https://www.zi-pp.de/pdf/ZiPP_Jahresbericht_2017.pdf

Management Consult Kestermann GmbH (MCK):

- https://www.dkgev.de/fileadmin/default/Mediapool/2_Themen/2.2_Finanzierung_und_Leistungskataloge/2.2.3._Ambulante_Verguetung/2.2.3.4._Ambulante_Notfallvehandlung_durch_Krankenhaeuser/2015-02-17_Gutachten_zur_ambulanten_Notfallversorgung_im_Krankenhaus_2015.pdf

National Association of Statutory Health Insurance Physicians (*Kassenärztliche bundesvereinigung*):

- https://www.kbv.de/media/sp/EBM_Gesamt_-_Stand_3._Quartal_2020.pdf
- https://www.kbv.de/media/sp/Honorarbericht_Quartal_4_2017.pdf
- https://www.kbv.de/media/sp/EBM_Gesamt_-_Stand_1._Quartal_2019.pdf
- https://www.kbv.de/media/sp/EBM_Gesamt_-_Stand_2._Quartal_2020.pdf
- https://www.kvno.de/fileadmin/shared/pdf/online/vertraege/katarakt/katarakt_vdek.pdf

Stadtverwaltung Königswinter:

- http://www.witten.de/fileadmin/user_upload/Dokumente/sta10/orecht/or3/314.pdf

**ITALY**

Italian Medicines Agency (*Agenzia Italiana del Farmaco*, AIFA):

- https://www.aifa.gov.it/liste-farmaci-a-h

Ministry of Health (*Ministero della Salute*):

- https://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2007-11-13&atto.codiceRedazionale=07A09617&elenco30giorni=false
- https://www.gazzettaufficiale.it/eli/id/2013/01/28/13A00528/sg
- http://www.regione.piemonte.it/sanita/cms2/component/phocadownload/category/68-nomenclatore-tariffario-regionale-delle-prestazioni-di-assistenza-specialistico-ambulatoriali.html
- http://www.mattoni.salute.gov.it/mattoni/documenti/11_Valutazione_costi_dell_emergenza.pdf

National Anti-Corruption Authority (*Autorità Nazionale Anticorruzione*, ANAC):

- https://www.anticorruzione.it/portal/rest/jcr/repository/collaboration/Digital%20Assets/anacdocs/Attivita/Pubblicazioni/RapportiStudi/Disp.medici09.07.2013.note_TAR%20.pdf

Territorial Healthcare Company of Mantua (*Azienda Socio Sanitaria Territoriale di Mantova*):

- https://www.asst-mantova.it/documents/338413/5738339/Esito+%28327%29.pdf/7579a98d-eba5-89f6-2bd0-4658ed326526

Provincial Health Authority (*Azienda Sanitaria Provinciale*, Enna):

- http://www.asp.enna.it/portale/attachments/article/3155/determina%20n.%20243%20del%2021.03.2017.pdf

Health System of the Sardinia Region (*Sistema Sanitario Regione Sardegna*):

- https://www.aobrotzu.it/documenti/9_204_20190124111717.pdf

Health System of the Liguria Region (*Sistema Sanitario Regione Liguria*):

- https://www.asl1.liguria.it/download.asp?id=38180

Regional Council of Veneto (*Giunta regionale di Veneto*):

- https://www.regione.veneto.it/web/sanita/prescrizione-e-dispensazione-dispositivi-per-diabetici

Italian Doctors' Union (*Sindacato Medici Italiani*):

- http://www.quotidianosanita.it/allegati/allegato4913967.pdf

National Collective Agreement (*Accordo Collettivo nazionale*):

- http://www.medicoeleggi.com/argomenti00/italia2006/acn2005-59.htm

National Institute of Statistics (*Instituto Nazionale di Statistica*):

- https://www.istat.it/it/archivio/194951

Piedmont Region (*Regione Piemonte*):

- http://www.regione.piemonte.it/sanita/cms2/component/phocadownload/category/68-nomenclatore-tariffario-regionale-delle-prestazioni-di-assistenza-specialistico-ambulatoriali.html

**POLAND**

National Health Fund (*Narodowy Fundusz Zdrowia*):

- https://www.gov.pl/web/zdrowie/obwieszczenie-ministra-zdrowia-z-dnia-30-kwietnia-2019-r-w-sprawie-wykazu-refundowanych-lekow-srodkow-spozywczych-specjalnego-przeznaczenia-zywieniowego-oraz-wyrobow-medycznych-na-1-maja-2019-r
- http://nfz.gov.pl/zarzadzenia-prezesa/zarzadzenia-prezesa-nfz/zarzadzenie-nr-1202018dsoz,6844.html
- http://www.nfz.gov.pl/zarzadzenia-prezesa/zarzadzenia-prezesa-nfz/zarzadzenie-nr-222018dsoz-tekst-ujednolicony,6924.html
- http://www.nfz.gov.pl/zarzadzenia-prezesa/zarzadzenia-prezesa-nfz/zarzadzenie-nr-382019dsoz,6906.html
- http://www.nfz.gov.pl/zarzadzenia-prezesa/zarzadzenia-prezesa-nfz/zarzadzenie-nr-452019dsoz,6912.html

**PORTUGAL**

National Authority for Medicament and Health Products (INFARMED):

- http://app10.infarmed.pt/genericos/genericos_II/lista_genericos.php?tabela=dispt&fonte=dci&escolha_dci=QXRvcnZhc3RhdGluYQ
- http://app10.infarmed.pt/genericos/genericos_II/lista_genericos.php?tabela=dispt&fonte=dci&escolha_dci=UGFyYWNldGFtb2w

Setúbal Hospital Center:

- http://www.base.gov.pt/base2/rest/documentos/737159

National Health Service (*Serviço Nacional de Saúde*):

- http://www.base.gov.pt/base2/rest/documentos/554949
- http://www.base.gov.pt/base2/rest/documentos/157090
- http://www.base.gov.pt/base2/rest/documentos/380625
- https://www.sns.gov.pt/wp-content/uploads/2016/05/Avalia%C3%A7%C3%A3o-nacional-da-situa%C3%A7%C3%A3o-das-unidades-de-cuidados-intensivos.pdf
- http://www.acss.min-saude.pt/category/acss_pt/tabelas-e-impressos/
- https://dre.pt/web/guest/pesquisa/-/search/924995/details/normal?q=Despacho+n.%C2%BA%2019965%2F2008
- https://dre.pt/web/guest/pesquisa/-/search/106955056/details/normal?q=3668-b%2F2017

Independent Physicians Union (*Sindicato Independente dos médicos*):

- https://www.simedicos.pt/fotos/editor2/ficheiros/tabela_salarial_2019.pdf

Portuguese Nurses Union (*Sindicato dos Enfermeiros Portugueses*):

- https://www.sep.org.pt/files/uploads/2017/06/sep_23062017_TSEnfermagem_2017_35horas_a_partir_1abril.pdf

Portuguese Court of Auditors:

- https://www.tcontas.pt/pt/actos/rel_auditoria/2014/2s/audit-dgtc-rel017-2014-2s.pdf

Central Administration of Health System (*Administração Central do Sistema de Saúde*):

- http://www.acss.min-saude.pt/wp-content/uploads/2017/11/Termos-Referencia-Contratualizacao-SNS_2018.pdf

Health Regulatory Entity (*Entidade Reguladora da Saúde*):

- https://www.ers.pt/uploads/writer_file/document/1010/ERS_-_Parecer_Limites_Pre_os_SNS__1.Abr.2014__pub.pdf
- https://www.ers.pt/uploads/writer_file/document/108/200731583312842202_original_rel.pdf

**SLOVENIA**

Public Agency of the Republic of Slovenia for Medicinal Products (*Javna agencija Republike Slovenije za zdravila*):

- https://www.jazmp.si/fileadmin/datoteke/seznami/SFE/Cene/cene_2007hist.html

UKC Ljubljana:

- https://www.enarocanje.si/objavaPogodb/PogodbaDetajli.aspx?IDPogodbeZaceten=72833

Health Insurance Institute of Slovenia (*Zavod za zdravstveno zavarovanje Slovenije*):

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**SPAIN**

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# Supplementary tables

**Supplementary Table 1** **European Economic evaluation manuals and guidelines included in the review**

| Country | Reference of Guide/manual for conducting Economic Evaluation of health technology | Author | Year |
|---|---|---|---|
| **AUSTRIA** | Guidelines on Health Economic Evaluation, Consensus paper, Institute for Pharmacoeconomic Research, 2006. (223) | Walter et al Institute for Pharmaceutical Economics Research | 2006 |
| | Methodenhandbuch für Health Technology Assessment. Version 1.(205) | | 2012 |
| **BELGIUM** | Belgian guidelines for economic evaluations and budget impact analyses: Second edition, KCE Report 183C, Belgian Health Care Knowledge Centre, 2012 (224) | Belgian Health Care Knowledge Centre | 2012 |
| | Manual for cost-based pricing of hospital interventions (18) | Belgian Health Care Knowledge Centre | 2012 |
| **CROATIA** | Guide for the Economic evaluation of health technologies, In: The Croatian Guideline for Health Technology Assessment Process and Reporting (225) | Agency for Quality and Accreditation in Health Care | 2011 |
| **CZECH REPUBLIC** | Check-list minimálních požadavků na kvalitu a úplnost hodnocení analýzy dopadu do rozpočtu (226) | State Institute for Drug Control (SUKL | 2017 |
| | Doporučené postupy České farmakoekonomické společnosti (ČFES) pro zdravotně-ekonomická hodnocení v ČR(227) | Working group for the creation of recommended practices of the Czech Pharmacoeconomic Society | 2016 |
| **DENMARK** | Health Technology Assessment Handbook (23) | Danish Centre for Health Technology Assessment, National Board of Health | 2007 |
| **ENGLAND** | Guide to the methods of technology appraisal 2013 (24) | NICE | 2013 |
| | Medical Technologies Evaluation Programme Methods guide (25) | NICE | 2011 |
| | Diagnostics Assessment Programme, 2011 manual (26) | NICE | 2011 |

| Country | Reference of Guide/manual for conducting Economic Evaluation of health technology | Author | Year |
|---|---|---|---|
| **FINLAND** | Preparing a Health Economic Evaluation to Be Attached to the Application for Reimbursement Status and Wholesale Price for a Medicinal Product. Application Instructions (27) | Ministry of Social Affairs and Health, Pharmaceuticals Pricing Board | 2019 |
| | Guidelines for preparing a health economic evaluation, Annex to the Decree of the (201/2009) (28) | Ministry of Social Affairs and Health, Pharmaceuticals Pricing Board | 2009 |
| **FRANCE** | Choices in Methods for Economic Evaluation (29) | HAS (Haute Autorité de Santé) Ministry of Health | 2012 |
| | French guidelines for the economic evaluation of health care technologies (30) | The French Health Economists Association | 2004 |
| **GERMANY** | General Methods for the Assessment of the Relation of Benefits to Costs (Version 1.0 dated 19/11/2009) (31) | Institute for Quality and Efficiency in Health Care (IQWiG) | 2009 |
| | Working Paper on Cost Estimation in health economic evaluations (32) | Institute for Quality and Efficiency in Health Care (IQWiG) | 2009 |
| **HUNGARY** | (33) | Hungarian HTA (OGYEI) | 2017 |
| | Methodological guidelines for conducting economic evaluation of healthcare interventions in Hungary: A Hungarian proposal for methodology standards. Eur J Health Econom 2002, 3:196–206. (34) | Szende A et al | 2002 |
| **IRELAND** | Guidelines for the Economic Evaluation of Health Technologies in Ireland (35) | Health Information and Quality Authority | 2019 |
| | Guidance on Budget Impact Analysis of Health Technologies in Ireland (36) | Health Information and Quality Authority | 2018 |
| **ITALY** | Proposta di linee guida per la valutazione economica degli interventi Sanitari (37) | Italian Association of health care economists | 2009 |

