DRAFT GUIDELINES FOR ESTIMATING EXPENDITURE BY DISEASE, AGE AND GENDER UNDER THE SYSTEM OF HEALTH ACCOUNTS (SHA) FRAMEWORK[1]

Abstract

1. This paper summarizes the methodology for general Cost of Illness (COI) studies and provides guidelines that others can use to set up and carry out a similar study. Special attention is given to the need to use the OECD's System of Health Accounts (SHA) as a framework for international reporting on outcomes of a national COI analysis. The paper is based on experiences of the authors with a series of Cost of Illness studies in the Netherlands. It contains extensive examples taken from the Dutch 2003 COI-study.

1. INTRODUCTION

2. Estimating expenditure by disease, age and gender is a priority area in the ongoing development of the System of Health Accounts (SHA) framework(1) (2). This paper will propose guidelines for making such estimates using a general Cost of Illness (COI) approach. It is mainly based on work done in the Netherlands, where since 1991 a series of COI studies have been published (3-6). In the most recent study on 2003 full compatibility with the SHA was achieved in the health provider dimension (HP-classification). Data from this study are published on the internet (www.costofillness.nl, www.costofillness.eu). Outcomes of these studies have also been used in comparisons with studies of similar design for other countries.(7, 8). Outcomes have been used by the Dutch government to determine the demand for healthcare resources caused by different types of illnesses and variation with age and gender (9). The Dutch ministry of Health also used COI data to project future expenditures and budget needs.(10)

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3. Since several authors demonstrated the rationale for (general) COI research, we focus in this document on 'how' to perform a general COI analysis rather than 'why' it should be done. The usefulness of a COI analysis has been the subject of some debate, ever since these studies started to appear in research journals (7, 11-16), although this critique focuses mainly on disease-specific COI studies. Opponents often argue that COI studies do not provide any concrete solutions, for example for priority setting. Proponents however, consider COI studies to be informative for policy making (not policy making by itself), because of their broad health care perspective.

4. General COI studies show the relative importance of diseases from an economic point of view. They furthermore provide insight in the demographic aspects of health care spending and by doing so COI studies provide a useful background to current policy debates about resource allocation, health care reforms and the effects of ageing on future health expenditure (9). Data from the Dutch COI studies have been used as input for chronic disease cost-modelling which evaluates the effects of current trends in smoking and obesity on future health care costs (17), and have been used in public health forecasting (18).

5. Debates about resource allocation in health care tend to focus on highly visible costs, which attract much public attention, like fees and drug costs. However, these costs usually form the tip of the iceberg. The debate has been especially strong on the costs of new cancer drugs. A recent research report (19) states: "Where data are available in some countries in Europe (eg Germany and France), they show that cancer care accounts for a similar proportion of overall healthcare expenditure to that in the USA (approximately 5%). Although drug costs account for less than 10% of the total healthcare expenditure for cancer, it can be argued that because drug acquisition costs can be easier to identify and calculate, they become a greater focus for cost control than some of the more general (and more difficult to calculate) costs of cancer healthcare.''

6. Such a statement can only be made because some countries did perform an analysis in which costs for specific diseases and specific providers were placed in the context of total health expenditure. A general COI analysis is especially useful in these type of discussions, because it aims to give all diseases and all types of costs equal attention, there by avoiding the 'easy-to-calculate bias'. Fortunately, in the last few years the number of internationally comparable COI-studies has risen (6, 20-22). We anticipate that in providing these guidelines the number will rise even further.

7. This report provides an overview of methodological issues concerning COI-research. In Chapter 2 the main definitions and basic concepts like cost framework and COI analysis will be described. This section also includes a brief description of the three dimensions added by the COI analysis to the SHA-based accounting system: age, gender and disease. Where necessary classifications for the description of dimensions will be proposed.

8. In Chapter 3 a four-step model for COI-calculation will be worked out. Chapter 4, Integration of national results in the SHA, describes the compatibility and implementation of COI-estimates within the health functions and health care funding dimensions of the SHA. Chapter 5 deals with the interpretation of COI-results and also discusses some limitations and caveats of using COI-results. The Appendices contain details about classifications, give examples of output tables and also provide some calculation examples based on the 2003 Dutch COI-study.

2 - DEFINITIONS

2.1 COI analysis

9. Cost of illness (COI) studies add patient-related information (disease, age, gender) to health expenditure data. In the literature three important uses are addressed (23):

- Providing information on resource allocation in health systems
- Analysing time trends and making projections of future health expenditure
- Making international comparisons of health expenditure

10. The COI Information is very useful in current discussions about ageing populations and rising health expenditure. The primary application is, at least until now, in national debates. Use in international comparisons has lagged, mainly because health systems differ substantially and countries use different boundaries of services included in health care costs.(24). However, the introduction of the SHA in 2000 has already improved comparability between countries (8) . Recently several overviews of current work in this field have been made (25, 26).

11. Typical output of a COI analysis is a multi-dimensional table which lists cost estimates for all combinations of all variables, such as health provider, health funding, health function, disease, gender and age. The table size depends upon the number of dimensions involved, and the level of detail in the classifications used to describe these dimensions. From this table secondary outcomes can be computed like costs per capita or per disease case.

12. Since the birth of the COI analysis(27), the field has expanded considerably, and the term is now used for quite different types of analysis. Some attempts to classify these different analyses have been made(28, 29). What these studies have in common is that they all assess the economic burden of disease. Common methodological aspects in which studies differ are:

1. Scope of disease: a distinction is made between 'specific' COI studies which focus on the cost of a particular disease and 'general' studies which calculate costs for all diseases simultaneously. The influential study of Rice(27) was of the general type, but nowadays most studies are disease specific.

2. Demarcation of costs: three groups of costs can be distinguished: direct costs, indirect costs and intangible costs. Direct costs can be divided in direct medical costs for treatment and non-medical costs, for instance the costs of transport to reach a hospital. An example of indirect costs is production losses due to illness. Intangible costs comprise for instance costs due to loss of life or quality of life caused by illness or disability. Various combinations of costs involved can be encountered in the literature.

3. Methods: Most studies use a prevalence based method: all costs due to prevalent cases of disease in a given period are aggregated to total costs. An alternative design is an incidence based method, in which life-time costs are calculated and costs are assigned to the period in which the incidence of the disease occurred. This requires substantially more data than the prevalence-based method and is therefore less often used.

4. Direction of approach: In a top-down design costs for a given disease are calculated by multiplying the total health expenditures with the proportion of this expenditure used by a specific disease. Alternatively, a bottom-up design can be used, in which units of health care used on a patient level are multiplied with a price for this unit. All individual costs are summed up to calculate total COI.

5. Definition of healthcare: even if studies agree in demarcation of costs, there can still be differences because different sectors are included. Some studies limit health care to personal care, Others take a societal view on disease-costs. Not only the cost made for those who are ill should be included. But also the costs made for the direct prevention of illness (screening, vaccination, prevention programmes, awareness programmes) and the administrative costs for running the system or managing insurance schemes.

13. It should be noted that choices regarding these different aspects depend on each other. A bottom-up approach, for instance, is most appropriate when a disease-specific study is performed, whereas a top-down approach is more suitable to meet the data and calculation needs of a general COI-study.

14. Regarding the integration of COI within the SHA framework we advise a: 1) general COI study including 2) direct medical costs only, using a 3) prevalence-based method in a 4) top-down design using a 5) broad definition of health expenditure. The next chapters of these guidelines will deal in more detail with the data requirements and methods of cost calculation in this type of COI analysis.

15. The choice for a general study is inherent to the purpose of specifying COI within the SHA framework: to compare relative amount of costs spent on specific diseases or demographic groups within and between countries. Possibilities for the demarcation of costs depend directly on the available cost framework. Data on direct medical costs are registered by health care providers and in most countries collected by the ministry of health or a national bureau of statistics. Most providers are bound by strict accounting rules for cost data, enforced by law, which ensures reliability. For direct non-medical costs, indirect costs and intangible costs no such accounting systems exist. They can be calculated using a wide range of data and methods, but for the purpose of dealing with COI in health accounts it seems most appropriate to exclude these costs and to focus entirely on direct health care costs. This is in line with the current OECD SHA manual and other international bodies. “The problems associated with ensuring comparability of direct costs between countries compiling SHA are considerable. To include indirect costs requires further collaboration in a separate study because of the different data sources and definitions used in these areas.’’ (26).

16. For a general COI analysis a top-down approach using a prevalence based method is advised. The choice of a prevalence based method is evident because the SHA advocates the collection of data on an annual basis. The top-down method ensures no double-counting of costs occurs, every euro, dollar or whatever the currency unit might be, is assigned to one disease only. In a bottom-up approach this cannot be guaranteed, due to existing co-morbidities. An example is diabetes, which is a major risk factor for cardiovascular disease. In a bottom-up approach costs for the treatment of heart-problems for this patient are counted with both heart disease and diabetes. In a top-down approach the resources spent on this patient are (proportionally) distributed among these diseases. However, the price for the desirable

avoidance of double counting is an underestimation of the 'true' costs of diseases like diabetes which often cause other diseases.

17. Finally, a broad societal perspective on health care in a COI study is preferred above a more limited definition like personal health care. This better represents the real (health care) costs of a disease to society. In most western countries childhood diseases like measles are almost eradicated, so the costs are negligible. However, these costs are low, because society has chosen to invest in vaccination programmes for the eradication of diseases. A COI analysis should show the costs of this investment, even if this is not considered to be 'personal health care'. It should be noted, however, that even in a broad perspective questions about the boundaries of health care arise, especially in the case of prevention. There is strong evidence to include vaccination and screening in COI, but what to do with expenditure on health protection as for instance sanitation and road safety. A Dutch study revealed that almost 80% of costs on prevention was made outside the boundaries of the health care system, even in the broad perspective of the national health accounts.(30, 31)

18. Similar reasoning can be applied for the inclusion of costs on management and health care administration. Between different countries or funding schemes differences in management costs can be considerable, which influences the prices charged to customers for health care services under these schemes, so indirectly influencing resource use. Including costs for running the system in the COI analysis ensures a better comparability of outcomes.

19. Inclusion of non-personal health care has a price: one gets costs for a disease, not for persons with a disease. This implies total costs for a disease can be translated to costs per capita, but not so easily to costs per prevalent case of a disease.

2.2 Cost framework

20. A cost framework for COI analysis can be defined as a table of health care costs (in national currency units). In- or exclusion is determined by criteria based on an established definition of health care costs. Every line in this table describes a single cost estimate in one or more dimensions, using -if available- standard classifications. In this sense COI provides an accounting system for disease costs.

21. Ideally the table should be complete, including all costs within the cost definition. Cost units should also be mutually exclusive: all costs involved should be part of only one cost unit. This ensures that no double-counting occurs.