| Country | Reference of Guide/manual for conducting Economic Evaluation of health technology | Author | Year |
|---|---|---|---|
| **LATVIA**<br>**LITHUANIA**<br>**ESTONIA** | Baltic guideline for economic evaluation of pharmaceuticals 2002 (38) | Experts from health authorities of Baltic countries. | 2002 |
| **THE NETHERLANDS** | Costing manual: Methodology of costing research and reference prices for economic evaluations in healthcare (39) | Institute for Medical Technology Assessment. Erasmus Universiteit Rotterdam | 2015 |
| | Guideline for the Conduct of Economic Evaluations in Health Care (40) | HealthCare Intsitute | 2016 |
| **NORWAY** | Guidelines on how to conduct pharmacoeconomic analyses. (41) | Norwegian Medicines Agency | 2012 |
| **POLAND** | (42) | Agency for Health Technology Assessment | 2009 |
| | Polish guidelines for conducting pharmacoeconomic evaluations (43) | Agency for Health Technology Assessment?? | 2010 |
| **PORTUGAL** | Guidelines for Economic Drug Evaluation Studies. (44) | INFARMED, National Authority of Medicines and Health Products | 1998 |
| **RUSSIAN FEDERATION** | Guidelines for conducting a comparative clinical and economic evaluation of drugs (45) | Center for Healthcare Quality Assessment and Control of the Ministry of Health of the Russian Federation | 2016 |
| | Guidelines for assessing the budget impact in the framework of the Programm of the State Guarantee of Free Medical Care in the Russian Federation (46) | | 2016 |
| **SCOTLAND** | Guidance to submitting companies for completion of New Product Assessment Form (47) | Scottish Medicines Consortium (SMC) | 2020 |
| | Guidelines for the Economic Evaluation of Health Technologies in Ireland (48) | Health Information and Quality Authority | 2019 |
| **SLOVENIA** | Rules on the Classification of Medicine on the List (Official Gazette of RS, no. 35/2013 , dated 26/04/2013 no. 1323) (49) | Health Insurance Institute | 2013 |

| Country | Reference of Guide/manual for conducting Economic Evaluation of health technology | Author | Year |
|---|---|---|---|
| **SLOVAKIA** | Guidelines for Economic Evaluation of Health Care Interventions (50) | Ministry of Health of the Slovak Republic | 2011 |
| **SPAIN** | Spanish Recommendations on Economic Evaluation of Health Technologies (51) | Bastida et al | 2010 |
| | (52) | CatSalut | 2014 |
| **SWEDEN** | General guidelines for economic evaluations from the Pharmaceutical Benefits Board, The Dental and Pharmaceutical Benefits Agency (TLV), 2003 (53) | The Dental and Pharmaceutical Benefits Agency (TLV) | 2017 |
| | Handbok till Tandvårds- och läkemedelsförmånsverkets föreskrifter (TLVFS 2011:3) om ansökan om pris och subvention för förbrukningsartiklar (54) | The Dental and Pharmaceutical Benefits Agency (TLV) | 2011 |
| **SWITZERLAND** | Handbuch betreffend die Spezialitätenliste (including Appendices), Bundesamt für Gesundheit, 2013 (55) | Federal Health Office | 2013 |

**Supplementary Table 2** **Descriptions of the methodology of use of resource and cost estimations.**

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **AUSTRIA** | Direct costs include direct medical and direct non-medical costs. Direct medical costs arise directly from the treatment (e.g. diagnosis, drug therapy, medical care, in-patient treatment, etc.). Direct non-medical costs arise from the consequences of the disease or treatment (e.g., transport costs, care services, etc.). | The resources should be presented in physical units. Unit quantities and prices should be defined in a transparent way. if experts were used to define the resource requirements, the method must be present. | In a competitive market, this value is represented by market prices (e.g. drugs, medical devices, etc.). In absence of competitive market, scales of charges or fees or other forms of administrative reimbursement should be used. In other cases, substitute quantities or "shadow prices" should be used. If there are no published data for the cost survey, calculations and individual assessments (estimates, mean values, exploration of published data from entire Austria) should be performed. |
| **BALTIC GUIDELINES** | All direct costs inside the health care system. If relevant, include all costs outside healthcare system, presented separately. | Costs should be adapted to the local health care circumstances and include: changes in the identification of resources (to include only those resources relevant to current practice)<br>- changes in the number of resources in natural units (number of consultations, number of bed days, etc.)<br>- changes in the cost per unit of resources. | All costs should be reflected in local currency. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **BELGIUM** | Reference case: Direct health care cost related to the disease and to the disease in life years gained.<br><br>Separate analysis: other non-healthcare cost, indirect cost important for the intervention evaluated | Measurement of resource use should be done by means of observations or derived from literature.<br><br>Observational data can be obtained from ECAS, prospective observational studies, databases and patients charts. Studies from other countries should be validated for Belgium.<br><br>Panel expert under specific conditions and as complementary source of information. It provides detailed description of databases to collect this information. | Valuation in market price or some kind of mechanism used for the reimbursement of Procedures.<br><br>Other: micro-costing.<br><br>*Drugs:* products under the reference pricing system or generic pharmaceutical products exist; the lowest priced product should be used.<br><br>*Per diem hospitalization*: the weighted average per diem prices that account for disparities in the case-mix (different levels of activities) of the hospitals should be used+ Lump sums for drugs, medical imaging and clinical biology (with specific methods for valuation explained in the guide). *Average transportation cost* is estimated in a standard cost of 0.30€ per kilometer (This fee is indexed each year with the health index). No adjustment is done for the type of transport (personal car, public transport, etc.) and the number of kilometers is limited to a maximum of 15 per journey (i.e. 30 kilometers per day). |
| **CROATIA** | Evidence should be presented to demonstrate that resource use and cost data have been identified systematically.<br><br>All costs and benefits outside the health care system, may be presented in addition, if considered relevant. | Not specified | The resources should be valued using the prices relevant to the Croatian Institute for Health Insurance. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **CZECH REPUBLIC** | It is necessary to properly identify all types of costs relevant to the disease (direct and no direct healthcare costs, indirect costs. Individual cost items can be identified from data obtained from the literature, recommended procedures for the treatment of the disease, expert opinions, questionnaires, patient registries or database data. | A description of the resources drawn and their frequency in terms of the average patient is recommended, both in terms of transparency of evaluation and for the possibility of reassessment of changes in payments, respectively.<br><br>Resource data can be drawn from databases and patient registers, data from health insurance companies, data from health facilities, cross-sectional / longitudinal or other studies. In case of lack of data from these sources, a panel of experts can also be used to obtain inputs to the analysis. The composition of the panel of experts, as well as its statements, must be documented, while the variability of individual expert answers should be discussed, which can then be tested in the sensitivity analysis. | Natural units of costs are assigned financial units according to the relevant code lists (e.g., List of medicines and PZLÚ covered by health insurance, Code list of hospital medicinal products, Code list of medical devices, Code of medical services, Code list of relative weights) and decrees (eg Decree on the list of medical procedures, as amended, Decree on the determination of point values, the amount of payments for paid services and regulatory restrictions).<br><br>The date of validity of the code lists or decrees used must always be indicated.<br><br>It is also possible to use the analysis of items specifically charged to health care payers (so-called institutional or outpatient accounts of the insured). |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **DENMARK** | Resource consumption that is expected to vary between the technologies compared as well as between the patients (marginal analysis) that needs to be collected.<br><br>Recommended method: the performance of pilot studies, modeling and expert opinions; or construction of a decision tree showing the possible courses of the disease and of the therapeutic options. | Distinction is made between prospective (resource use collected during a clinical study) and retrospective (sending questionnaires to patients, general practitioner or via register data).<br><br>With deterministic data, resource consumption is in practice assumed to be the same for all patient (standard templates). A characteristic feature is using average data.<br><br>Some relevant hospital registers include Danish National Patient Registry (NPR). In the primary sector, the Health Insurance Service Registry, Sick Pay Registry, Pharmaceutical Database. | Use micro-costing method when the resource consumption is relevant for the analysis and a gross-costing method when costs are less relevant (by DRG).<br><br>Market prices are used for example for medicines.<br><br>Examples of unit costs used in practice for different resource inputs:<br><br>*Labour*: Average rate of pay for the specific personnel group (where appropriate, corrected for length of service)<br><br>*Medicine Hospital:* cost price. Primary sector: the pharmacy's retail price (comprising both the user payment share and the share of the Danish National Health Insurance Service)<br><br>*Material Hospital:* purchase prices. Primary sector: the patient's own payment (ifany) (and the Danish National Health Insurance Service's share).<br><br>*Capital equipment (plant, buildings):* Operating costs + depreciation. The depreciation of the equipment per annum is calculated on the basis of the investment price, the depreciation period and the discount rate<br><br>*Overhead activity*: All hospital expenditure on overheads (cleaning, food, lighting, etc.) is distributed on a "step-down" basis to a department's activity, e.g. overheads per bed day<br><br>*In-patient stay*: Daily price for hotel expenditure in connection with hospitalization. Alternatively, distributed on a "step-down" basis as above.<br><br>VAT is included in the cost analysis. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **ENGLAND** | Costs should relate to resources that are under the control of the NHS and personal and social services. Evidence should be presented to demonstrate that resource use and cost data have been identified systematically.<br><br>Costs related to the condition of interest and incurred in additional years of life gained as a result of treatment should be included in the reference-case analysis. Costs borne by patients may be included when they are reimbursed by the NHS or personal social services. When care by family members, friends or a partner might otherwise have been provided by the NHS or personal social services it may be appropriate to consider the cost of the time of providing this care in a separate analysis. | Healthcare resource groups (HRGs) are a valuable source of information for estimating resource use. | Public list prices for technologies, when there are nationally available price reductions then the reduced price should be used in the reference-case analysis to reflect more faithfully the price relevant to the NHS. When a reduced price is available through a patient access scheme that has been agreed with the Department of Health, the base-case analysis should include the costs associated with the scheme. In the absence of a published list price and price agreed by a national institution, the price submitted by the manufacturer may be used, provided that it is nationally and publicly available.<br><br>Using HRG can reduce the need for local micro-costing (costing of each individual component of care related to the use of a technology) when HRG is not appropriate, micro-costing studies can be more appropriate. VAT is excluded for the cost. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **FINLAND** | *All direct health care and comparable social welfare costs related to the therapies that are being compared.*<br><br>Costs must also be divided into entities that are relevant to the evaluation. It is recommended to separate between direct healthcare costs and direct non-healthcare costs. | The doses used in the medicinal treatment, the frequency and the route of administration and possible dose titration with grounds and source references must be reported | *The costs of medicinal products are calculated using the retail price, excluding VAT. If a medicinal preparation is administered in the outpatient unit within public healthcare, from which it is also dispensed, the wholesale price has to be used.*<br><br>The costs of medical products administered in public healthcare must be based on the product's wholesale price. If the comparator or other medication considered in the evaluation has conditional reimbursement status with a confidential agreement between the Pharmaceuticals Pricing Board and the pharmaceutical company, the applicant must assess the effects of the agreement on the results of the evaluation with sensitivity analyses.<br><br>Medicine wastage has to be included in the costs. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **FRANCE** | All the resources, which are likely to vary between the interventions being compared, are identified over the time horizon selected.<br><br>Future costs independent of the interventions being studied are not taken into account.<br><br>The reference case analysis systematically identifies all resources incurred in the production of the interventions evaluated. The identification of resources covers the whole time horizon selected to take into account the long term cost consequences of interventions. | The volumes of resources used in the production of interventions are given for France, preferably on the basis of publications or ad hoc studies, giving priority to data from current practice: prospective observational studies, databases, patient registers.<br><br>Several French sources exist, most of which have been set up with an objective other than evaluation such as: reimbursement by the health insurance schemes; invoicing of the establishments' activities; analysis of health product markets; medical registers, etc. | Valuation based on Tariffs. Expenditure over and above the tariffs are included in the reference case analysis; differences between the tariff and the acquisition price paid are documented and studied in a sensitivity analysis.<br><br>*Hospital cost*: To approximate the production cost of a hospital stay, the preferred source of data is the National costs study (represent average costs), based on the hospital cost accounting system by DRG, or data from payment for hospital activity based on HRG valued as tariffs. When it is necessary, any change made to the components of the average cost issued must be explicit and well argued.<br><br>When the interventions studied are likely to be funded across several DRGs (or HRGs), the cost is valued taking into account the distribution of the interventions.<br><br>It is preferable to weight the tariffs from both the public and private sectors (including fees).<br><br>Costs in the outpatient sector are based mainly on tariffs.<br><br>Resources lacking a tariff are valued at the average acquisition price paid if it can be identified, or by another method which must be specified.<br><br>Micro-costing techniques are particularly suitable in case of innovation.<br><br>Foreseeable cost changes are taken into account. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **GERMANY** | Resource identification requires specifying the perspective, selecting a time horizon and determining the relevant health care providers.<br><br>Expert opinion may be considered.<br><br>Future costs independent of the interventions under study should be considered in separate sensitivity analyses.<br><br>If cost-offsets are taken into consideration, they should be investigated in a comprehensive sensitivity analyses. These start-up costs should also be identified and quantified. | Measuring the quantity of relevant resource consumption must be based on up-to-date and high quality data.<br><br>It should consider the frequency of use, the proportion of the relevant patient population that uses each service and the duration of that service have to be taken into account.<br><br>Level of precision in measuring services and resources is influenced, for instance, by the tariff system and particularly by the service units, which are stipulated in a fixed pricing system. Either a micro-costing or a macro-costing approach can be used. When using the micro-costing approach, quantification is based on the resource utilization (personnel, material, equipment, building, overheads, etc.) for health care services. | When using micro-costing approach, it is recommended to use resource prices. When cost estimation focusses on medical procedures, it is recommended to use market prices, if available, unless there are good reasons for adjusting to social opportunity costs.<br><br>Recommendations for the valuation of drugs:<br><br>A rough estimation of long-term opportunity costs (on the basis of "market shares") might be performed. For other drugs (other than the intervention and the technologies compared in the health economic evaluation), adjusted market prices will often be sufficient for the estimation of opportunity costs. In the case of considering R&D costs, they should be reported separately. In addition, an analysis without considering R&D costs should be conducted.<br><br>A Working group has calculated standard costs for the most relevant health services and resources. |
| **HUNGARY** | Costs closely connected to the given Health service and the costs avoided by means of the new technology can be taken into account (direct healthcare costs and direct non-healthcare costs). Future cost independent of the interventions under study should be considered in separate sensitivity analyses. | Micro-costing can be useful when the DRG source is not sufficient for defining the costs of the technologies used. | Fees set in legal regulations. If necessary, other cost can be analyzed separately from the base case. In any case, additional analyses must be compared at real prices (the realness of prices is to be ascertained by the authority assessing the healthcare technology, with the involvement of the payer). The costs of healthcare services need to be presented indicating the International Classification of Procedures in Medicine and HBCs list price values (outpatient and inpatient care cost values). Taxes, including VAT, must be taken into account in the cost calculations. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **IRELAND** | The resources that should be considered are direct medical costs for the HSE.<br><br>Current and future costs arising because of a technology and that occur during the specified time horizon of the study should be included in the reference case analysis.<br><br>The inclusion of cost offsets must be clearly justified, as they may not be achievable in practice.<br><br>Capital costs should be appropriately depreciated. Relevant maintenance costs may apply over the lifetime of certain equipment (for example, MRI scanner) and should be included in calculations. | Resource use data can be obtained from the literature or by primary data collection: RCTs, meta-analysis, clinical practice guidelines, local administration and accounting data, and expert opinion. The quality, validity, relevance and generalizability of this data to the publicly-funded Irish healthcare setting should be clearly described. | As there are no agreed Irish cost models available, there is a need for flexibility regarding cost valuation.<br><br>All assumptions and cost estimates must be clearly reported and subjected to sensitivity analysis.<br><br>Two general approaches: micro-costing and macro-costing (involve the use of diagnosis-related group (DRG) or, in exceptional cases, average per diem costs). Cost will have to be estimated as a weighted average of several DRGs, where weights are based on the expected number of cases with each DRG code.<br><br>For non-drugs, the public list price should be used in the reference case analysis.<br><br>Prices for drugs supplied through the community drugs schemes are listed in the reimbursement files of the Primary Care Reimbursement Service which are updated monthly. For new drugs, a system of external reference pricing is used. In the absence of a published list price, the price submitted by a manufacturer of a technology may be used. Drug administration costs, the cost of drug wastage, and the cost of therapeutic drug monitoring should be itemized and included where appropriate. Discounted prices that reflect the true cost to the HSE can be taken into account.<br><br>Labour (pay) should be calculated using consolidated salary scales available from the HSE, Adjusting for pay-related costs in Ireland.<br><br>VAT should be excluded. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **ITALY** | A list must be made of all cost categories (direct medical, direct non-medical, indirect) with the types of resources (for example, doctor's visit, type of hospitalization, time dedicated by the caregiver, time lost at work, etc.) and their amount. | The impact of the intervention on the use of NHS resources must be documented by solid empirical evidence, such as ECAs, observational studies (prospective or retrospective) and registries. For some cost items, the impact of which is not particularly significant, it is possible to refer to the expert opinion, if the method of collecting the opinions is adequately described in the presentation report.<br><br>Micro-costing is better when if the cost estimation is carried out at various healthcare structures.<br><br>When resources derive from an in-depth examination of one or more healthcare structures, or from a study, the analysis criteria used and the population must be specified, both in terms of user and productive capacity. | For reference case, estimates of unit costs that derive from adequately representative samples of Italian healthcare facilities, using the available accounting systems are preferred.<br><br>In the absence of adequate estimates of production costs, the prices with which the services are purchased from the NHS or the tariffs used to finance public or private structures can be used. In this sense, the reference case would use prices and tariffs as a cost proxy.<br><br>The prices and rates used for the reference case must be those practiced on average in the NHS and may differ from official prices and list values. The use of prices and tariffs must be justified and discussed, also by referring to each other different approaches to the estimate of unit costs.<br><br>If necessary, reference may also be made to unit cost estimates used in other studies, except that the procedure by which they were obtained must be clear and the relevance of the data for the specific context of the reference case must be verified. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **THE NETHERLANDS** | Unit identification does not refer to the costs associated with initial treatment, but also to the costs associated with side effects, complications or follow-up treatments. (direct healthcare cost/cos for patient and family/Cost in other sector). | These sources can be divided into primary data and secondary data.<br><br>Primary data are clinical trial, in which, in addition to clinical data, data on the use of care are also collected. Secondary data sources are formed by already existing data sources, for example patient statuses, financial information systems of healthcare institutions or databases of insurers. Important sources for identifying units are:<br>• Clinical guidelines, including those of general practitioners (NHG; nhg.artsennet.nl) and medical specialists (www.richtlijnendatabase.nl).<br>• Treatment protocols of hospitals.<br>• Medical and health economic literature.<br>• Registrations (for example observational studies / real-world data) that show healthcare consumption in daily Dutch practice. • Expert opinion.<br>• DBC Information System. | Main source for valuing resource units are references prices, which are average unit costs.<br><br>The gold standard method is bottom-up micro costing, when is not available, gross-costing methods can be applied.<br><br>Emergency care, ambulances, blood products, daycare treatment in mental health care and rehabilitation: reference prices calculated using top-down gross-costing, for which data on costs and volumes were derived from healthcare providers.<br><br>Primary care physicians, paramedical care, elderly care, home care, mental healthcare and healthcare for disabled patients (expenditures and volumes derived from national health care database): reference prices calculated using top-down gross-costing,<br><br>independent psychotherapists and psychiatrists, ambulatory consultation in a general institution and inpatients days in mental health care: tariffs are used<br><br>Important sources for valuing units are:<br>• Reference prices (main source)<br>• Own cost price research<br>• Financial registrations within care organizations<br>• NZa rates<br>• DBC / DOT rates<br>• Market prices<br>• National registrations<br>• Literature |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **NORWAY** | Not specified | Not specified | Market prices should be used as proxies for unit costs / calculation prices.<br>VAT is excluded. Average cost is used.<br>Capital costs associated with treatment are usually already included in physician fees, DRG-weights, outpatient clinic fares, grants to nursing homes, etc.<br>Nevertheless, the potential for generic competition have to be incorporated when forecasting future drug prices. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **POLAND** | It is recommended to describe a given technology in detail, to identify the resources to be accounted for in the analysis. | The choice of data sources depends on the required degree of detail to be analyzed, and it is based on the following criteria: research perspective, share of a given component in the total or incremental cost, data availability, equilibrium between internal and external reliability.<br><br>Resource use should be measured and assessed separately in detail by micro-costing or gross-costing. The gross-costing is acceptable when the implementation of the more accurate micro-costing might have no significant impact on the analysis of results. | The following methods of assessing the monetary value of resource use can be implemented:<br><br>use the standard cost lists; use the formerly published research, use local scales of charges, direct calculation.<br><br>It is recommended to use local scales of charges.<br><br>Direct calculation can be used when the assessment of resource units, which have special impact on the total or incremental cost, and in the cases when no data from other sources are available. the researcher should select:<br><br>a specific environment, --<br><br>a calculation method (either —top-to-bottom‖ or —bottom-to-top‖), --<br><br>a method of cost allocation (e.g. costs from other hospital wards, buildings, the cost of general purpose equipment and fixed costs).<br><br>Top-to-bottom method can be used in the case when services of a given ward are characterized by a high degree of uniformity. bottom-to-top method is more suitable if the services at a given ward are heterogeneous. The allocation of costs from other hospital wards, buildings and the cost of equipment and fixed costs should be apportioned by the direct allocation method.<br><br>It is recommended to use standard values for the calculation of certain unit costs. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **PORTUGAL** | Direct cost (those related to the treatment and its consequences) and non-medical direct cost are included. | The quantification of the resources used is based on country's clinical experience. When data have to be obtained on the basis of foreign studies, they should be reassessed in the light of the situation in the country. | Market prices (societal perspective), shadow prices (DRGs or convention tables as the approximate price of healthcare), or fixed standard costs. Cost tables should be created, validated and maintained for use in these studies. The costs have to reflect the opportunity cost. In data used during a study, researchers should clearly identify the values used. The least consistent method of resource valuation is using accounting costs. |
| **RUSSIA** | Direct cost is included. The inclusion of direct non-medical and indirect costs in the analysis is left to the discretion of the researcher. | Not specified | The financial costs and / or tariffs applicable in the budget insurance system are used:<br>- rates of compulsory medical insurance (MHI) (for types of medical care provided under the basic program of MHI);<br>- financial support standards for the State Guarantees Program for providing Russian citizens with free medical care;<br>- standards of financial costs for the payment of high-tech medical care; |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **SCOTLAND** | Resource use and cost data have been identified systematically. | For resource use, data from elsewhere in the UK are acceptable. Resource use data from other countries or estimated by a panel of experts should be avoided if possible, or at least validated for the Scottish setting (e.g. by demonstrating that treatment patterns are similar between the country in question and Scotland) and included in a sensitivity analysis. | First point of reference: official listing published by the Scottish Government Health Department, National Services Division, the Department of Health in England and/or the Welsh Assembly Government. Other references: Data on Scottish hospital costs; NHS Reference Costs; Primary care and community costs from the Unit Costs of Health Care publication.<br>Literature: the methods used to identify the sources should be defined. Where several alternative sources are available, a justification for the costs chosen should be provided.<br>Capital costs should be annuitized and included in all types of costs where relevant, unless a specific short-term perspective is required and only resources that can be released within this timeframe are considered. VAT should be excluded from all economic evaluations |
| **SLOVAKIA** | Direct health care costs should be included | Relevant sources should be used for unit costs | The resources should be valued by prices regulated by a competent authority. The prices should be modified by +/- 30% in the sensitivity analysis. |
| **SLOVENIA** | Direct health costs | Scientific publications, GPC, professional activity, data from WHO and other institutions responsible for setting drug prices. | No information |
| **SWEDEN** | Not specified | Not specified | The pharmacy's retail price (AUP) should be used for medicines. |