22. The SHA is the preferred definition of health care costs to be used. Limiting the COI analysis to direct medical costs and taking a broad societal definition of health care – as has been done when defining the COI analysis - does not end discussions on which costs should be included and which not. Different opinions exists within and between countries over what should be counted as health care costs. Should we count the costs of all dental procedures as medical costs? Or should we make a distinction between procedures performed due to accidents, diseases like caries and procedures performed for cosmetic reasons? How should we count training costs for medical specialists? And what about housing costs in homes for frail elderly people: should we view at least part of these costs as care, or do these costs belong to ordinary living costs, and therefore have to be excluded? And still, if we include care costs for the elderly shouldn't we also include child care costs in a comprehensive way that also comprises playgrounds for toddlers, as is the case in the Dutch health accounts? Obviously the SHA was introduced to give guidance in this type of discussions. In the SHA definition paper (1) a detailed description of the SHA is given, which shows how costs should be divided and what should be included and what not. Therefore this will not be elaborated upon in these guidelines.

23. For the purpose of a COI study it is advised to gather in an early stage as much information as possible on the exact nature of every cost unit, if possible a worded description, because this often contains better pointers to where extra information is to be found than the bare dimension-definition. For instance, if in dimensional terms a cost unit is described as: provider/'academic hospital', function/'medical goods' and funding/'government', this doesn't give much clues to the nature of this cost unit. A detailed description for this real-life example 'subsidy experimental drug-therapy hereditary endocrine diseases' gives much better clues for the COI analysis.

2.3 COI dimensions

24. This paragraph provides some guidelines on the descriptions and recommended classifications to be used in individual dimensions of the COI analysis, in both analysis and reporting. For all dimensions it is recommended to use classifications which are in common use internationally, enhancing the comparability of health outcomes. First the three main COI dimensions disease, age and gender are described and second, the provider dimension, also found in the SHA. The other two dimensions of the SHA (funding and function) are not frequently used in COI studies, although they have been experimentally added to the latest Dutch COI study. The linking of outcomes to the functional and funding dimensions is the subject of paragraph 4 'Mapping national results on the SHA'.

25. For all dimensions some aspects are common, and taken for granted: all classifications in use should be complete. This means that it must always be possible to classify a certain cost within the classification. The individual classes used in a dimension classification should be non-overlapping: costs belong to one group in the classification only.

2.3.1 Disease

26. The International Classification of Diseases (ICD) of the World Health Organisation (WHO) is the most important general classification of diseases. Use of this classification in the attribution of health care use is strongly recommended. However, there can be several practical problems with this. The first problem is the sheer size. The ICD contains many thousands of diseases. Analyzing all these is impossible, and moreover not desirable since the most common diseases comprise several individual ICD-codes. The second problem is that two different not fully compatible versions of the ICD are in common use (ICD-9 and ICD-10) and that many countries use slightly different versions of both these classifications. This is especially a problem with the ICD-9 which was originally introduced in 1977. New diseases like AIDS and legionella were not always incorporated in the same way in national translations. Furthermore, not every health care registration will use the ICD as its base classification. The use of the ICD is common in hospitals, but much rarer for other providers like general practitioners, who tend to use much cruder classifications as the ICPC, or psychiatrists who use a classification specific for mental disorders (DSM).

27. These problems might largely be solved by an internationally recognized shortlist of diseases. It would then be possible to map the locally used classifications on this list. Unfortunately such a list does not exist, although some progress has been made. The WHO has in collaboration with OECD, Eurostat and NOMESCO recently developed an international shortlist for the tabulation of hospital data(32) (ISHMT, Appendix I). This is a useful departing point for discussion, but the disadvantage for use in a COI analysis is that it is developed for use on hospital data, and might not be suited for a COI analysis which covers all providers. A survey of available general COI analysis, shows that it is very common to report disease-specific cost data at least at the chapter-level of the ICD (infectious diseases, neoplasm's etc). Further divisions are mainly based on the importance of diseases for national health care policy.

28. An important consideration in the selection of the disease classification regards the level of detail in which disease-specific data are registered. A rough survey of the most important health care registers

before the start of the analysis should provide information on this. Sometimes registers contain no diagnostic information at all. Check in this case if the register contains information that can be used as a proxy, and investigate how this can be linked to a disease. For example a register of drug consumption generally will not contain information on disease or diagnosis. Surveys of prescriptions by medical professionals can then be used to link these consumption data to specific diseases by probabilistic methods. Remember that for each disease classification in use in local health care registers a mapping to the selected diagnostic groups for the analysis must be made.

29. In view of the absence of a firm internationally recognized shortlist of diseases to be used in a COI it is recommended that as a minimum general COI analysis should be performed on main groups of diagnosis as defined by the ICD. Because chapters within ICD-9 and ICD-10 differ slightly it is recommended to use the definitions in ICD terms as provided by the ISHMT shortlist (Appendix I) which contains a definition of chapters in both ICD-9 and ICD-10 terms. A second step is to identify diseases for which it is nationally or internationally important to collect cost-data. This can be a project in itself, and should be done both on a national and international scale. International organizations like the OECD and Eurostat are promising candidates for such an international project, as an extension on current efforts with the ISHMT.

30. For national lists of diseases some considerations should be:

- Epidemiology of disease: include diseases which have a high incidence or a high prevalence and therefore potentially high costs. Australia provides an example(33). The study on health expenditures on disease included a chapter on National Health Priority Area conditions. These conditions were selected by the government as priority areas, because they were considered to contribute significantly to the burden of disease in Australia and potential for health gain was present.

- Morbidity: include diseases with substantial health care needs.

- Mortality: include diseases with a high mortality.

- Severity: include diseases which have a severe impact on the quality of life, even if they are not associated with high morbidity or mortality.

- Public profile: Some diseases have a high public profile (like AIDS or tuberculosis) but not always a high incidence or high costs. Still, they should be included in a COI analysis because they are bound to play a role in policy discussions.

- Importance for public health policy: the occurrence of some diseases depends on the effectiveness of public health policy (for instance vaccination campaigns for infectious diseases).

- Association with important risk factors which are subject to public debate, for example smoking with lung cancer and obesity with diabetes.

- Technical reasons: Some groups are not disease at all, but traditionally grouped with health care costs and must be distinguishable because of this. The prime example regards the costs of pregnancy and (normal) childbirth.

- Gender or age specificity: some groups are important diseases in specific age groups or genders, like breast cancer or prostate cancer. If one does not distinguish these groups, overall comparisons, for instance in costs per capita between man and women can be distorted.

- Known high cost: For some diseases it is known in advance that care or cure costs are very high. It is advised to split these groups. In the last Dutch COI study for instance, 'eye disorders' and 'dental diseases' were split in multiple groups, because from earlier studies it was known these groups carried huge costs, and it was felt more insight would be gained by subdividing these groups in smaller units. Of course, data should allow for this.

- Classifications in use in national health care registers: it is useless to create a detailed classification of diseases for use in a COI analysis, if the main national health care registers do not register in similar detail. A golden rule for the application of this is hard to give. It is best to look first at the classification used in the main curative sectors: hospital, primary care (general practitioner) and drug prescriptions. If for these important sectors a detailed disease classification is possible, using existing health care registers, then a detailed analysis is feasible. If not, it is better to stick with the basic ICD-chapter classification. If this is also impossible, health care registrations have to be improved before a COI analysis is sensible.

31. One way to select diseases is to make a fairly large shortlist from many different sources (for example ISHMT, local mortality/morbidity lists, surveys under health professionals and public) and score these diseases on the aspects above. Select those with the highest scores. In Appendix II the shortlist as used in the most recent Dutch COI- analysis is provided, including a definition in ICD-9 terms, and an indication in terms of costs associated. This list was based on a local project to establish the most important diseases in the Dutch context.

32. For reasons of clarity it is recommendable to select no more than about 100 groups. If this number of diseases is selected, a two-level classification is advised: a 'chapter-level' (based on the ICD-chapter), and a 'group-level' within these chapters. Add to every chapter a rest group for the classification of costs which belong to the chapter but are not classified in a subgroup (other infectious diseases, other respiratory diseases etc). This structure has also been followed within the ISHMT.

33. It is necessary to add some groups to every disease-classification for the costs which can not be classified elsewhere. Two groups are suggested: 'Disease could not be determined' or 'Disease unknown' for disease related-costs for which classification was impossible because of lack of data, and 'Not-disease related' for the classification of costs that are by definition not associated with any disease, for instance the medical examination of a healthy person, or of non-medical costs such as living costs in some residential services.

34. A special issue regards the specification of the costs of accidents and other external causes in disease classifications. In the ICD system the external cause is of secondary importance. In some health care registers a secondary diagnosis is added in which the external cause can be recognized, which in theory should enable the attribution of costs to external causes. However, in many health care registers the external cause is not known. It is recommended that if costs of external causes are determined, these should be published in a separate table, based on a separate COI analysis of relevant health providers.

2.3.2 Age

35. Many health care registers contain detailed age information on health care use. Health care use differs markedly with age, so it is important to use a classification which can identify age simultaneously with disease. Important groups to recognize separately in the analysis are:

- Newborn children (<1 year): this group has special health care needs.

- Adults in the reproductive ages (~20-40 women): this age group is also associated with use of specific health services.

- Middle age: The age of the onset of many diseases.

- Older citizens (>65): use of the health care system rises with age. A detailed breakdown in five year classes is recommended for this group, because health expenditure rises quite steeply with age, although in some countries it has been found that per capita expenditure reaches a peak in the 75-84 bracket and declines afterwards.(26). To capture this effect one should distinguish several strata for the oldest old.

36. It is recommended to use a classification of 21 five year groups with newborn children separate (0,1-4,5-9,10-14,…. ,90-94, 95+). For reasons of clarity and interpretation a smaller set of age groups should be used whenever results are published in (general) tables. In the Netherlands we used 8 groups in most of the reporting, which turned out to be a very useful classification for several purposes (0,1-14, 15-24,25-44,45-64,65-74,75-84,85+). In Germany(34) and Australia(33) different age classifications were chosen. The German COI study used 20 age groups in their study and 6 age groups in reporting (-15, 15-30, 30-45, 45-65, 65-85, 85+) whereas in Australia 10 age groups were reported (0-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, 85+).

37. A common problem encountered in COI analysis is that some health registers do not contain age in sufficient detail. If important registers (in terms of costs associated) contain an age classification with less detail, outcomes should be analyzed and reported for this cruder classification. However, if these costs are relatively minor, one could artificially transform outcomes for these groups to the 21 group-classification, for instance by dividing costs known for 10-year age groups in two five-year groups, using the known population age distribution. Thereby the possibility to report on age in detail is preserved, without sacrificing too much in reliability of outcomes. Appendix II contains a table for the most recent Dutch COI study with outcomes for different age-groups. This clearly demonstrates the importance to distinguish data in five-year age groups, especially for per capita costs for the oldest old.

2.3.3 Gender

38. A gender classification (male/female) seems trivial, but the attribution of costs to gender is not always so. This is especially true for costs associated with pregnancy and reproduction. Traditionally these are grouped with health care. In COI it is common to attribute these costs to the mother. For reasons of comparing men and women it is very important that the cost for pregnancy and reproduction can be separated from other costs. The same applies to gender specific diseases. Appendix II contains a crosstabulation of age and sex taken from the most recent Dutch COI study. Also shown is the share of gender specific costs and the reproduction costs within each group.. This clearly shows the importance of distinguishing these costs in separate diagnostic groups.