| Country | Resources identification | Measurement of resource use. Methodology used | Monetary valuation of direct cost |
|---|---|---|---|
| **SPAIN** | Include present and future costs directly related to the evaluated interventions. | Recommend reporting on the use of resources of the compared technologies indicating the resources used in physical units (amounts) prior to their monetary transformation. | Official publications, analytical accounting data and tariffs applied to the NHS service provision contracts.<br>CatSalut (ref): medications: CatSalut catalogue prices. |
| **SWITZERLAND** | Direct healthcare costs are included. Significant savings in indirect costs should be documented. Unrelated future costs due to prolonged survival should be included in the budget impact analysis. | Not specified | Reimbursement rates established by health insurers, tariffs and other administratively fixed rates; 2. market prices if 1 is not available. |

**Supplementary Table 3** **Source of cost information by country**

| Country | PRIMARY RESOURCE | | | |
|---|---|---|---|---|
| | staff | medical device | drugs | Other consumables |
| **AUSTRIA** | Austrian data from cost calculations published in cost studies | | | |
| **BELGIUM** | | **Reimbursed implants and invasive medical devices per category**: http://www.riziv.fgov.be/fr/professionnels/sante/fournisseurs-implants/Pages/remboursement-implants-dispositifs.aspx#Mesures_d%E2%80%99%C3%A9conomies%C2%A02018 | **Unit price for reimbursement and non-reimbursed drugs**: http://www.cbip.be/fr/chapters/1?frag=9990003 | |
| **CROATIA** | Croatian National Institute of Public Health, *http://www.hzjz.hr/epocetna.htm*<br>Republic of Croatia - Central Bureau of Statistics, *http://www.dzs.hr/default_e.htm*<br>Croatian Institute for Health Insurance, http://www.hzzo-net.hr/index.php | | | |
| **Czech REPUBLIC** | | Ministry's website<br>http://www.mzcr.cz/Odbornik/obsah/zdravotnicke-prostredky_1968_3.html | The list of prices and reimbursements of LP / PZLÚ is published by the Institute on its website (Home / SÚKL / Official Board / Overviews of prices and reimbursements of medicines / List of medicines and PZLÚ covered by health insurance): http://www.sukl.cz/sukl/seznam-medicines-covered-health-insured | Ministry's website<br>http://www.mzcr.cz/Odbornik/obsah/zdravotnicke-prostredky_1968_3.html |
| **UK** | | | | |
| **DENMARK** | No info | No info | No info | No info |
| **ITALY** | No info | No info | No info | No info |

| Country | PRIMARY RESOURCE | | | |
|---|---|---|---|---|
| | staff | medical device | drugs | Other consumables |
| **SLOVENIA** | Scientific publications, CPG, evidence from professional societies, data from the WHO and other institutions responsible for drug prices ... | No data | No data | No data |
| **FRANCE** | Tariff | TARIFF (reference case) or average purchase price observed in the national hospital-discharge summaries database system (PMSI) database for expensive drugs and devices are not included in the hospital stay tariff | National hospital-discharge summaries database system (PMSI).<br>Generic drugs are reimbursed on the basis of the reference tariff (the least expensive generic product, *"tarif forfaitaire de responsabilité"*), but can be marketed at a price which is freely determined by the manufacturer. They are valued at their average purchase price, all taxes included; drugs that are not reimbursed or medical devices invoiced at prices above tariff are rated at the purchase price actually paid.<br>In the case of a drug, and if the patent is about to expire, the foreseeable fall in price is studied in a sensitivity analysis. | TARIFF (reference case) or average purchase price observed in the PMSI database for some expensive products not included in the hospital stay tariff |
| **FINLAND** | Evaluation must be based on as up-to-date information on the costs in Finland as possible. | | | |
| **GERMANY** | Administrative data (Health insurance funds, Private health insurance, Statutory pension insurance, Statutory long-term care insurance, National Association of SHI Physicians, German Hospital Federation, Hospitals | | | |

| Country | PRIMARY RESOURCE | | | |
|---|---|---|---|---|
| | staff | medical device | drugs | Other consumables |
| **HUNGARY** | | | | |
| **SCOTLAND** | Staffing costs should include all costs incurred by the NHS as an employer, not just the salary. Standard approach to estimate staff cost time would be to use estimates that include annuitized capital and education costs as in the long term all costs are variable and therefore have an alternative use and subsequent opportunity cost.<br><br>In order to calculate staff costs for use in economic models, SMC ask for salary plus on-costs divided by the full working week. | | Medicine costs should be based on unit prices listed in the BNF or MIMS. Where a Patient Access Scheme (PAS) is proposed for the medicine under review, both the list price and the PAS price should be used for calculating the base case results and all sensitivity analyses.<br><br>For the comparator medicine cost, if a volume-weighted average based on Scottish practice is used, a comparison with the cheapest medicine should be included in a sensitivity analysis. | |
| **RUSSIA** | | | The source of information on prices for medicines should be the State Register of maximum selling prices for vital and essential medicines (http://grls.rosminzdrav.ru/pricelims.aspx) including VAT (10%) and maximum wholesale allowances (weighted average value) for subjects of the Russian Federation included in the analysis (based on population). The price of the drug submitted for inclusion in the essential drugs used for conducting the CEI must correspond to the price that will be submitted for state registration (the maximum selling price of the manufacturer), if the drug is included in | |

| Country | PRIMARY RESOURCE | | | |
|---|---|---|---|---|
| | staff | medical device | drugs | Other consumables |
| | | | the lists of medicines for medical use taking into account the maximum wholesale allowances (weighted average for subjects of the Russian Federation included in the analysis) and VAT (10%). | |
| **IRELAND** | *Using consolidated salary scales* available from the HSE by adjusting for pay-related costs | No reference | Reimbursement files of the Primary Care Reimbursement Service (PCRS) | No reference |
| **NORWAY** | | | *Source for Pharmaceuticals used in in-patient treatment of cancer:* Norwegian national register for cancer drug treatment . In cases where treatments affect only the variable cost estimates and not the fixed costs, fixed costs should be calculated and then subtracted from the proxy estimates.<br>The potential for generic competition must nevertheless be incorporated when forecasting future drug prices. this is regulated by the stepped pricing system. Information about registered market access applications for generic products can be found on NOMA's website. | |
| **THE NETHERLANDS** | Personnel costs can be calculated with a top down or bottom up approach. Cost categories that are counted as personnel costs:<br>Personnel costs<br>Gross salary<br>Irregularity allowance | Tariffs (costing manual). tariffs for the most common diagnostic procedures, such as common laboratory assessments, MRI and CT-scan. Generally, these tariffs come close to the actual costs. Tariffs for other diagnostic procedures can be | The calculation of medication costs consists of two components:<br>1) the price of the medication itself (including VAT), which can be derived from www.medicijnkosten.nl and 2) delivery costs of the pharmacy, which is €6.00 for regular deliveries | |

| Country | PRIMARY RESOURCE | | | |
|---|---|---|---|---|
| | staff | medical device | drugs | Other consumables |
| | Holiday pay<br>Health insurance allowance<br>Social insurance contributions<br>Pension contributions<br>Supplement for WAO benefits<br>Commuting travel costs<br>Gratuities<br>Parental leave | found on the website of the Dutch National health care authority (NZa) and are updated regularly. | | |
| **NORWAY** | *Physician and specialist services:* The cost may be calculated by multiplying the relevant fee stated in the official tariff lists, by two (x2).<br><br>The Norwegian Medical Association and the Norwegian Health and Care department can be contacted in order to obtain a copy of the official list of fees and grants. | | Norwegian national register for cancer drug | |

**Supplementary Table 4** **Source of cost information by country. Composite good and service and Process or Intervention**

| Country | Composite GOODS AND SERVICES | PROCESS OR INTERVENTION |
|---|---|---|
| **BELGIUM** | **Length of hospital stay**: Resource: (APR-DRG) Cellule Technique pour la gestion des données RCM-RFM: https://tct.fgov.be/webetct/etct-web/html/fr/index.jsp<br>**Ambulatory and hospital health care services**:<br>Cost:http://www.riziv.fgov.be/fr/themes/cout-remboursement/par-mutualite/prestations-individuelles/prix/Pages/default.aspx#.Wo1RYajiaUk<br>**Hospitalization per day and per type of hospital stay:** http://www.riziv.fgov.be/fr/themes/cout-remboursement/par-mutualite/hopitaux/Pages/prix-journee-hospitalisation.aspx#.WpPhp6jiaUk | Aggregated data (coupled MKG and MFG data). Classification according to the ICD9-CM and INAMI–RIZIV nomenclature codes:<br>• Mean length of hospital stay per APR-DRG / Severity of illness<br>• Distributional parameters per APR-DRG / Severity of illness<br>• Average cost per hospital stay per APR-DRG / Severity of illness<br>https://tct.fgov.be/etct/index.html |
| **CZECH REPUBLIC** | Decree on setting the values of the point, the amount of payments for paid services and regulatory restrictions for the given year<br>http://www.mzcr.cz/Odbornik/obsah/zdravotni-sluzby_1046_3.html | The code list of relative weights is published on the Ministry's website (Main page / Health services / DRG / Methodological materials): http://www.mzcr.cz/Odbornik/dokumenty/metodicke-materialy-2014_8590_1058_3.html |
| **NORWAY** | *Outpatient laboratory and radiology services:* sum of the reimbursement fee per consultation and patient co-payment, multiplied by two (x2). For a copy of the official list of tariffs, user fees and grants, please contact the Norwegian Directorate of Health and/or HELFO.<br>*Nursing home services:* It is recommended to contact SSB (KOSTRA) and the Norwegian Directorate of Health for access to reliable estimates of the average cost of nursing home services.<br>*Psychiatric care:* It is recommended to contact the Norwegian Directorate of Health for reliable estimates of unit costs in the mental health service. | *Hospital services* : Cost calculated using an ISF-reimbursement rate of 100%. |
| **CROATIA** | Croatian National Institute of Public Health, http://www.hzjz.hr/epocetna.htm<br>Republic of Croatia - Central Bureau of Statistics, *http://www.dzs.hr/default_e.htm*<br>Croatian Institute for Health Insurance, http://www.hzzo-net.hr/index.php<br>MEDTAP International, http://www.medtap.com/ | |

| Country | Composite GOODS AND SERVICES | PROCESS OR INTERVENTION |
|---|---|---|
| **HUNGARY** | No reference | No reference |
| **IRELAND** | No reference | No reference |
| **GERMANY** | In primary care sector, there is a detailed price system (Doctors' Fee Scale by reimbursement through the SHI), specifying prices for a broad range of medical procedures (e.g. examination, lab test, diagnostic imaging, etc.). In addition, it is possible to derive less precise valuations (e.g. expenditure per consultation). | PROCEDURE. Tariff system based on DRG-based hospital payment: http://www.g-drg.de/Datenbrowser_und_Begleitforschung/G-DRG-Report-Browser/G-DRG-Report-Browser_2017<br>Standard cost list for the most relevant health services and resources by *Methods in Health Economic Evaluation" Working Group of the German Society for Social Medicine and Prevention* |
| **FRANCE** | HOSPITAL STAY: National costs study (ENCC) based on hospital cost accounting system by DRG (Represent average cost), and data from the T2A (Payment by hospital activity) based on Healthcare resource groups and which must be viewed as tariffs. Micro-costing studies provide other evidence that could be more appropriate in case of innovation (the intervention evaluated changes the production cost of one or more components of medical products or services for which there is a tariff, when the intervention evaluated has no tariff.<br>Tariff for an HRG<br>Flat-rate price<br>Outpatient sector: Medical, paramedical and technical procedures can be valued on the basis of tariffs | PROCEDURE: ENCC by DRGv, tariff for an HRG |
| **PORTUGAL** | HOSPITAL STAY: DRG and public price (Ordinance 234, of August 7, 2015 **Regulation and Price Tables of Institutions and Services Integrated into the National Health Service** Diário da República (Federal Official Journal), 1st series – No. 153) | PROCEDURE: DRG and public price (Ordinance 234, of August 7, 2015 **Regulation and Price Tables of Institutions and Services Integrated into the National Health Service** Diário da República (Federal Official Journal), 1st series – No. 153) |
| **SCOTLAND** | No reference | Data on Scottish hospital costs are available on a per diem basis from Scottish Health Service Costs, which can be found at:<br>http://www.isdscotland.org/isd/info3.jsp?p_applic=CCC&p_service=Content.show&pContentID=797 |

| Country | Composite GOODS AND SERVICES | PROCESS OR INTERVENTION |
|---|---|---|
| | | NHS Reference Costs from the Department of Health are acceptable. Primary care and community costs from the Unit Costs of Health Care publication by Personal Social Services Research Unit, University of Kent, are also acceptable (www.ukc.ac.uk/PSSRU/). Other sources of cost data should be clearly explained. |
| **NORWAY** | The valuation of intermediate goods and services must, to the greatest extent possible, reflect market prices and exclude VAT (although taxes that correct for externalities such as environmental taxes must be included, if relevant). Use of average costs instead of marginal costs. NOMA recommends:<br><br>Hospital services: The cost can be calculated using an ISF-reimbursement rate of 100% instead of the reimbursement rates hospitals operate with (most often, under 100%).<br><br>*Physician and specialist services and Outpatient laboratory and radiology services:* The cost may be calculated by multiplying the relevant fee stated in the official tariff lists, by two (x2). True cost of providing medical and specialist services (e.g. consultations) is covered through both fees and government grants. An official list of fees and grants are provided by The Norwegian Medical Association and the Norwegian Health and Care department, and HELFO<br><br>*Nursing home services: average cost provided by* SSB (KOSTRA) and the Norwegian Directorate of Health<br><br>*Psychiatric care : unit cost for mental care service provided by* Norwegian Directorate of Health | No reference |
| **THE NETHERLANDS** | Hospital day stay/ outpatient visits according to medical speciality: Public tariff (Costing manual) | Costing manual |

**Supplementary Table 5 Remuneration of medical staff given the type of setting and country**

| | Primary care | Ambulatory care | Hospital |
|---|---|---|---|
| **England** | salary | salary | salary |
| **France** | fee-for service | fee-for-service | salary |
| **Germany** | capitation | fee-for-service | salary |
| **Italy** | capitation | | |
| **Poland** | capitation | | |
| **Portugal** | salary* | | salary |
| **Slovenia** | Capitation + fee-for-service | salary | salary |
| **Spain** | salary | salary | salary |
| **Sweden** | salary | salary | salary |

*Source: Own elaboration*
*Notes: *The salary may consists of a base salary and achievement of performance indicators.*

**Supplementary Table 6 Countries where remuneration of medical staff is based on a capitation**

| | ITALY | POLAND | GERMANY |
|---|---|---|---|
| Annual earnings per patient | 38,62 € | 159 zł | |
| Quarterly earnings per patient | | | 63,15 € |

*Source: Own elaboration*

**Supplementary Table 7 Countries where remuneration of general practitioners is mostly based on a salary: cost elements included in the contract**

| | ENGLAND | GERMANY | PORTUGAL | | SLOVENIA | SPAIN** | SWEDEN |
|---|---|---|---|---|---|---|---|
| Annual (net) income (before tax) | 109,600 £ | 170,351 € | | | | | |
| Monthy disposable net income | | 7,117 € | | | | | 45,061 kr |
| Working hours per week | 41.8 | 48 € | 35 | 42 | 40 | | |
| Monthly salary | | | 2,253.07 € | 2,974.06 € | | | 90,700 kr |
| Hourly wage | 125 £* | 39 € | 14.86 € | 16.34 € | | | |
| Annual gross salary | | | | | 44,330.53 € | 44,779.05 € | |
| Annual leave | | | | | yes | | 5,858 kr |
| Medical pension plan | | 20,654 € | | | yes | | |
| Health and long term care insurance | | 9,295 € | | | yes | | |
| Income tax | | 55,002 € | | | yes | | |
| Annual disposable net income | | 85,399 € | | | | | |
| Sick pay | | | | | yes | | 406 kr |
| Overheads | yes | | | | | | 12,831 kr |
| Social fees | | | | | | | 26,591 kr |
| Incentives | no | no | no | | yes | no | no |
| Endangered positios (like RTG) | | | | | yes | | |
| Transport | yes | | | | yes | | |
| Qualifications | yes | | | | | | |
| Capital costs | yes | | | | | | |
| 3-year supplement | | | | | | yes | |
| Destination supplement | | | | | | yes | |
| Supplement for the position held | | | | | | yes | |
| Working weeks per year | 42.8 | 46 | | | | | |
| Working hours per month | | | | | | | 165 |
| Working hours per year | | | | | 2,088 | 1,642 | |
| Number of annual payments | | | 14 | | 12 | 14 | |

*Source: Own elaboration*
*Notes: Hourly wages were filled in the table only in case they were supported by an official document, otherwise it is up to each investigator to calculate them. *Hourly wage when including direct care staff costs and excluding qualification costs; **Data corresponding to Andalusia region*

**Supplementary Table 8** **Cost of a General Practitioner visit (England)**

| Unit cost 2016/2017 | Including direct care staff costs | | Excluding direct care staff costs | |
|---|---|---|---|---|
| | With qualification costs | Without qualification costs | With qualification costs | Without qualification costs |
| Per hour of patient contact | 243 £ | 204 £ | 219 £ | 181 £ |
| Per minute of patient contact | 4 £ | 3.4 £ | 3.66 £ | 3 £ |
| Per surgery consultation lasting 9.22 min | 37 £ | 31 £ | 34 £ | 28 £ |
| Par patient contact lasting 9.22 minutes (including carbon emissions (8.9 KgCO2e)) | 37.4 £ | 31.3 £ | 34.3 £ | 28.3 £ |

*Source: Adopted from Kurtis and Burns (2018)* (32)
*Notes: The duration of surgery consultation was taken from Hobbs at al. (2016)*(228)
*The cost of carbon emissions including patient and staff travel, electricity and gas for the building, emissions in goods and services used to provide a patient consultation was taken from NHS England report on Natural Resource Footprint*(229)

**Supplementary Table 9** **Tariffs associated to Accident and Emergency care according to investigation and department categories (England)**

| Health Related Group (HRG) name | Type 1 and 2 Departments | Type 3 Departments |
|---|---|---|
| Emergency Medicine, Any Investigation with Category 5 Treatment | 338 £ | 73 £ |
| Emergency Medicine, Category 3 Investigation with Category 4 Treatment | 338 £ | 73 £ |
| Emergency Medicine, Category 3 Investigation with Category 1-3 Treatment | 252 £ | 73 £ |
| Emergency Medicine, Category 2 Investigation with Category 4 Treatment | 227 £ | 73 £ |
| Emergency Medicine, Category 2 Investigation with Category 3 Treatment | 184 £ | 73 £ |
| Emergency Medicine, Category 1 Investigation with Category 3-4 Treatment | 130 £ | 73 £ |
| Emergency Medicine, Category 2 Investigation with Category 2 Treatment | 163 £ | 73 £ |
| Emergency Medicine, Category 2 Investigation with Category 1 Treatment | 155 £ | 73 £ |
| Emergency Medicine, Category 1 Investigation with Category 1-2 Treatment | 106 £ | 73 £ |
| Emergency Medicine, Dental Care | 99 £ | 73 £ |
| Emergency Medicine, No Investigation with No Significant Treatment | 73 £ | 73 £ |
| Emergency Medicine, Patient Dead On Arrival | 73 £ | 73 £ |