2.3.4 Health provider

39. The classification of health providers used in the analysis depends on the one hand on the desired reporting level, and on the other hand on the available cost framework and health care registers. A COI analysis will usually be performed in terms of National Health Accounts (NHA), from which cost distributions in terms of the SHA will be extracted afterwards. NHA and SHA both contain lists of providers. If a NHA provider contains both costs included and excluded in the SHA, it is necessary to separate costs of this provider in subgroups, before the analysis. In most cases this can be done using other information in the NHA. For instance costs not contained in the SHA could be associated with a specific function or source of funding, which can also be distinguished.

40. Another consideration regards the homogeneity of the health services provided and the available utilisation data. Some providers provide many different types of health care, and for each type a separate register may exist. To allow for the attribution of expenditure to disease, age and gender, more homogeneous sets of services should be distinguished among such providers. This subdivision of a provider into several groups will have to be done artificially based on a priori assumptions about the use of health services provided by these health care suppliers. Surveys among providers can be a useful tool to make this subdivision more reliable.

41. Because of these requirements the COI provider classification will contain much more groups than will be published. In the Netherlands, the National Health Accounts distinguish 81 providers. In the Dutch COI study it was decided to report on 22 clusters of providers according the NHA, while with respect to the SHA the highest provider level in the ICHA-HP classification was chosen (8 groups). Furthermore a separate report was made, using a third grouping of (parts of) providers that fitted the definitions of the Dutch Ministry of Health. In order to estimate COI for all these different perspectives about 204 (parts of) providers were analysed separately.See appendix V for a full list of cost units. In France the number of provider groups was restricted to only 5 main provider groups, including 16 subcategories(35). The Australian study(36) could include 18 providers in 9 main groups along the National Accounts and the German COI study(37) reported 16 provider groups which could also be linked to the SHA provider classification.

42. Afterwards the COI calculations for these 204 ‘cost centres’ were aggregated to the three perspectives mentioned above (NHA, SHA, Dutch government). In conclusion: for reporting to international organizations it is strongly recommended to use the ICHA-HP classification of the SHA, at least at the first level. If the study is also to be used on a national level, a national classification of providers should also be adopted in the study. Appendix II contains a table for the most recent Dutch COI study which shows outcomes for the SHA. In a separate cross tabulation the distribution of costs over SHA and NHA providers is shown. This illustrates that differences between these two perspectives can be large.

3 - METHODS

43. Every general COI analysis consists of five phases:

- A definition study to establish whether or not a general COI analysis is feasible, and to specify the dimensions and levels of detail.
- The collection of data on health care utilisation.
- The attribution of costs to the specified dimensions (disease, gender, age and (at least) health provider).
- Verification of attribution of costs
- Presentation of outcomes

3.1 Definition study

44. A definition phase is especially important if no COI analysis has been performed before. It serves to establish that sufficient data are available to the analysis, and sketches general contours of outcomes. The exact structure of a definition study depends on the national situation. However, the goals of the study are more or less the same in every country.

45. The main purposes of this stage are:

- To verify both cost data and health care utilisation data are available in sufficient detail for meaningful outcomes.
- To describe available cost frameworks for the study and assess compatibility with the SHA.
- To produce a comprehensive list of registers of health care utilisation and other data sources (ad hoc surveys, research reports etc) for potential use in the actual COI analysis
- To describe the global properties of these data sources in relation to a COI-analysis
  - Available dimensions (look for age, sex, disease, provider, funding, function). Researchers should be aware that sometimes a dimension in itself is not available, but other types of information are present from which a diagnosis can be estimated. Be creative. Examples are: types of procedures performed, types of care given, types of drugs sold.
  - Available classifications for these dimensions.
  - Time-period: which data years are available?

- Periodicity: regular, ad hoc, frequency
- Type of register (national, regional).
- Validity of the registration: are the data representative?
- Available utilisation indicators (sales, hospital days, number of patients treated, number of procedures performed contact time etc)
- Other relevant properties (sample-size, sample-method etc)
- Terms of use. Some registers have very strict rules on use of information, which could prohibit actual use. Some register holders will charge for the cost of extraction or charge a fee for the use of data.

- To identify gaps in registers (costs in the framework without a suitable health care utilisation indicator)

- To verify for which dimensions a COI analysis is feasible. As a minimum age, gender, disease and at least one SHA-dimension, typically the provider dimension, should be part of the analysis.

- To establish which level of detail is attainable within dimensions.

- To select internationally compatible classifications for these dimensions.

- To create a national network of cooperation. Much of the information needed for the analysis will be dispersed over different register holders. A successful analysis needs input from these register holders, because they often have extra information about registered data (quality, reliability etc) which is not regularly published. So creating good working relations with the holders of these registers, or even participation in the analysis, is essential, and should be part of the project from the start. A central place should generally be given to national bureaus of statistics which commonly keep national accounts, especially for the division of costs in smaller units for analysis their input will be indispensable.

46. If no previous COI-study has been done it is necessary to devote a lot of resources to this phase. But after the construction of a first successful COI analysis this phase becomes routine, and consists mainly of checking up on the continuing availability of data sources used in the previous study, and the adding of new sources. If a previous study exists, it is advisable to start the definition phase with an evaluation of the previous study design and identify areas were improvement is possible.

47. In this definition phase researchers can also learn much from similar studies that were performed in other countries. It might be recommended that the OECD or another international agency takes the initiative to start a network to facilitate the exchange of knowledge and to share expertise.

3.2 Collection of data on health care use

48. For every distinct cost-unit in the chosen cost framework, data on the health care utilisation associated with these costs must be collected. The way data are collected depends on the local situation.

49. Sometimes detailed health data are already collected for the total cost framework on a national level for other purposes, for instance reimbursement. Very often then, a structure will exist for the local

collection of data, either collection by provider or source of funding. In this case data collection means negotiating access to this national collection. Only for a few type of costs will it be necessary to collect extra information, for instance from population health surveys or published research on the utilisation of specific providers. If no such central collection of health data exists, as is the case in the Netherlands, this can be a very time-consuming phase, because each individual register has to be contacted and terms of use must be negotiated.

3.2.1 Gaps in the data-collection

50. It is by no means certain that a health registration exists for every cost unit, especially for relatively small units with a specific purpose, for which a special registration would not be very cost-effective. As long as the costs associated with gaps are relatively small this is not a serious problem, because this will not show up in the total cost analysis, where costs-units are often aggregated to larger units. Very often other sources can be used to give reliable information on at least some dimensions of the cost-unit. Some examples of the Dutch COI study may illustrate this:

3.3 Attribution of costs to disease, age and gender

51. As soon as the definition study has been completed and utilisation data are obtained, the cost calculations in a general COI analysis for direct medical costs using a prevalence based method with top-down attribution of costs is a fairly straightforward procedure, which can be divided into four steps (figure 1):

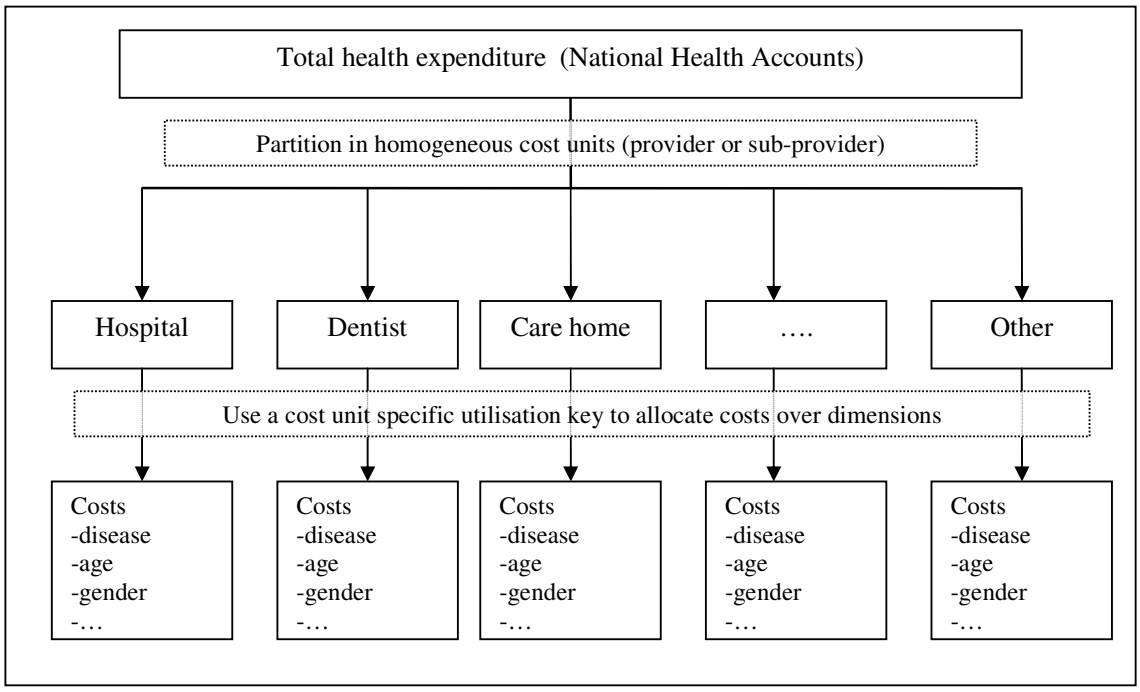
1. Selection of a suitable year for analysis and assessment of national health expenditure.

2. Partition of national health expenditure in homogeneous cost-units.

3. Construction of a detailed probability map (all combinations of all dimensions) based on health care utilisation data retrieved from the collected data sources.

4. Multiplication of health expenditure for a homogeneous unit (from step 2) with the probability map (from step 3) to establish a partial cost of illness table for this unit. Aggregate partial tables for each unit to establish total cost of illness.

Figure 1. Schematic overview general COI-analysis.



3.3.1 Establish national health expenditure

52. For international comparisons it is desirable to select a cost framework which is compatible with the SHA, and uses the same definitions of costs, providers, sources of finance and functions. Collection of basic cost data is not part of the actual COI analysis. The definition study for the COI analysis should produce a list of frameworks already in use, and one should select the framework which is best suited for COI analysis: a detailed description of costs, an as compatible as possible with the SHA.

53. Common sources of cost frameworks are national bureaus of statistics or national health authorities. Because the first application of results is on a national level, it is advised to perform the COI for the selected national framework, using national cost definitions, even if part of it is not compatible with the SHA. For international comparisons one should extract the SHA compatible parts of the COI analysis after performing the analysis.

54. If health care is regionally organized, it might be necessary to collect and analyze regional frameworks separately, and add up afterwards to the national level. The Canadian ´Burden of Illness´ study for example partly relied on regional level data(20). This is in line with the regional orientation of the organization of the Canadian health care system.