*Source: Adapted from: Annex A: The national tariff workbook*(47)

**Supplementary Table 10 Cost of intensive care ambulance (England)**

| | Unit cost | Unit of measurement |
|---|---|---|
| Calls | 7 £ | Call |
| Hear and treat or refer | 37 £ | Patient |
| See and treat or refer | 192 £ | Incident |
| See and treat and convey | 252 £ | Incident |

*Source: Adapted from National Schedule of Reference costs: Year 2017-2018*(44)
*Notes: Cost of a call is not included in categories mentioned in the table.*

**Supplementary Table 11 Weights and costs of nursing activities (France)**

| Professional acts | Metropolitan areas | Overseas areas and Mayotte |
|---|---|---|
| Acts different from nursing care | 3.15 € | 3.30 € |
| Nursing care acts | 2.65 € | 2.70 € |
| Development of a nursing care procedure | 10.00 € | 10.00 € |
| Fixed travel allowance | 2.50 € | 2.50 € |
| Kilometric allowance (flat land) | 0.35 € | 0.35 € |
| Kilometric allowance (mountain) | 0.50 € | 0.50 € |
| Kilometric allowance (foot, ski) | 3.40 € | 3.66 € |
| Night supplement for acts performed between 8 pm and 11 pm and between 5 am to 8 am | 9.15 € | 9.15 € |
| Night supplements for acts performed between 11 pm and 5 pm | 18.30 € | 18.30 € |
| Supplement for acts performed on Sundays and public holidays | 8.50 € | 8.50 € |
| Supplement for single act | 1.35 € | 1.35 € |
| Supplement for nurse coordination | 5.00 € | 5.00 € |

*Source: Adopted from: Les tariffs applicables en métrople, dans les départements d'outre-mer et à Mayotte. Available at:*https://www.ameli.fr/infirmier/exercice-liberal/facturation-remuneration/tarifs-conventionnels/tarif (65)

**Supplementary Table 12 Examples of complex and very complex outpatient consultations (France)**

| |
|---|
| Complex consultations |
| First contraceptive consultation and prevention for a 15 to 18 year girls who wants contraception |
| Chidlhood obesity (over 3 and under 12 years old) |
| Mandatory examintation of an infant (day 8, months 9 and 24) |
| Infant maternity exit consultation |
| Scoliosis |
| Gestational diabetes |
| First consultation for tuberculosis |
| Very complex consultations |
| Initial consultation for information and implementation of a therapeutic strategy for patients suffering from cancer, HIV, Alzheimer's disease |
| Information for parents on fetal or congenital malformations |
| Preparation for renal transplantation |
| Follow-up of an under 7 year old child born very premature |

*Source: Remboursement d'une consultation médicale (2018)*(230)

**Supplementary Table 13 (France)** **Conventional rates applicable to transport by a light medical vehicle**

| Tariff elements | Amount |
|---|---|
| County flat rate zone A | 13.85 € |
| County flat rate zone B | 13.45 € |
| County flat rate zone C | 12.60 € |
| County flat rate zone D | 11.97 € |
| Additional charge | 15.58 € |
| Kilometric rate (per km) | 0.89 € |
| Short journey valuation | |
| journey = 7 km | 6.26 € |
| 7 km < journey ≤ 8 km | 6.05 € |
| 8 km < journey ≤ 9 km | 5.53 € |
| 9 km < journey ≤ 10 km | 5.00 € |
| 10 km < journey ≤ 11 km | 4.48 € |
| 11 km < journey ≤ 12 km | 3.96 € |
| 12 km < journey ≤ 13 km | 3.44 € |
| 13 km < journey ≤ 14 km | 2.92 € |
| 14 km < journey ≤ 15 km | 2.40 € |
| 15 km < journey ≤ 16 km | 1.88 € |
| 16 km < journey ≤ 17 km | 1.36 € |
| 17 km < journey ≤ 18 km | 0.83 € |

*Source: VSL: les tariffs conventionnels. Available at: https://www.ameli.fr/transporteur-sanitaire/exercice-professionnel/facturation/tarifs/vsl-tarifs-conventionnels* (70)
*Notes: The tariffs are valid as of January 1, 2015*

**Supplementary Table 14 Net price of blood glucose test strips of Region Westphalia-Lippe (Germany)**

| Number of packs (of 50 stips each) | Group A1 | Group A2 | Group B |
|---|---|---|---|
| 1 | 26.10€ | 22.85€ | 20.85€ |
| 2 | 26.00€ | 22.75€ | 20.75€ |
| 3-5 | 24.25€ | 21.00€ | 19.00€ |
| 6 and more | 23.25€ | 20.00€ | 18.00€ |

*Source: Adopted from Preisvereinbarung und Preisliste Blutzuckerteststreifen (2019)*(75)

**Supplementary Table 15 Net income in 2016 (Germany)**

| | Mean | Median |
|---|---|---|
| Annual net income | 170,351€ | 147,857€ |
| -Medical pension plan* | 20,654€ | 20,654€ |
| -Health and nursing care insurance** | 9,295€ | 9,295€ |
| -Income tax*** | 55,002€ | 45,036€ |
| Annual disposable net income | 85,399€ | 72,871€ |
| Monthly disposable net income | 7,117€ | 6,073€ |
| Net hourly rate**** | 39€ | 33€ |

*Source: Adopted from Zi-Praxis-Panel – Jahresbericht 2017*(76)
*Note: *General supply tax of a full paying member; 14% or maximum amount 20,654 €/year*
***Contributions to health and long-term care insurance as a voluntarily insured person (childless).*
****Deductible pension expenses: 82% of pension contributions plus health and long-term care contributions*
*****For 46 working weeks per year and a working week of 48 hours*

**Supplementary Table 16 Gross income and income per patient in the last quarter of 2016 (Germany)**

| | Gross income | Income per patient |
|---|---|---|
| General practitioner | 55,490€ | 63.15€ |
| Pediatrician | 56,874€ | 58.58€ |
| Specialist | 55,125€ | 66.53€ |

*Source: Honorarbericht*(77)

**Supplementary Table 17 Average costs per accident & emergency room visit (Germany)**

| Cost center group | Medical service | Nursing and functional service | Drugs | Health products, consumables | Medical infrastructure | Non-medical infrastructure | Total |
|---|---|---|---|---|---|---|---|
| Ordinary ward | 0.49€ | 0.01€ | 0.00€ | 0.00€ | 0.02€ | 0.07€ | 0.59€ |
| Operating room | 0.02€ | 0.02€ | 0.00€ | 0.02€ | 0.02€ | 0.02€ | 0.11€ |
| Anaesthesiology | 0.37€ | 0.19€ | 0.01€ | 0.06€ | 0.02€ | 0.11€ | 0.77€ |
| Endoscopy | 0.09€ | 0.12€ | 0.01€ | 0.09€ | 0.05€ | 0.07€ | 0.42€ |
| Radiology | 4.03€ | 4.68€ | 0.04€ | 2.40€ | 1.44€ | 3.40€ | 15.98€ |
| Labour | 0.28€ | 1.88€ | 0.19€ | 3.01€ | 0.20€ | 0.77€ | 6.34€ |
| Other | 0.46€ | 0.37€ | 0.01€ | 0.14€ | 0.10€ | 0.24€ | 1.32€ |
| Emergency room | 34.87€ | 34.97€ | 1.39€ | 4.75€ | 5.20€ | 18.99€ | 100.18€ |
| Total | 40.62€ | 42.24€ | 1.65€ | 10.48€ | 7.05€ | 23.68€ | 125.71€ |

*Source: Adapted from Gutachten zur ambulanten Notfallversorgung im Krankenhaus (2015)* (80)
*Notes: A cost centre group "emergency room" maps the physical emergency areas in the strict sense.*

**Supplementary Table 18 Type of personnel costs included in the cost of a day of hospitalization (Germany)**

| |
|---|
| Doctors |
| Nursing: nursing care, nursing and nursing staff, carers in intensive care and treatment facilities and dialysis stations |
| Medical-technical service: pharmacy staff, chemists, dieticians, physiotherapists, speech therapists, masseurs, medical-technical assistants, orthoptists, psychologists, typists in the medical and medical-technical field, social workers |
| Function service: nursing staff for the surgical service, anaesthetics, in the outpatient clinic and polyclinics, midwives and maternity assistants, occupational therapists, ambulance service. |
| Clinical home staff: House and cleaning staff of clinics and wards |
| Economic and supply service: disinfection, craftsmen and janitors, kitchens and diet kitchens (including nutritionists), businesses (e.g., butchers and gardeners), laundry and sewing room |
| Technical service: staff working in the following areas or with the following functions: plant engineers, heating, hot and cold water, fresh air, medical gases, electricity, maintenance (e.g., painters, upholsterers and other craftsmen). |
| Management service: Personnel of the narrower and wider administration, registry, and technical administration (e.g., reception and care costs department, security staff, messenger services (postal service), cash office and accounting, gatekeeper, statistical department, telephone operators, administrative staff) |
| Special services: pastoral worker, health care worker, co-worker, etc. |
| Other staff: pupils, as far as these are not counted towards the occupation of the wards with nursing staff, preschool students, trainees |
| Non-allocable staff costs: personnel costs that cannot be assigned to one of the abovementioned personnel groups (e.g., the contributions to be paid by the municipal hospitals for retired civil servants formerly working in the hospitals, occupational benefit contributions, severely disabled persons' fees, costs for a non-hospital occupational health service, non-personnel personnel expenses arising from presentation contracts, retirement and pensions expenses, as far as they are not divisible by personnel groups |

*Source: Gesundheit. Kostennachweis der Krankenhäuser*(81)

**Supplementary Table 19 Type of operating costs included in the cost of a day of hospitalization (Germany)**

| |
|---|
| Food and related services: In addition to meat, sausage, fish and baked goods as well as beverages, fruits, vegetables, frozen foods and canned goods, the foods also include the usual children's nutrition, breast milk and dietetic foods. This item also includes the costs of any food sample inspections and the shipping costs associated with the deliveries. The cost item includes both the expenses for the patients and the staff. |
| Medical needs: The medical need consists of medicines, blood /stored blood/plasma, healing and aids, medical and nursing supplies/instruments, anaesthesia and other surgical needs, laboratory supplies, implants, transplants, dialysis needs, costs for ambulance services and other medical needs. The last three positions are not proven separately in the statistics. |
| Water, energy, fuels: E.g., water including sewage, electricity, district heating, oil, coal, gas. |
| Economic needs: Cleaning/disinfecting, laundry cleaning/care, fuels and lubricants, garden maintenance, cleaning by foreign companies, cultural and religious events (e.g., church services, patient's library, music and theatre performances). |
| Administrative Requirements: The administrative costs include, but are not limited to, such as ffice supplies, printing, postage, post office and bank charges, telephone and teleprinter installations, radio and television, recruitment costs, travel expenses, fares, computer and organizational expenses. |
| Central administrative services: services provided by central bodies of the executing agency, as far as operational and not supervisory services are concerned. It also includes services provided by facilities that the hospital operator operates independently of the hospital or in conjunction with a hospital for several of its own hospitals. |
| Central community services: The main Community services are community laundries, central pharmacies, central kitchens, central computer equipment, central purchasing, etc., which are operated jointly by several hospitals. |
| Rescued commodities: Assets with an average useful life of up to three years, such as: service and protective clothing, laundry, textiles, glass and porcelain items, breathing bags, electric blankets and pillows, image, sound and data recorded in the recovered household goods. |
| Nursing maintenance: Maintenance costs are costs of preserving or restoring assets of the hospital (if the asset does not substantially increase in substance, does not significantly change in substance, does not significantly extend its useful life or is not clear beyond its present state is improved, or if it is completely or predominantly replaced in structural units building parts), operational facilities and installations or outdoor facilities. Only the costs of services (here: maintenance), which were provided for the area of full and part-inpatient hospital services as well as for the deduction of benefits for pre- and post-inpatient services, are eligible for care. |
| Insurance: Premiums for property insurance (fire, liability, glass breakage, burglary, business interruption, etc.) are allocated to insurance costs. |
| Other charges: These include Municipal taxes, chimney sweep fees and garbage collection costs. |
| Other material costs: In this collective item, the costs of rent and lease, material expenses for continuing education and training, premiums within the scope of the employee suggestion scheme, etc. are recorded. |
| Noticeable expenses: Expenses for medical and non-medical personnel not employed in the hospital (e.g., fee-earners or temporary staff employed in the so-called personnel leasing procedure to support the hospital staff) as well as expenses for outsourced services, e.g., external cleaning company, Catering service for the canteen) are reported. They are already included in the aforementioned material costs and will be summarized separately here. |

*Source: Gesundheit. Kostennachweis der Krankenhäuser*(81)

**Supplementary Table 20 Other costs included in the cost of a day of hospitalization (Germany)**

| |
|---|
| Interest and similar expenses |
| These include interest on commercial and residential buildings and interest on facilities and interest on other debt. Be shown separately: Interest on working capital loans = Short-term interest rates borrowed to bridge short-term liquidity difficulties. |
| Taxes |
| The taxes include property tax, vehicle tax, but not wage, church, turnover and land transfer tax, since these are already covered elsewhere. |
| Costs of the training centers |
| The costs of the training centers are reported separately from the costs of the remaining hospital in order to achieve a better comparability of hospitals with and without training centers. The costs of the training centers include the costs of the staff and the material costs of the training centers. |
| Expenses for the training fund |

*Source: Gesundheit. Kostennachweis der Krankenhäuser*(81)

**Supplementary Table 21 General practitioner's increase to be added to the annual flat-rate fee per patient according to the doctor's seniority and number of patients attended (Italy)**

| Nº of patients attended | General practitioner's seniority (years) | | | |
|---|---|---|---|---|
| | From 0 to 13 years | From 13 to 20 years | More than 20 years | More than 27 years |
| Up to 500 | 13.73 € | 15.56 € | 17.26 € | 18.46 € |
| up to 600 | 11.50 € | 13.19 € | 14.98 € | 16.21 € |
| up to 700 | 9.10 € | 10.82 € | 12.61 € | 13.83 € |
| up to 800 | 7.54 € | 9.05 € | 10.86 € | 12.10 € |
| up to 900 | 5.96 € | 7.75 € | 9.50 € | 10.75 € |
| up to 1000 | 4.94 € | 6.75 € | 8.53 € | 9.74 € |
| up to 1100 | 4.10 € | 5.91 € | 7.67 € | 8.91 € |
| up to 1200 | 3.42 € | 5.20 € | 6.99 € | 8.23 € |
| up to 1300 | 2.84 € | 4.63 € | 6.43 € | 7.65 € |
| up to 1400 | 2.35 € | 4.15 € | 5.93 € | 7.14 € |
| more than 1400 | 1.91 € | 3.70 € | 5.49 € | 6.73 € |

*Source: Adapted from Accordo Collettivo Nazionale per la Disciplina dei Rapporti con i Medici di Medicina Generale ai sensi dell'art. 8 del D.LGS. n. 502 del 1992 e successive modificazioni ed integrazioni* (101)

**Supplementary Table 22 Cross-departmental variation of fixed and variable costs over the total costs of Accident & Emergency Department (Italy)**

| | Fixed costs | Variable costs |
|---|---|---|
| A. Directly attributed costs | 94.99% | 5.01% |
| B. Radiology | 5.09% | 94.91% |
| C. Laboratory | 23.62% | 76.38% |
| D. Overheads | 66.86% | 33.14% |
| Total | 75.57% | 24.43% |

*Source: Ministero della Salute*(104)

**Supplementary Table 23 Average cost of Accident & Emergency room (Italy)**

| Hospital | Average cost |
|---|---|
| A | 226.57€ |
| B | 262.34€ |
| C | 237.40€ |
| D | 206.48€ |
| E | 153.37€ |
| F | 353.10€ |
| Average cost of a sample | 241.05€ |

*Source: Ministero della Salute*(104)
*Notes: A to F corresponds with 6 different hospitals that took part in the study.*

**Supplementary Table 24 Standardized average cost of Accident & Emergency room (Italy)**

| Hospital | Average weight for access classified according to IR-DRG | Average cost per standardized case* |
|---|---|---|
| A | 0.5935 | 239.99€ |
| B | 0.6383 | 258.12€ |
| C | 0.6031 | 243.88€ |
| D | 0.6159 | 249.06€ |
| E | 0.5965 | 241.23€ |
| F | 0.5613 | 226.99€ |
| Average cost of a sample | 0.5987 | 242.09€ |

*Source: Ministero della Salute*(104)
*Notes: The weights are based on the activity and cost data of Maryland (US) and they relate to 2002 year.*
**Average cost per standardized case is the result of multiplying the previously defined average cost (see Supplementary Table 23) by the corresponding weight, that is the average weight for access classified according to IR-DRG.*
*IR-DRG, International-Refined Diagnosis-Related Groups*

**Supplementary Table 25 Analysis of the information capabilities of the key indicators of the ambulance intervention suggested in the European Emergency Medical Services (EMS) Project**

| What we want to measure | Variables required | Formula |
|---|---|---|
| Resource indicator | Annual number of hours of personnel available for the entire population for ambulance emergency | Total annual hors staff/ 100,000 inhabitants |
| Indicator of satisfaction of needs (outcome indicator) | Prehospital intervention time for patients who are life threatening | % of red colour interventions met within x minutes |
| Indicator of population needs (state of risk) | Incidence of emergencies for so-called "quintet of the first hour" (cardiac arrest, coronary syndrome, stroke, respiratory crisis and severe trauma) | number of emergencies of this type/ 100,000 inhabitants |
| Complexity indicator welfare | Percentage of "complex" interventions on total intervention (to define what is meant be complex, e.g. if drug administration, assisted ventilation or intubation is necessary, etc.) | Number of complex interventions/total interventions |

*Source: Ministero della Salute*(104)

**Supplementary Table 26 Weights of services provided to patients at the accident and emergency consultation (Poland)**

| Category | The scope of services provided to patients | Weight |
|---|---|---|
| 1 | Assessment of the patient's condition (triage), basic diagnostics (laboratory tests - basic package, ECG), medical advice, nursing care, pharmacotherapy | 93 |
| 2 | Extended diagnostics (laboratory tests - additional package, review X-ray, ultrasound), consultation, small procedures | 248 |
| 3 | Extended imaging diagnostics, monitoring of basic vital functions, pharmacotherapy (intravenous, intramedullary), small outpatient surgery, invasive examination (lumbar puncture, puncture of body cavities), other additional tests | 342 |
| 4 | Activities related to maintaining vital functions, extended diagnostics, intravenous infusions, endoscopy, resuscitation (advanced life support (ALS) using mechanical devices) | 498 |
| 5 | One-day hospitalization of the patient at A&E - monitoring of vital functions, expanded imaging diagnostics (angiotomography, trauma scan, CT under general anesthesia in children) | 746 |
| 6 | One-day hospitalization of a patient at intensive care unit - monitoring of the patient's vital functions according to the card of increased supervision - constituting Annex 8 and 9, respectively, monitoring, artificial ventilation, pharmacotherapy, further diagnostics, damage control | 871 |

*Source: Zarządzenie Nr 16/2018/DSM (2018)*(109)

**Supplementary Table 27 Monthly and hourly salary of nursing staff depending on the salary category (Portugal)**

| | | 35 working hours per week | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal work/hour | | | Extra work | | | | | |
| | | Day work on working days | Night work on working days and day work on Saturdays after 1 pm, Sundays and public holidays | Night work on Saturdays after 8 pm, Sundays and public holidays | Day work on working days | | Night work on working days and day work on Saturdays after 1 pm, Sundays and public holidays | | Night work on Saturdays after 8 pm, Sundays and public holidays | |
| Salary category | Monthly salary 2017 | | | | First hour | Following hours | First hour | Following hours | First hour | Following hours |
| 15 | 1.201,48 € | 7,92 € | 1,98 € | 3,96 € | 9,41 € | 10,89 € | 12,38 € | 13,86 € | 15,54 € | 16,83 € |
| 19 | 1.407,45 € | 9,28 € | 2,32 € | 4,64 € | 11,02 € | 12,76 € | 14,50 € | 16,24 € | 18,21 € | 19,72 € |
| 23 | 1.664,91 € | 10,98 € | 2,75 € | 5,49 € | 13,04 € | 15,10 € | 17,16 € | 19,22 € | 21,55 € | 23,33 € |
| 27 | 1.819,38 € | 12,00 € | 3,00 € | 6,00 € | 14,25 € | 16,50 € | 18,75 € | 21,00 € | 23,55 € | 25,50 € |
| 30 | 2.025,35 € | 13,35 € | 3,34 € | 6,68 € | 15,85 € | 18,36 € | 23,86 € | 23,36 € | 26,20 € | 28,37 € |
| 33 | 2.179,83 € | 14,37 € | 3,59 € | 7,19 € | 17,06 € | 19,76 € | 22,45 € | 25,15 € | 28,20 € | 30,54 € |
| 36 | 2.385,80 € | 15,73 € | 3,93 € | 7,87 € | 18,68 € | 21,63 € | 24,58 € | 27,53 € | 30,87 € | 33,43 € |
| 39 | 2.488,78 € | 16,41 € | 4,10 € | 8,21 € | 19,49 € | 22,56 € | 25,64 € | 28,72 € | 32,20 € | 34,87 € |
| 42 | 2.591,76 € | 17,09 € | 4,27 € | 8,55 € | 20,29 € | 23,50 € | 26,70 € | 29,91 € | 33,54 € | 36,32 € |
| 45 | 2.746,24 € | 18,11 € | 4,53 € | 9,06 € | 21,51 € | 24,90 € | 28,30 € | 31,69 € | 35,54 € | 38,48 € |
| 48 | 2.849,22 € | 18,79 € | 4,70 € | 9,40 € | 22,31 € | 25,84 € | 29,36 € | 32,88 € | 36,88 € | 39,93 € |