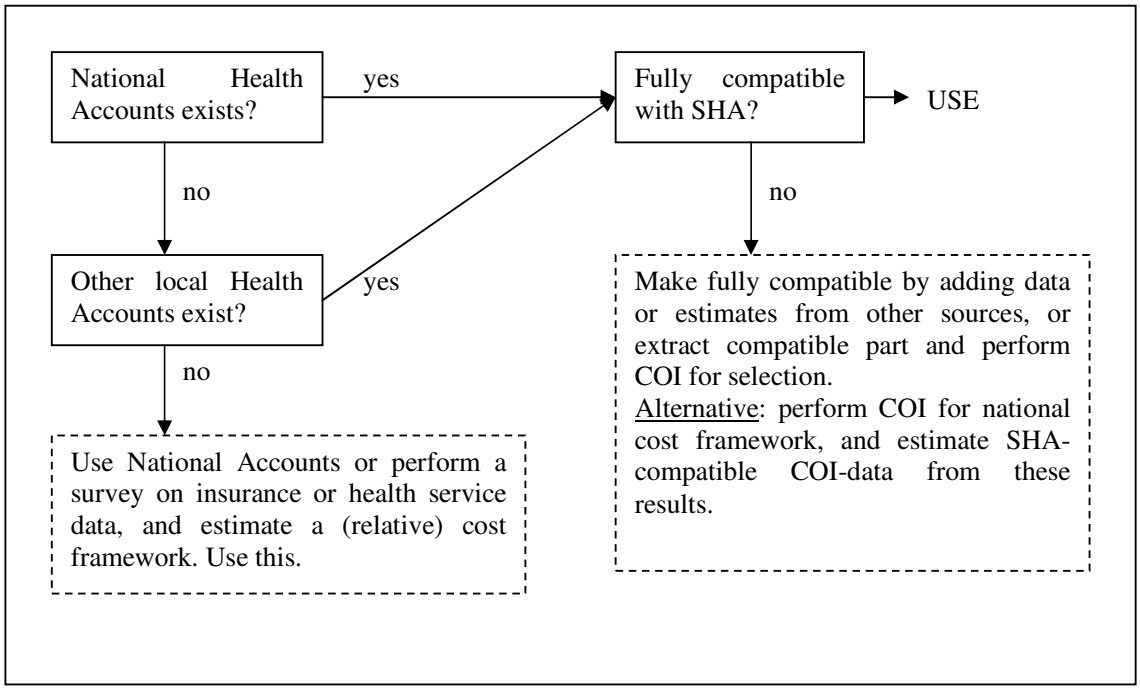
55. If a suitable framework of health expenditure does not exist, one could estimate a cost framework from national accounts. But these measure only added value and not turnover or total costs. A better alternative in the absence of a framework would be to use a population survey, based on data from insurers or a national health service. If total costs are available from these sources, estimation of national health care costs is possible. If not, one could still calculate relative distributions for disease, age and sex, which also give relevant insights. However, comparisons with other countries will be more difficult. Figure 2 gives a summary of the selection options.

Long term stability and SHA-compatibility of framework

56. An important issue is the long-term stability of the cost-framework used. To be of any value in future comparisons, definitions of costs, providers, sources of finance should remain roughly the same, and a track record of changes in definitions should be available. A related issue is compatibility with the SHA. Mapping of the available cost framework on the SHA is a trivial exercise if SHA definitions are already in use. If this is not the case, every distinct element in the cost framework should be re-classified using SHA-definitions. For detailed health accounts this should not be a problem. Two alternative approaches can be followed. The first is to extract the SHA from the selected framework before performing the COI analysis on the SHA framework. The second is to perform the COI analysis on the national cost framework, and extract the SHA afterwards. The second alternative is to be preferred, because it allows for comparison of outcomes between national health definitions and international health definitions. The disadvantage of this approach is that it requires a more detailed cost framework (which allows for the breakdown in SHA and non-SHA costs afterwards) and also demands more data for the analysis.

57. If the selected health framework does not contain enough detail for a match with the SHA, a modelling approach could be used to carve up these costs in a SHA compatible framework, for instance based on data from population surveys or based on existing research reports for cost units which should be decomposed.

Figure 2. Flowchart selection of a cost framework for COI analysis



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Detailed versus aggregated analysis

58. Detail is a two-edged sword in COI analysis. The dimensions of the SHA are defined in multiple levels. Performing the analysis with more aggregated cost data on the highest level speeds up the analysis: less data are needed, but outcomes will be less reliable because many different types of costs have been

aggregated. If costs are more detailed a more reliable COI analysis can be performed because individual elements of the cost framework will be fairly homogeneous.

59. There is interplay here with the availability of data for the analysis. If for instance a DRG registration is in use in national hospitals, which keeps track of disease, age and gender of patients and also weights the severity of the case, a top-down division of hospital costs using this DRG register should give reliable results. If this is not the case it might be necessary to divide hospital costs in several homogeneous groups (for instance ambulatory care, in-hospital care or fees of medical specialists) and analyze these separately using data from different sources. However, this method is much more labour-intensive. Therefore, one should decide on the level of detail after a rough survey of available data sources has been done.

60. Another issue is the availability of resources (time, number of researchers) for the analysis. The amount of costs involved in the analysis has no bearing on the difficulty of the analysis. Small amounts of costs can be as difficult or as easy to analyze as large amounts. This implies a more or less linear relationship between the number of individual cost elements which should be analyzed and the time needed for the analysis. Common sense is also important: if the biggest providers of health care (in terms of costs involved) can only be analyzed on a fairly aggregated level, in-depth analysis of other providers will not make much difference in the aggregated outcome (except for some specific diseases catered for by the smaller providers).

Choosing a time-period

61. It is of course desirable to use as recent data as possible for the COI analysis. This ensures outcomes can play a role in ongoing discussions about health resource allocation. Two processes have to be taken into account: a) the speed with which national health expenditure can be established b) the speed with which indicator-registrations become available.

62. In most countries detailed data on health expenditure are already nationally collected, in a fully automated process, and are available within about one or two years. So in practice it is the second process which determines the choice of the year of analysis.

63. Many different organizations are usually involved in registering health utilisation data, usually organized on provider level. For some providers there will be nation-wide registrations, for others only sparse data exists, often at a local level. In many cases data are collected on a local level alongside the process of care delivery, and are aggregated to a national level after the closure of this period. Moreover, there is generally no automatic collection of this type of data by a national institution. So data have to be collected from many different sources (see also Chapter 2). Because information on a wide range of providers must be collected the speed of the slowest providers of data determines the speed of the over-all process. In addition to this the analysis itself and the reporting of results needs some time. In the Netherlands the time lag between the closure of the period of analysis and the moment of publication of the analysis has been about 2-3 years. Recent COI analysis from other countries have been mostly published within 2-4 years after closure of the analysis period.

3.3.2 Partition of national health expenditure in homogeneous cost-units.

64. Use of a suitable national health cost framework for a COI analysis which is compatible with the SHA, implies in itself a fairly large amount of detail: costs will be split in different units, which quite often are already homogeneous in the provider dimension, and sometimes also in the funding and functional dimension. If this is not the case in public available versions, it will often be possible to use non-published information from the statistical bureau which keeps the national health accounts.

65. The SHA has three basic dimensions of health care provider, health care function and health care source of finance. In practice the best known of these dimensions in many countries, is the provider dimension. This is a direct consequence of how data on costs and health are collected. Often records of these are kept by individual provider-units (individual hospital, GP-practices etc) and aggregated to total cost for a provider on a national or regional level. For the funding dimension complementary registrations exists, for instance for government funding health expenditure or insurance-funded expenditure. In practice both these sources are used in the construction of national health accounts, because they are often complementary.

66. Reasons for the further splitting of available cost units fall into three groups:

- Ensuring compatibility with other frameworks (especially SHA)
- Heterogeneity in key dimensions
- Fitting of cost data to health care utilisation data

Ensuring compatibility with other cost frameworks

67. As a first step, in partitioning units in the national cost frame should be split in two groups if necessary costs included in the SHA and those outside the SHA (if any). For example: national health accounts costs attributed to a provider will often include also non-medical costs. For instance, optometrists sell mostly glasses and lenses to correct eye problems. These medical costs are related to the SHA. However, they commonly also sell sunglasses and optical equipment like telescopes. These costs are non-medical and should be excluded from the perspective of the SHA, and in a COI study using national health accounts they should be labelled as 'not-disease related'. Other examples of non-medical costs are for instance the income from commercial activities within hospitals (shops, restaurants etc).

Heterogeneity in key dimensions

68. Costs-units in a cost framework should also be split into smaller units, if the underlying costs are composites of costs for quite different products. Applying for instance the utilisation key associated with the main product to the total cost-unit can lead to an underestimate of costs of illness associated with specific products for relatively minor diseases. An example from the Dutch COI-study is influenza vaccination. This is administered by general practitioners, but paid for from a special budget. The administering of the vaccination is in collective sessions and doesn't show up in the health register used for GP's, because only individual visits are registered. If GP-costs are analyzed as a single cost-unit, costs for most diseases would hardly be affected because of the tiny amount of costs associated with influenza vaccination (~1% of GP-costs). However the total costs for the disease group 'influenza and pneumonia' would be significantly underestimated (by about 10% as was demonstrated in a post hoc analysis). Therefore, it was decided to analyse influenza vaccination costs in a separate cost unit, split off from other GP-costs. Fortunately this was easy, because the total costs of the vaccination programme were known.

69. In other cases this will likely be not as easy. For instance the costs for in-hospital use of drug prescriptions could not be analyzed separate from total hospital costs, which led to a slight underestimation of costs of illness for diseases which are associated with high prescription costs. Many cost units in national health accounts are homogenous in the provider dimension, but not in the funding or health care function. To split these in homogeneous units might be tempting, but it is useless unless it is possible within health registers to separate health care use between classes of funding or function. In the Canadian study(20) it was mentioned that hospital care expenditures should actually be divided in more groups than

acute care, chronic care and psychiatric care, because of heterogeneity within the defined groups. This however was unattainable.

70. In summary, a separate cost unit is recommended if: a) a certain amount of costs within a larger unit is inhomogeneous in one or more COI dimensions; and b) detailed information on health care utilisation is known for the new sub-unit, so allowing for a separate COI analysis.

Fitting of cost data to health care utilisation data

71. Sometimes cost-units have to be split or even rearranged in artificial units, because no health registration is suitable for analyzing the complete unit, but by rearranging the costs in new artificial units, a fit with existing registers is possible. For example, in the Dutch COI study costs for specialty hospitals form a single cost-unit, but there is no single health register for these types of hospitals. This is solved by splitting the total costs for specialty hospitals in several artificial units, composed of the costs of specialty hospitals which focus on similar diseases (cancer, respiratory diseases, eye disorders, epilepsy etc). For these artificial units analysis is possible, using existing health registers. Sometimes more elaborate rearrangement is necessary: existing units which can't be analyzed are merged and recombined in artificial units which can be analyzed. Appendix IV shows an example of this.

3.3.3 Construction of utilisation keys

72. After the decomposition of total health expenditure in more or less homogeneous units, a utilisation key to distribute costs should be constructed for every cost-unit. A utilisation key is an estimate of the distribution of health care use over distinct combinations of all dimensions. To every key a fraction of total utilisation within the cost-unit is assigned. With six dimensions, the size of keys varies from a few combinations to many thousands. It is important that this key should be complete: fractions in the key must add up to 100% of all care delivered by the cost-unit. Furthermore, the distinct combinations of dimension-classes within a key should refer to the same unit of utilisation only once: no double-counting should occur. The estimate of health care use is based on an indicator for the health care utilisation associated with the cost unit. Appendix III shows an example of such a key for the (sub) provider 'influenza vaccination' which has a distinct budget in Dutch Health Accounts.

Properties of a suitable indicator

73. The main properties of a good indicator for a cost unit are:

- it measures the bulk of total care delivered by the unit
- it is an accurate measure of health care utilisation within the unit: there is a clear relationship between units of the indicator used to estimate COI and the resource costs of the associated health care services.

74. Direct indicators of utilisation often produce the best results. For instance, for dispensing chemists number, type and price of prescriptions are often accurately known. If the prescription registration also contains information on the COI-dimensions is also possible to construct a key using the total sales on drugs. It is important to see that total sales (number of prescriptions of a type times price of this type), is a better indicator than for instance the number of prescriptions alone, because there is a huge variation in the costs of individual prescriptions. In fact in this example the number of prescriptions is weighted with the price. Such a weighting procedure is often encountered. These weights account for differences in resource use, and most often (real cost or market) prices are used as a proxy for resource use. For instance, in hospitals the number of hospital days is a good indicator for part of the hospital care.

However, there is a huge price difference between the costs of a hospital day on a normal ward and a day in an intensive care unit. If the register also contains an indication of the type of hospital day, this type can be used to weight the number of hospital days with the (estimated) price of the type. The distribution of this weighted number of hospital days is a better indicator of utilisation than the unweighted number of hospital days. Not at least in COI research since admission rates for normal wards and intensive care vary among diseases.

75. From this example it can be concluded that direct measurements of health care utilisation in monetary terms (units of care x price of a single unit) often produce the best results. However, this type of data is often incomplete (it covers only particular types of funding), and often a diagnosis is missing, especially in health insurance data, because for reasons of privacy, diagnoses are most often neither registered nor even known by insurance companies. Therefore often other, mostly volume-indicators are used. Table 1 lists some common examples.

Table 1. Commonly encountered indicators of health care utilisation Error! Bookmark not defined.

Provider	Often used indicators
<all providers>	health insurance data
Hospitals	# hospital days, # admissions, # patients, #procedures , DRG's, length of stay
Nursing and residential care facilities	# beds, # in-patient days
Providers of ambulatory health care	# contacts, # visits, # treatment sessions
Retail sale and other providers of medical goods	# prescriptions, sales value
Public health services	Composition target population, # vaccinations, # screenings

Source: #: numbers of the indicator.

Dealing with co-morbidity

76. A common problem in health registers is co-morbidity: a patient is diagnosed with multiple diseases. In a top-down COI analysis it is necessary to attribute costs to a single diagnosis, co-morbidity is ignored.

In a top-down COI analysis health care costs should all be attributed to the primary diagnosis, if the hierarchy of diagnosis is known. If this is unknown costs should be divided between all known diagnosis, if possible using a disease specific weight, for instance based on the average costs of a patient with a single disease. In the French COI study expenditures on physicians were in some cases allocated to a number of conditions when several diagnoses were reported alongside one consultation(35).

3.3.4 Methods for the construction of utilisation keys

77. The methods used for the construction of utilisation keys differ between the cost units, because they are dependent on the availability of health care utilisation data, but they can broadly be divided in five groups, the first being the most desirable method, the fifth the least desirable method.

1. Construction of a utilisation key from a single health care register.
2. Combination of health care registers to construct a suitable utilisation key.
3. Fitting cost data to available health care registers
4. Using a proxy key based on utilisation keys for other cost units or other COI-studies
5. Other methods

Construction of a utilisation key from a single health care register

78. This method can be used if the cost unit is relatively homogeneous, and a specific health care register exists for the cost unit which accurately registers the delivered care (see previous paragraph). At least the dimensions age, gender and disease should be registered. An important example is the Dutch national survey under general practitioners, which registers among many other items diagnosis, age and gender, and measures utilisation as time spent on individual patients, which is a very good indicator for health care utilisation by GP's. By using time spent on a patient as an indicator, individual differences between the use of GP-resources by individual patients are weighted automatically. Similar registers exist for paramedics and for screening programs for diseases. Another example is the register for the use of mental care services which register age, gender and disease, and measure health care utilisation using a government approved product-list, which carry fixed prices. It is important to see that this type of indicators should be preferred over for instance number of patients treated, because this does not account for differences in time and other resources spent on a patient, which differs both between individuals with the same disease and between individuals with different diseases. Example (1) in Appendix IV shows in more detail how a key of this type is computed.

Combination of registers

79. This method has been used if no single register contained all necessary dimensions (age, sex and disease) for the COI analysis. In most cases direct information on the disease was missing from registers. For this method to work, it is necessary that both registers contain the same proxy indicator for the missing dimension, and that one of the registers allows for translation to the dimension-classification actually used in the study For example, ambulatory hospital care in the Netherlands is measured as the number of visits to a medical specialist. The type of specialist is registered, but not the specific diagnosis. Using referral data form a general practitioner database (which did contain both specialist type referred to as well as a specific diagnosis), it was possible to estimate a distribution of the use of ambulatory hospital care for the disease-dimension. Example (2) in Appendix IV shows in more detail how a key of this type is computed. A combination of registers was used to allocate expenditures on medicines in France(21) and the Netherlands(6). Physician consultation data had to be combined with specific prescription data to get all necessary key dimensions.

Fitting cost data to available health care registers

80. Sometimes there exists a mismatch between the definition of costs units in the cost framework and health care registers. If this is the case, costs should be artificially rearranged in units which can be analyzed using existing registers. This has already been described in paragraph 3.3.2. In the Dutch health care study this method has been used within the hospital sector, and is worked out in paragraph 6.3. Example (3) in Appendix IV shows in more detail how a key of this type is computed.

Using a proxy key

81. This method is especially useful for non-personal expenditures on health care. An example regards the costs of management and health care administration. In the Dutch COI study it was decided to assign these costs to disease, gender and age proportional to the distribution of total costs paid out under the different insurance schemes. If management costs referred to multiple cost-units, the utilisation keys for these units were added together, using the total cost in the cost-unit as a weight in this addition. In this way an artificial utilisation key was constructed for management costs, by using other already analyzed keys as a proxy. Proxies were in some cases based on labour survey data. In Australia a survey for staff in aged care homes was used to determine which conditions cause most health problems and most health care use(33). In the French COI study survey data were used to allocate health expenditures on physiotherapists to diseases(35).

82. A very different application of essentially the same method occurs if registration data are missing for the chosen year of analysis but are available for other years. Then the utilisation key can be analyzed for the available year, but applied to costs of the year of analysis. If the difference between these years is small, this should give a good approximation. If a larger difference in time exists the approximation can sometimes be improved by adjusting for demographic shifts over the elapsed period. However this can only be done under the assumption resource use within distinct demographic groups has remained constant, which is obviously not always the case. In Australia expenditures from 1993-1994 were used for some cost units and projected on 2001 while adjusting for demographic changes. It was noted that the results of these projections should be used with caution(33).

Other methods

83. If all else fails there are several methods for still completing a COI analysis for a cost unit. One method is to model a key instead of extracting this from a register. An example from the Dutch COI-study regards the costs for medical care within the military services, for which no direct registration was available. Based on data on the demographic composition of the army, and assumptions on the use of these services an artificial key was created for this cost unit. Another example is vaccination for childhood diseases. The key was based on the structure of the programme. Disease was derived from the type of vaccination, age and sex were derived from the composition of the target group of each vaccination within the programme. Because uptake of vaccines is very high in the Netherlands, this approach should give reliable results. This also shows that ‘other methods’ - were keys are based not on a register but a key is artificially constructed - is not synonymous with guessing, but can produce good results

84. If no method could be found relatively small cost-units have been merged to larger cost units, and the key of the larger unit or a subselection of this key hasbeen applied to the smaller unit. Only for a few cost units this was necessary, an example from the Dutch COI-study is the costs of blood products, which have been merged with hospital cost-units, assuming most of the blood products were used in this sector. Merging was done in final reporting of results. In the analysis groups were not merged, so we would be

able to verify that the impact of the merge was small for all diagnostic groups involved. The utilization key for blood products was based on a subselection of hospital admissions in which use of bloodproducts should be common (injury, surgery, childbirth).

3.3.5 Creating the main output table of the COI analysis

85. After an utilisation key has been constructed for every cost unit, a total COI analysis is easy to perform: multiply the costs for every cost unit with the utilisation key for this unit, and aggregate costs over the study-dimensions. This produces the basic COI output table: one column with costs, and additional columns which describe every dimension in the study, using the most detailed classification level. From this table all other aggregations of costs can be made, by mapping the cost units on the frameworks of interest, like national health accounts or System of Health Accounts.

86. As for cost per capita, these are calculated by dividing costs in every record of the basic output table by the appropriate number of citizens to which costs in this record apply, as described by the gender and age dimension. Remember that a prevalence-based method is used, so we must divide costs by the average population in the year of study. There is a small caveat here: if a population group is relatively small and has a high mortality (which in most countries is the case for instance in the 95+ population), different methods for calculating the average population for age/gender classes in a given year can give markedly different results. Therefore one should always explicitly report how the average population was calculated especially for the older age groups. In the Dutch COI study average population was calculated by averaging the size of age classes on January the 1st and December 31st . Costs per capita for 95+ differed up to 20% if other methods were used (like using the July 1st population as an estimate), while for other age-groups there was almost no difference in calculated costs per capita.

3.4 Verification of data and outcomes

Verification might be applied upon different parts of the COI study, for example the original data (e.g. utilization keys) or on final outcomes (after application of utilization keys and subsequent aggregation). Verification requires that extra data or figures, to verify the original data and outcomes with, are available. This will prove to be difficult in most cases, because in most cases only one data source is available.

Standard statistical methods -for instance the computation of confidence limits on final outcomes- cannot be applied to a general COI-analysis, because many assumptions underlying the analysis can't be verified in a quantitative manner. For instance, a basic assumption in utilization keys is that one unit of product (be it costs, time spent, days in hospital etc) corresponds with an equal amount of health care resources used. In practice this is not the case, and an unknown distribution underlies the average ratio between unit of product and amount of health care resources used. Sometimes this distribution can be estimated (for example by making a distinction between low- medium and high care hospital days, and weighting these with different tariffs), but in many cases this won't be possible. An implicit assumption of the COI analysis is that these individual differences in resource use are largely cancelled out when applied to total costs within a cost unit. It should also be remembered that the goal of a general COI analysis is to establish and compare relative distributions over diseases and demographic categories, NOT comparing point estimates.

Verification of individual keys is generally not useful. In most cases only one source for data on utilization is available, and this has been used in the creation of utilization keys. If multiple sources are available they can usually be ranked a priori on logical grounds for reliability. An example of this is given in Appendix IV, example 1, the screening of cervical cancer. Three alternative sources for the age distribution of women involved in the screening are available, but the measurement of actual turnout by age for the screening gives of course the best estimation, and so this is used in the actual utilization key. It would be pointless to compare outcomes of this key with alternative keys which were judged a priori more

unreliable. Only in rare cases, were two keys of equal reliability are available it could be useful to compare alternative utilization keys from these multiple sources. If one finds large differences it is an indication the key is unreliable.

In most cases it is better to start verification by examing final outcomes, after application of utilization keys. It is recommended to use the basic outcome table to make some simple aggregations first, and examine these qualitatively. Create simple one-dimensional tables which aggregate costs for age groups, both genders and main diagnostic groups. Do the patterns match expectations, or are they comparable to results of previous studies or similar studies in other countries?