*Source: Adopted from Tabela salarial enfermagem 2017*(118)
*Notes: The salary table published by a Ministry of Health contains 115 salary categories. The categories in this table refers to nursing staff.*

**Supplementary Table 28 Monthly salary supplement according to the group the general practitioner belongs to and a number of patients subscribed (Portugal)**

| Nº of patients subscribed to each general practitioner | Group A | Group B | Group C | Group D |
|---|---|---|---|---|
| Up to 1750 | 326.85 € | 228.38 € | 181.24 € | 104.76 € |
| 1751-2000 | 353.04 € | 254.04 € | 205.89 € | 129.90 € |
| More than 2000 | 375.57 € | 278.13 € | 229.42 € | 156.10 € |

*Source: Adopted from Sindicato Independente dos Médicos*(119)
*Notes: Letters A-D refer to different municipalities that are listed elsewhere*(231)

**Supplementary Table 29 Hourly remuneration of medical staff (Portugal)**

| | Normal work | Extra work |
|---|---|---|
| Day work on working days (from 08:00 to 20:00 in case of unionized doctors; including Saturdays from 08:00 to 13:00) | R | First hour - 1.25 R<br>Following hours - 1.5 R |
| Night work on working days (from 20:00 to 08:00 in case of unionized doctors) | 1.5 R | First hour - 1.75 R<br>Following hours - 2 R |
| Day work on Saturdays after 13:00, Sundays and public holidays | 1.5 R | First hour - 1.75 R<br>Following hours - 2 R |
| Night work on Saturdays after 20:00, Sundays and public holidays | 2 R | First hour - 2.25 R<br>Following hours - 2.5 R |

*Source: Adopted from Sindicato Independente dos Médicos*(119)
*Notes: R depends on whether a doctor is a general practitioner or specialist and whether he works 35 or 42 hours per week. Thus, R corresponds to 14.86€ or 16.34 (general practitioner) and 26.17 or 28.79 (specialist).*

**Supplementary Table 30 Types of a "short outpatient visit" (Slovenia)**

| |
|---|
| Shorter telephone or electronic consultation between doctor and patient |
| Blood pressure measurement or parenteral administration of the drug if one or the other is performed by a nurse on the order of a physician |
| Re-prescription of prescription(s) to regulated chronic patients for long-term therapy (renewable prescription is calculated only once in the current year) |
| Inability to work on the basis of a letter of discharge or a medical examiner with clinical findings and prescribed therapy that clearly dictates an inability to work |
| Issue referrals in the case of commissioned supervision by a specialist after the first, urgent specialist examination or hospitalization |
| Re-prescribing a medical device under the responsibility of a personal physician |

*Source: Splošni dogovor za pogodbeno leto 2019*(127)

**Supplementary Table 31 Annual salaries of medical and nursing staff in 2020 (Spain)**

| | Annual salary |
|---|---|
| General practitioner | 44,779.05 € |
| Paediatrician | 44,779.05 € |
| Midwife | 32,033.23 € |
| Nurse | 29,827.10 € |
| Specialist | 53,190.92 € |

*Source: Adapted from Resolución: 0004/2020. Retribuciones del personal de Centro e Instituciones Sanitarias. Ejercicio 2020.(2020)*(140)

**Supplementary Table 32 Average monthly salary of specialist and non-specialist doctor (Sweden, region of Skåne)**

| | Specialist | Non-specialist | Specialist | Non-specialist |
|---|---|---|---|---|
| Average montly salary | | | 74,858 kr | 45,061 kr |
| Vacations | 15.50% | 13.00% | 11,603 kr | 5,858 kr |
| Sick pay | 0.90% | 0.90% | 674 kr | 406 kr |
| Overheads | 25.00% | 25.00% | 21,784 kr | 12,831 kr |
| Social fees | 47.10% | 47.10% | 45,144 kr | 26,591 kr |
| Total | | | 154,100 kr | 90,700 kr |

*Source: Adopted from: Enhetliga principer för debitering av gemensamma läkarresurser (2020)*(153)
*Notes: Vacations: Assessment of the number of vacation days for specialist doctors and non-specialist doctors. The specialist doctors are older than the non-specialist doctors and thus have more vacation days.*
*Sick pay: Standard rate of 0.9% based on the approximate the ratio of sick pay/salary in recent years previously used for to calculate this premium.*
*Overheads: Allowance for training costs, administration for the service and personnel social initiatives such as occupational health, wellness and supervision.*
*Travel costs are invoiced separately by the seller and correspond to real cost. Whether traveling time should be outside or within working hours is decided by individual assessment of each selling and buying manager. Special agreement must be reached if exceptions are to be made which means that medical staff travel during working hours.*
*Invoicing of worked hours during on-call time by specialist doctors and non-specialist doctors corresponding to real cost and with transparency surcharge as above.*

# Appendix

**Stylized example showing how the indices are calculated**

Let us now consider a practical example with:

- Years: 2010, 2012, 2014, 2016, 2018.
- Three elements: consumption goods and . Also, let us assume that good is imported.
- This stylised example has been constructed didactically to show that when prices of goods increase, the quantity consumed of that good tends to fall (at least for goods X and Y).

**Appendix Table 1** **Data for the stylised example.**

| | Good X | | Good Y | | Good Z | |
|---|---|---|---|---|---|---|
| | ***P*** | ***Q*** | ***P*** | ***Q*** | ***P*** | ***Q*** |
| **2010** | 10 | 3 | 5 | 5 | 10 | 4 |
| **2012** | 11 | 3 | 6 | 5 | 12 | 4 |
| **2014** | 11 | 3 | 7 | 5 | 14 | 4 |
| **2016** | 12 | 2 | 15 | 1 | 16 | 4 |
| **2018** | 12 | 2 | 20 | 1 | 18 | 4 |

*Note: P = Price of good, Q = quantity consumed*

**Calculating a Laspeyres index (e.g. CPI):**

In order to calculate the CPI and the inflation rate associated with it, we consider the following formula:

Where represents prices of goods in the current year and represents prices of goods in the base year. As previously mentioned, in this type of index the weights are fixed and are given by the participation (quantity) of each consumer good in the base year. Accordingly, the will be calculated as follows:

$$PC\_C\ (2010) = (10^* 3) + (5^* 5) + (10^* 4) = 95.$$

$$PC\_C\ (2012) = (11^* 3) + (6^* 5) + (12^* 4) = 111.$$

$$PC\_C\ (2014) = (11^* 3) + (7^* 5) + (14^* 4) = 124.$$

$$PC\_C\ (2016) = (12^* 3) + (15^* 5) + (16^* 4) = 175.$$

*PC_ C (2018) = (12* 3)+ (20* 5)+(18* 4) = 208.*

Similarly, will be:

*PC_B = (10* 3)+ (5* 5)+(10* 4) = 95.*

These calculations show how the weights (quantities) to calculate the CPI are set at the base year, and the only thing that varies over time is the price of each good.

**Appendix Table 2** **Calculation of CPI using Laspeyres formula**

| | Good X | | Good Y | | Good Z | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *P* | *Q* | *P* | *Q* | *P* | *Q* | *PC_C* | *PC_B* | *CPI* | *Inflation % per year* |
| **2010** | 10 | 3 | 5 | 5 | 10 | 4 | 95 | 95 | 100 | . |
| **2012** | 11 | 3 | 6 | 5 | 12 | 4 | 111 | 95 | 117 | 16.8 |
| **2014** | 11 | 3 | 7 | 5 | 14 | 4 | 124 | 95 | 131 | 11.7 |
| **2016** | 12 | 2 | 15 | 1 | 16 | 4 | 175 | 95 | 184 | 41.1 |
| **2018** | 12 | 2 | 20 | 1 | 18 | 4 | 208 | 95 | 219 | 18.8 |

*Note: Goods X and Y are domestically produced and consumed by domestic households. Good Z is "imported"*

where the inflation index is simply the growth rate of the CPI from one year to the next, expressed by the following formula:

**Calculating a Paasche index (e.g. GDP Deflator):**

The GDP deflator (henceforth, GDP_D) is calculated using the following formula:

Where the nominal GDP is simply the price of each good produced in the economy multiplied by the quantity consumed of said good in each year, while real GDP in each year is the quantity consumed in that year multiplied by the prices of those goods in an arbitrarily chosen "base year". In a Laspeyres index the quantities are held constant, and the prices vary. However, in a Paasche index, to calculate the denominator ("real GDP"), the prices are held constant to a base year and the quantities are allowed to vary. As before, we report here the calculation for each year:

*Nominal GDP (2010) = (10*3) +( 5* 5) = 55*

*Nominal GDP (2012) = (11*3) +( 6* 5) = 63*

*Nominal GDP (2014) = (11*3) +( 7* 5) = 68*

*Nominal GDP (2016) = (12*2) +(15* 1) = 39*

*Nominal GDP (2018) = (12*2) +(20* 1) = 44*

Vice versa, the real GDP is calculated as follows:

*Real GDP (2010) = (10*3) +( 5* 5) = 55*

*Real GDP (2012) = (10*3) +( 5* 5) = 55*

*Real GDP (2014) = (10*3) +( 5* 5) = 55*

*Real GDP (2016) = (10*2) +(5* 1) = 25*

*Real GDP (2018) = (10*2) +(5* 1) = 25*

The other difference between the CPI and the GDP deflator is the types of goods included in the calculation. The CPI includes all consumer goods and services, including imported goods. The GDP deflator includes all domestically produced goods and services, but does not include imported goods.

**Appendix Table 3** **Calculation of GDP deflator using Paasche formula**

| | Good X | | Good Y | | Good Z | | Nominal | Real | GDP | Inflation |
|---|---|---|---|---|---|---|---|---|---|---|
| | *P* | *Q* | *P* | *Q* | *P* | *Q* | GDP | GDP | Deflator | % per year |
| 2010 | 10 | 3 | 5 | 5 | 10 | 4 | 55 | 55 | 100 | . |
| 2012 | 11 | 3 | 6 | 5 | 12 | 4 | 63 | 55 | 114.5 | 14.5 |
| 2014 | 11 | 3 | 7 | 5 | 14 | 4 | 68 | 55 | 123.6 | 8.0 |
| 2016 | 12 | 2 | 15 | 1 | 16 | 4 | 39 | 25 | 156 | 26.2 |
| 2018 | 12 | 2 | 20 | 1 | 18 | 4 | 44 | 25 | 176 | 12.8 |

*Note: Goods X and Y are domestically produced. Good Z is "imported" so its price is not included in the GDP deflator*

Similar to before, in this case the inflation index is simply the growth rate of the GDP deflator (GDP_D) from one year to the next, expressed by the following formula:

In this example the inflation rate derived from the GDP deflator (Paasche index) is less than the CPI inflation rate and fluctuates less. This stylised example has been constructed didactically to show that when prices of goods increase, the quantity consumed of that good tends to fall (at least for goods X and Y). Because the Laspeyres index does not take account of these substitution effects, it tends to

overestimate the inflation rate. However, the rates of inflation estimated by the two indices are not directly comparable because they are composed of different items.