If these seem fine, then start making some two-dimensional tables. It is recommended to start with basic plots of costs per age group for every disease. Based on the epidemiology of diseases, and known demographic composition of the population certain patterns should emerge. Most diseases start to appear from a certain age, and cost will rise quite gradually with age from this moment. Among the older ages total costs (per age group) should fall, as mortality increases (and population numbers decline). This pattern is quite general, although details might differ among countries, due to differences in absolute numbers of people per age group, depending on the population history of a country. If strange anomalies appear from this pattern one should re-examine important utilisation keys to check the validity of the analysis.

In the end the comparison with previous studies and studies in other countries still does not provide a hard verification. Face validity is what counts in this case.

A comparison of outcomes with those of other countries requires detailed studying of underlying differences. We would propose that, also for efficiency reasons, a (detailed) international comparison should be performed at a central (international) point.

If countries start international comparisons by themselves they should gain insight into a number of issues. For example differences in data and utilization keys, differences in health system structures or differences in prevalence of diseases. In appendix VI some examples of tables and figures are given which have been used in the comparison of Dutch COI data with those of other countries. These can be used as a starting point for similar comparisons.

3.5 Reporting on outcomes

The basic COI outcome table (see 3.3.5) lists costs for all existing combinations of dimensions. This can be a very large table. The Dutch COI study 2003 resulted in a COI table with more than 400,000 records. This table forms the base of all public reporting on the COI study. The large detail provided by the basic table is useful for research purposes, and for communicating results to the wider research community. Therefore the Dutch study provides a website (www.costofillness.eu) where researchers can create specific tables and graphs, based on this basic output table. It is recommended to make data available to other researchers in as much detail as possible, because this opens up the outcomes for scrutiny by other research groups and enhances the applicability of outcomes for other types of research.

The basic table is also used for creating tables and graphs which should provide a quick overview of the most relevant outcomes. At least the following tables should be provided when reporting to a national audience. Total costs should be defined using a national cost framework:

1. Total cost by disease and gender. Disease should be classified on the ICD-chapter level.

2. Total cost by disease and age. Disease should be classified on the ICD-chapter level.

3. Total cost by age and gender. For analytical purposes a division of age on the most detailed level available is recommended. In the Dutch study 21 categories were used (0,1-4, 5-9,…,95+) For clarity in reporting it is advisable to use less categories. The Dutch study used eight categories, but other COI studies use slightly more categories.

4. Cost per capita for age and gender.

5. If the provider dimension is part of the study: Total cost by disease and provider. Disease should be classified on the ICD-chapter level. Provider should be classified on a meaningfull level for the national audience.

6 If the functional dimension is part of the study: total costs by disease and health care function. Disease should be classified on the ICD-chapter level. Health care function should be classified on a meaningfull level for the national audience.

In addition more detailed tables can be provided, for instance ranking tables of the most important diseases for gender, age or specific providers, or costs per capita for disease and gender, but it should be remembered that too much tables can obscure the message. It might be a good idea to put these type of tables in an appendix, or to make these available on demand.

For international reporting the same basic tables should be provided, but not for total costs (using the national definition), but for costs using the cost frame of the system of health accounts. For provider and health care function the HP and HF classifications should be used.

4 - INTEGRATION OF NATIONAL RESULTS IN THE SHA

87. The technicalities of extracting a COI analysis for the SHA from a COI analysis for national health accounts has already been discussed (3.3.1). This section focuses on the conceptual aspects of this extraction, and is mainly based on the Dutch experience with trying to allocate costs in a COI analysis to provider, function and source of funding simultaneously.

88. In an ideal health care accounts system the exact location within all three dimensions is known for all cost units, and for each element a health care use registration is known in which the provider, functional and financial dimensions can also be recognized. Alas, this is not the case. Information on metadata of published (partial) COI analysis (26) shows that the breakdown of a COI analysis along the provider, funding and functional dimension is strongly determined by a) the structure of national health accounts and b) available health registers.

89. For instance, in the Netherlands and Germany a fairly detailed breakdown of costs along the provider dimension was possible, because both costs and health care use along the provider dimension was fairly well known. But in France costs were subdivided using a classification with both aspects of a provider and a functional classification. This was directly derived from the structure of the French health accounts. As a consequence an exact translation to the provider classification of the SHA (ICHA-HP) was not possible. The same applied to the functional or ICHA-HC classification. The Dutch study was the only study that could separate health expenditures along the funding dimension (although roughly).

90. In the Netherlands, it was attempted to combine the three basic dimensions of any COI analysis (age, gender and disease) with the three dimensions of health care supply: provider, function and funding. This was only partially successful. The main reasons for this were:

- Difficulties in applying the functional classification proposed in the current SHA manual
- Allocation of national health cost data over SHA dimensions
- Incompleteness of health registers

Difficulties in applying the SHA-functional approach

91. It was felt there was some discrepancy between what a health care function should be according to the SHA manual and the current practice within the SHA (using the ICHA-HC classification). In the description of the functional boundaries of health care the functional approach is described as: '…it refers to the goal or purpose of health care such as disease prevention, health promotion, treatment, rehabilitation and long-term care.'

92. However, it seems that in the actual ICHA-HC classification a slightly different approach has been followed, which mixes a functional approach with a provider approach, and in practice allocates expenditure over economic functions, with a basic division in goods and services. This is very clear in HC5 (medical goods dispensed to outpatients) which, if applied on a three-digit level, in the Dutch situation

closely matches providers in this field (for instance HC5.1.1 Prescribed medicines ~pharmacies, HC5.2.1 Glasses and other vision products ~optometrists).

93. But in the Dutch COI research community, this attribution to 'medical goods' is seen to be at odds with a goal-directed definition of health care function. Some medical goods should be viewed as curative, others as mainly for care or prevention. The main focus should be the goal or purpose of services and goods delivered in the context of the processes of cure and care.

Allocation of national health cost data

94. In the Netherlands cost data are collected by Statistics Netherlands from both providers and sources of funding. The functional dimension, using ICHA-HC classification is also added, sometimes based on the nature of the provider or source of funding: for instance costs of the screening program for breast cancer were allocated to the ICHA-HC function prevention and public health services. In other cases a more detailed product register was used to allocate costs over function. For instance the cost for a regular check-up with the dentist were added to prevention. This was only possible because this check-up is a distinct product in product registrations. In many other cases no such registration exists and an estimate has to be made, for instance for the share of prevention cost in occupational services.

95. Estimates often have to be made too for sources of funding, especially for co-payments, because these are generally not available on a patient level, and have to be inferred from aggregated data. For instance by subtracting total costs in insurance schemes (which exclude co-payments) from billing registers of individual providers (which include co-payment). Another source of uncertainty in this field was the large difference between the national and the SHA definitions of health care costs. Large portions of health care expenditure according to the Dutch national definition were not seen as health care following the SHA definition. This is shown by a table in Appendix II. The separation between SHA and non-SHA costs could only be done on an aggregated level of costs, which added more estimates to the cost frame, especially in the functional dimension. The use of estimates in the funding and functional dimension limits the use of these allocations for a COI-analysis.

Incompleteness of health care registers

96. Using a dimension in a COI analysis is only useful if a distinct use of utilisation for these functions can be found. In the Dutch situation, where cost of provider is usually reliably known three scenarios are possible:

1. The costs for a provider can be attributed to a single health care function or source of funding.

2. The costs for a provider should be attributed to multiple health care functions or sources of funding, but these are only partial or not distinguishable in the health care registers. If a COI analysis is forced on this type of cost unit, the same utilisation key is used for every artificial unit. One way of forcing is by a priori dividing the unit in artificial units homogeneous in all three SHA dimensions

3. The costs for a provider should be attributed to multiple health care functions or sources of funding, and these are distinguishable in the health care register, for instance because different functions or sources of funding use different products.

Discussion

97. If the first situation dominates, there is no need to include function and funding in the actual COI-analysis, these dimensions then tend to reduce to alternative aggregations on the provider dimension. If the

second situation dominates attribution of costs to function and funding becomes trivial, and does not provide any extra insight in resource allocation over these dimensions. Only in the third situation new insights can be gained.

98. The relative importance of these situations depends on the classifications used. For the funding dimension in the Netherlands the first and second situation dominate, especially for insurance-based health care and co-payments. Co-payments are generally indistinguishable in health registers used, or incompletely registered. Other sources of funding like special government programs can be distinguished, because they are accounted for separately in Dutch health accounts, so although COI-analysis adds in these cases information on how resources are allocated for these types of funding, reporting on the funding level does not add extra information above reporting on the provider level.

99. For the functional dimension a similar situation exists. Only the health care function prevention was fairly distinguishable in different health registers, and distinct utilisation keys could be made for the allocation of the costs of prevention. However, a definition for prevention was used which was broader than the current SHA-definition. If the current SHA-definition had been used, the COI for prevention would have been reduced to a rather trivial aggregation of costs for several public health providers.

100. Based on existing publications of general COI studies, we think this situation will be rather typical for most countries, although details may differ. In some countries the funding dimension will be much more useful than in the Netherlands as a start for a COI analysis, but in these cases often the provider dimension is less well known.

101. Integrating all dimensions of the SHA in a COI analysis is clearly a field for development. As for funding, because of the large differences in health care systems between countries, even if funding is integrated this will be of only limited use for international comparisons, unless very broad categories are used.

102. From the point of view of international comparison, it would be most useful to have at least some information on the functional dimension of health care, fully integrated within the COI analysis. Differences in opinion about the allocation of costs to functions, should not withhold countries from trying to attribute costs of illness to health care functions. From the comparisons of different results more insight could be gained into what the most fruitful direction in this field is. The best approach would probably be to start with very broad definitions of health care functions, and to achieve firm international comparison of results in these dimensions before more detailed functions can be used. Based on our Dutch experience we would advocate the reporting on three basic functions: prevention, curative functions and long term care functions. The last Dutch COI analysis uses the following definitions for these functions:

- Prevention: all direct medical costs associated with the future prevention of disease both those delivered as personal health care (drugs, vaccination individual anti-smoking programs etc.) and public health care (screening programs), including management costs of such functions.

- Cure: all costs associated with curing diseases and short-term rehabilitation of patients, including management costs of these services, and including both services and goods.

- Long term care: all costs associated with long term care for people with chronic diseases or health related impairment, disability or handicaps, including management cost for these services, and goods specifically used in long-term care.

103. Within the SHA framework only direct medical costs are included in these functions, within the Dutch National Health Accounts, housing and some welfare costs are included too. This especially affects costs allocated to the long term care function.

104. This functional classification, which differs both in level of detail and definition from the SHA should not be viewed as a 'best' way to look at a functional approach, its purpose is to provide a starting point for further discussion. It is clear however, that for purpose of integrating COI in the SHA, the functional classification should be either abandoned or revised.

5 - INTERPRETATION OF RESULTS

105. The methods used in allocating costs set limits on the use of COI data. In this paragraph some final remarks are made about the interpretation of outcomes of a COI analysis.

Average costs per patient

106. In these guidelines a prevalence based method for a COI analysis is described. That means translating costs to average costs per prevalent disease case is theoretically possible. However, there are several caveats. In the first place it is often very difficult to establish the number of patients, and different costs attributed to the same disease may in fact refer to different patient groups. An example regards the number of Dutch patients with arthritis. About ten times as much patients are treated for this condition by a primary care giver than in a hospital. The number of people with arthritic complaints is even much bigger than those seeking treatment.(38) This situation arises because population prevalence is based on self-reported complaints, and prevalence in hospitals on detailed diagnostic tests, which are only used in severe cases, with prevalence in primary care in between. It is clear that average costs per patient can only be computed with much uncertainty in such a situation. Only if very clear, undisputed definitions of diseases are available costs per patient can be computed with any certainty. This is for instance the case for most types of cancer.

107. Another problem is that many diseases have an intermittent character, and severity may vary with long periods without complaints. That means that the costs attributed to the prevalent patients with this disease in a given year are in fact often generated by only a part of the prevalent population, also adding uncertainty.

108. Before average costs are computed one should always consult researchers or health professionals with in-depth knowledge of the disease.

Interpretation

109. The main interpretation of results of a COI analysis should be in the relative importance of all diseases and trends in these. Interpretation of results for specific diseases, ages or gender as exact point estimates of costs should be done with the greatest caution. The main reason for this is that it is impossible to establish firm limits of confidence on the individual point estimates. In both the division of costs in cost units and the derivation of utilisation keys to analyse these units many assumptions have to be made. Sometimes full registers have been used in other cases relatively small samples. Therefore it is impossible to quantify limits of confidence around individual COI estimates.

Cross-sectional data

110. COI analysis offers a cross-sectional view on the use of health care resources, within a fixed time period. Only if multiple COI estimates are available, for different time-periods, it is possible to give a more dynamic interpretation of the changes of resource use over time. Having said this, the cross-sectional data of a single COI study are sometimes used in more longitudinal interpretation. Costs for different

demographic groups (age, gender) from these studies have been used in models to estimate for instance lifetime costs of healthcare, or to predict future demand for health care services.(18) This is useful in estimating the potential effects on resource allocations. However, these results should not be interpreted as predictions of future resource use, but rather as indications for how current use of health care resources should be interpreted. For real longitudinal analysis of dynamics in resource use patient groups should be followed over prolonged periods of time. This falls outside the limits of COI analysis.

Cost-effectiveness

111. A COI study shows the division of costs over the selected dimensions. It provides a background to current resource use, a 'canvas' against other research outcomes can be interpreted, for instance when comparing the cost-effectiveness of two treatment options for a single disease. In this case COI data can be used to estimate an average for total costs on a national level. It is important to stress that a COI analysis in itself does not provide information on the desirability of outcomes. High costs for a disease with a low prevalence could point to expensive treatment, but also to a very effective prevention of this disease, without which costs would even be higher.

112. For this reason one should not interpret results of a COI analysis as potential savings, for instance in a prevention programme. If costs for one disease are brought down, costs for other diseases could rise. Some diseases are each others 'natural enemy'. For instance, since mortality due to coronary heart disease has fallen sharply in many countries, prevalence and costs of chronic heart failure experienced an upward trend. Another variant of this is that even if prevention is successful this could result in higher future health care costs if life expectancy also increases. A fine example of this - partially based on Dutch COI data - can be found in Feenstra et al(17).

113. A similar argument applies to interpreting high costs in certain providers as potential targets for cost containment, this could easily lead to higher costs in other providers, the classical example being that restrictions in the capacity for long term care leads to higher hospital costs, because it becomes more difficult for hospitals to find a place for patients in long term care institutions. On the other hand the opposite might also be possible: investments in a particular health care services could substitute or postpone much higher expenditure in other parts of the health care system. In this context the Lindenberg Hypothesis should be mentioned, which states that higher drug expenditure will save hospital costs.

ACKNOWLEDGEMENTS

114. These guidelines have been prepared for the OECD by the Dutch institute for Public Health and the environment, department of Public Health Forecasting (RIVM-VTV). The mission of this department is to collect and integrate knowledge on health and put this to public use. These guidelines are a good example of this. Development of general COI analysis has very much been a community effort, in which there has been a national and international exchange of methods, tricks and tools. In the Netherlands the Department of Public Health of the Erasmus University Rotterdam has been the first to perform a Dutch general COI analysis (in 1991), later versions have been done in co-operation with RIVM-VTV, which has since 2003 taken over the main responsibility for the study. A very important partner since 2003 is Statistics Netherlands. The extensive knowledge of this institute in the field of national health accounts was essential for connecting the COI analysis to the SHA. Internationally many analysis have been performed since the first general COI analysis of Rice for the United States(27). Reports of these countries have been used extensively in the preparation of this document. An extensive international comparison of these studies has been made and recently published (8). In several International workshops in recent years COI analysis has been a topic. Very useful in the preparation of this document were presentations of Michael Cordes of the Statistisches Bundesamt on a Eurostat workshop (37) and of Johan Polder at a OECD workshop(39).

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Appendices

Appendix I: Disease Shortlist ISHMT.

Chapter-groups highlighted.

Source: http://www.who.int/classifications/apps/icd/implementation/hospitaldischarge.htm

(German and French translations are also available at this site)

International shortlist for hospital morbidity tabulation (ISHMT) - Eurostat/OECD/WHO					
Version 2006-11-24					
ICD Chapter	Group	Code	Heading	ICD-10 Code	ICD-9 Code
I		**0100**	**Certain infectious and parasitic diseases**	**A00-B99**	**001-033, 0341-0992, 0995-134, 1360, 1362-139, +042-044 or 2795, 2796 for HIV (varies according to country)**
I	1	0101	Intestinal infectious diseases except diarrhoea	A00-A08	001-008
I	2	0102	Diarrhoea and gastroenteritis of presumed infectious origin	A09	009
I	3	0103	Tuberculosis	A15-A19, B90	010-018, 137
I	4	0104	Septicaemia	A40-A41	038
I	5	0105	Human immunodeficiency virus [HIV] disease	B20-B24	042-044 or 2795, 2796 (varies according to country)
I	6	0106	Other infectious and parasitic diseases	remainder of A00-B99	remainder of 001-139, except 0340, 0993, 0994, 135, 1361
II		**0200**	**Neoplasms**	**C00-D48**	**140-239**
II	7	0201	Malignant neoplasm of colon, rectum and anus	C18-C21	153, 154
II	8	0202	Malignant neoplasms of trachea, bronchus and lung	C33-C34	162
II	9	0203	Malignant neoplasms of skin	C43-C44	172, 173
II	10	0204	Malignant neoplasm of breast	C50	174, 175
II	11	0205	Malignant neoplasm of uterus	C53-C55	179, 180, 182
II	12	0206	Malignant neoplasm of ovary	C56	1830
II	13	0207	Malignant neoplasm of prostate	C61	185
II	14	0208	Malignant neoplasm of bladder	C67	188
II	15	0209	Other malignant neoplasms	remainder of C00-C97	remainder of 140-208
II	16	0210	Carcinoma in situ	D00-D09	230-234
II	17	0211	Benign neoplasm of colon, rectum and anus	D12	2113, 2114
II	18	0212	Leiomyoma of uterus	D25	218
II	19	0213	Other benign neoplasms and neoplasms of uncertain or unknown behaviour	remainder of D00-D48	remainder of 210-239
III		**0300**	**Diseases of the blood and bloodforming organs and certain disorders involving the immune mechanism**	**D50-D89**	**135, 2790-2793, 2798, 2799, 280-289**
III	20	0301	Anaemias	D50-D64	280-285
III	21	0302	Other diseases of the blood and bloodforming organs and certain disorders involving the immune mechanism	D65-D89	135, 2790-2793, 2798, 2799, 286-289

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Version 2006-11-24					
ICD Chapter	Group	Code	Heading	ICD-10 Code	ICD-9 Code
IV		**0400**	**Endocrine, nutritional and metabolic diseases**	**E00-E90**	**240-278**
IV	22	0401	Diabetes mellitus	E10-E14	250
IV	23	0402	Other endocrine, nutritional and metabolic diseases	remainder of E00-E90	remainder of 240-278
V		**0500**	**Mental and behavioural disorders**	**F00-F99**	**290-319**
V	24	0501	Dementia	F00-F03	2900-2902, 2904-2909, 2941
V	25	0502	Mental and behavioural disorders due to alcohol	F10	291, 303, 3050
V	26	0503	Mental and behavioural disorders due to use of other psychoactive subst.	F11-F19	292, 2940, 304, 3051-3059
V	27	0504	Schizophrenia, schizotypal and delusional disorders	F20-F29	295, 2970-2973, 2978-2979, 2983-2989
V	28	0505	Mood [affective] disorders	F30-F39	296, 2980, 3004, 3011, 311
V	29	0506	Other mental and behavioural disorders	remainder of F00-F99	remainder of 290-319
VI		**0600**	**Diseases of the nervous system**	**G00-G99**	**320-359, 435**
VI	30	0601	Alzheimer's disease	G30	3310
VI	31	0602	Multiple sclerosis	G35	340
VI	32	0603	Epilepsy	G40-G41	345
VI	33	0604	Transient cerebral ischaemic attacks and related syndromes	G45	435
VI	34	0605	Other diseases of the nervous system	remainder of G00-G99	remainder of 320-359
VII		**0700**	**Diseases of the eye and adnexa**	**H00-H59**	**360-379**
VII	35	0701	Cataract	H25-H26, H28	366
VII	36	0702	Other diseases of the eye and adnexa	remainder of H00-H59	remainder of 360-379
VIII	**37**	**0800**	**Diseases of the ear and mastoid process**	**H60-H95**	**380-389**
IX		**0900**	**Diseases of the circulatory system**	**I00-I99**	**390-459 except 435 and 446**
IX	38	0901	Hypertensive diseases	I10-I15	401-405
IX	39	0902	Angina pectoris	I20	413
IX	40	0903	Acute myocardial infarction	I21-I22	410
IX	41	0904	Other ischaemic heart disease	I23-I25	411-412, 414
IX	42	0905	Pulmonary heart disease & diseases of pulmonary circulation	I26-I28	415-417
IX	43	0906	Conduction disorders and cardiac arrhythmias	I44-I49	426, 427
IX	44	0907	Heart failure	I50	428
IX	45	0908	Cerebrovascular diseases	I60-I69	430-434, 436-438
IX	46	0909	Atherosclerosis	I70	440
IX	47	0910	Varicose veins of lower extremities	I83	454
IX	48	0911	Other diseases of the circulatory system	remainder of I00-I99	remainder of 390-459 except 435 and 446
X		**1000**	**Diseases of the respiratory system**	**J00-J99**	**0340, 460-519**
X	49	1001	Acute upper respiratory infections and influenza	J00-J11	0340, 460-465, 487
X	50	1002	Pneumonia	J12-J18	480-486

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ICD Chapter	Group	Code	Heading	ICD-10 Code	ICD-9 Code
X	51	1003	Other acute lower respiratory infections	J20-J22	466 (acute lower respiratory infections other than acute bronchitis, acute bronchiolitis and pneumonia were not separated in ICD-9, no J22 equivalent)
X	52	1004	Chronic diseases of tonsils and adenoids	J35	474
X	53	1005	Other diseases of upper respiratory tract	J30-J34, J36-J39	470-473, 475-478
X	54	1006	Chronic obstructive pulmonary disease and bronchiectasis	J40-J44, J47	490-492, 494, 496
X	55	1007	Asthma	J45-J46	493
X	56	1008	Other diseases of the respiratory system	J60-J99	remainder of 460-519
XI		**1100**	**Diseases of the digestive system**	**K00-K93**	**520-579**
XI	57	1101	Disorders of teeth and supporting structures	K00-K08	520-525
XI	58	1102	Other diseases of oral cavity, salivary glands and jaws	K09-K14	526-529
XI	59	1103	Diseases of oesophagus	K20-K23	530
XI	60	1104	Peptic ulcer	K25-K28	531-534
XI	61	1105	Dyspepsia and other diseases of stomach and duodenum	K29-K31	535-537
XI	62	1106	Diseases of appendix	K35-K38	540-543
XI	63	1107	Inguinal hernia	K40	550
XI	64	1108	Other abdominal hernia	K41-K46	551-553
XI	65	1109	Crohn's disease and ulcerative colitis	K50-K51	555, 556
XI	66	1110	Other noninfective gastroenteritis and colitis	K52	558
XI	67	1111	Paralytic ileus and intestinal obstruction without hernia	K56	560
XI	68	1112	Diverticular disease of intestine	K57	562
XI	69	1113	Diseases of anus and rectum	K60-K62	565, 566, 5690-5694
XI	70	1114	Other diseases of intestine	K55, K58-K59, K63	557, 564, 5695, 5698, 5699
XI	71	1115	Alcoholic liver disease	K70	5710-5713
XI	72	1116	Other diseases of liver	K71-K77	570, 5714-573
XI	73	1117	Cholelithiasis	K80	574
XI	74	1118	Other diseases of gall bladder and biliary tract	K81-K83	575, 576
XI	75	1119	Diseases of pancreas	K85-K87	577
XI	76	1120	Other diseases of the digestive system	remainder of K00-K93	remainder of 520-579
XII		**1200**	**Diseases of the skin and subcutaneous tissue**	**L00-L99**	**680-709**
XII	77	1201	Infections of the skin and subcutaneous tissue	L00-L08	680-686
XII	78	1202	Dermatitis, eczema and papulosquamous disorders	L20-L45	690-693, 6943, 696-6983, 6988, 6989
XII	79	1203	Other diseases of the skin and subcutaneous tissue	remainder of L00-L99	remainder of 680-709
XIII		**1300**	**Diseases of the musculoskeletal system and connective tissue**	**M00-M99**	**0993, 1361, 2794, 446, 710-739**

International shortlist for hospital morbidity tabulation (ISHMT) - Eurostat/OECD/WHO					
Version 2006-11-24					
ICD Chapter	Group	Code	Heading	ICD-10 Code	ICD-9 Code
XIII	80	1301	Coxarthrosis [arthrosis of hip]	M16	Not a concept in ICD-9 at four-digit level. Can only be defined by using the optional fifth digit 5 to 715, i.e. 715.15, 715.25, 715.35 and 715.95
XIII	81	1302	Gonarthrosis [arthrosis of knee]	M17	Not a concept in ICD-9 at four-digit level. Can only be defined by using the optional fifth digit 6 to 715, i.e. 715.16, 715.26, 715.36 and 715.96
XIII	82	1303	Internal derangement of knee	M23	717
XIII	83	1304	Other arthropathies	M00-M15, M18-M22, M24-M25	0993, 711-716, 718, 719, 7271*, 7284*
XIII	84	1305	Systemic connective tissue disorders	M30-M36	1361, 2794, 446, 710, 725, 7285
XIII	85	1306	Deforming dorsopathies and spondylopathies	M40-M49	720, 721, 7230, 7240, 737
XIII	86	1307	Intervertebral disc disorders	M50-M51	722
XIII	87	1308	Dorsalgia	M54	7231, 7234, 7236, 7241-7243, 7245
XIII	88	1309	Soft tissue disorders	M60-M79	726*, 7270*, 7272-7279*, 7280-7283, 7286-7289, 729
XIII	89	1310	Other disorders of the musculoskeletal system and connective tissue	M53, M80-M99	remainder of 710-739
XIV		**1400**	**Diseases of the genitourinary system**	**N00-N99**	**0994, 580-5996, 5998-629, 7880**
XIV	90	1401	Glomerular and renal tubulo-interstitial diseases	N00-N16	580-5834, 5838, 5839, 5900-5902, 5908, 5909, 591, 5933-5935, 5937, 5996
XIV	91	1402	Renal failure	N17-N19	5836, 5837, 584-586
XIV	92	1403	Urolithiasis	N20-N23	592, 594, 7880
XIV	93	1404	Other diseases of the urinary system	N25-N39	0994, 587-589, 5903, 5930-5932, 5936, 5938, 5939, 595- 597, 5980, 5981, 5988, 5989, 5990-5995, 5998, 5999, 6256
XIV	94	1405	Hyperplasia of prostate	N40	600
XIV	95	1406	Other diseases of male genital organs	N41-N51	601-608
XIV	96	1407	Disorders of breast	N60-N64	610, 611
XIV	97	1408	Inflammatory diseases of female pelvic organs	N70-N77	614-616
XIV	98	1409	Menstrual, menopausal and other female genital conditions	N91-N95	6250-6255, 6258-627
XIV	99	1410	Other disorders of the genitourinary system	remainder of N00-N99	remainder of 580-629
XV		**1500**	**Pregnancy, childbirth and the puerperium**	**O00-O99**	**630-676 (no exactly equivalent ICD-9 codes for the three phases)**
XV	100	1501	Medical abortion	O04	635
XV	101	1502	Other pregnancy with abortive outcome	O00-O03, O05-O08	630-634, 636-639
XV	102	1503	Complications of pregnancy predominantly in the antenatal period	O10-O48	640-646, 651-659
XV	103	1504	Complications of pregnancy predominantly during labour and delivery	O60-O75	660-668, 6690-6694, 6698, 6699
XV	104	1505	Single spontaneous delivery	O80	650

International shortlist for hospital morbidity tabulation (ISHMT) - Eurostat/OECD/WHO					
Version 2006-11-24					
ICD Chapter	Group	Code	Heading	ICD-10 Code	ICD-9 Code
XV	105	1506	Other delivery	O81-O84	6695, 6696, 6697
XV	106	1507	Complications predominantly related to the puerperium	O85-O92	670-676
XV	107	1508	Other obstetric conditions	O95-O99	647, 648
XVI		**1600**	**Certain conditions originating in the perinatal period**	**P00-P96**	**760-779**
XVI	108	1601	Disorders related to short gestation and low birth weight	P07	765
XVI	109	1602	Other conditions originating in the perinatal period	remainder of P00-P96	remainder of 760-779
XVII	**110**	**1700**	**Congenital malformations, deformations and chromosomal abnormalities**	**Q00-Q99**	**740-759**
XVIII		**1800**	**Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified**	**R00-R99**	**780-799 except 7880, but including 5997**
XVIII	111	1801	Pain in throat and chest	R07	7841, 7865
XVIII	112	1802	Abdominal and pelvic pain	R10	7890
XVIII	113	1803	Unknown and unspecified causes of morbidity (incl. those without a diagnosis)	R69	7999
XVIII	114	1804	Other symptoms, signs and abnormal clinical and laboratory findings	remainder of R00-R99	remainder of 780-799 except 7880, but including 5997
XIX		**1900**	**Injury, poisoning and certain other consequences of external causes**	**S00-T98**	**800-999**
XIX	115	1901	Intracranial injury	S06	8001-8004, 8006-8009, 8011-8014, 8016-8019, 8031-8034, 8036-8039, 8041-8044, 8046-8049, 850-854 (Definition includes relevant ICD-9-CM codes.)
XIX	116	1902	Other injuries to the head	S00-S05, S07-S09	8000, 8005, 8010, 8015, 802, 8030, 8035, 8040, 8045, 830, 870-873, 900, 910, 918, 920, 921, 925 (Definition includes relevant ICD-9-CM codes.)
XIX	117	1903	Fracture of forearm	S52	813
XIX	118	1904	Fracture of femur	S72	820, 821
XIX	119	1905	Fracture of lower leg, including ankle	S82	823, 824
XIX	120	1906	Other injuries	S10-S51, S53-S71, S73-S81, S83-T14, T79	805-812, 814-819, 822, 825-829, 831-848, 860-869, 874-897, 901-904, 911-917, 919, 922-924, 926-939, 950-959
XIX	121	1907	Burns and corrosions	T20-T32	940-949
XIX	122	1908	Poisonings by drugs, medicaments and biological substances and toxic effects of substances chiefly nonmedicinal as to source	T36-T65	960-989
XIX	123	1909	Complications of surgical and medical care, not elsewhere classified	T80-T88	996-999
XIX	124	1910	Sequelae of injuries, of poisoning and of other consequences of external causes	T90-T98	905-909
XIX	125	1911	Other and unspecified effects of external causes	remainder of S00-T98	990-995

International shortlist for hospital morbidity tabulation (ISHMT) - Eurostat/OECD/WHO					
Version 2006-11-24					
ICD Chapter	Group	Code	Heading	ICD-10 Code	ICD-9 Code
XXI		**2100**	**Factors influencing health status and contact with health services**	**Z00-Z99**	**V01-V82**
XXI	126	2101	Medical observation and evaluation for suspected diseases and conditions	Z03	V71
XXI	127	2102	Contraceptive management	Z30	V25
XXI	128	2103	Liveborn infants according to place of birth ("healthy newborn babies")	Z38	V30-V39
XXI	129	2104	Other medical care (including radiotherapy and chemotherapy sessions)	Z51	V071, V58
XXI	130	2105	Other factors influencing health status and contact with health services	remainder of Z00-Z99	remainder of V01-V82
		0000	All causes	A00-Z99 (excluding V, W, X and Y codes)	001-V82 (excluding E800-E999)

Appendix II: Tables Dutch COI study 2003

Table II-1 Costs for disease

Full list of diseases used in the Dutch COI-study 2003: name, definition in ICD-9 terms and costs for 2003 in million euro. Cost add up to total costs within SHA definition.

Disease group	Definition (ICD9)	Costs
all diseases		***45,113***
Infectious and parasitic diseases	***001-139, 320-322, 573.1, V01-V07, V73-V75***	***1,042***
Intestinal infectious diseases	001-009	42
Tuberculosis	010-018, 137	50
Meningitis	036, 047, 320-322	21
Septicaemia	038	39
HIV/AIDS	042-044	20
Sexually transmitted diseases	054, 078, 090-099	40
Hepatitis	070, 573.1	10
Other infectious diseases	019-035, 037, 039-041, 045-046, 048-053, 055-069, 071-077, 079-089, 100-136, 138-139, V01-V07, V73-V75	821
Neoplasms	***140-239, V76***	***2,164***
Oesophagus cancer	150	35
Stomach cancer	151	50
Colorectal cancer	153-154	225
Pancreas cancer	157	32
Lung cancer	162	173
Breast cancer	174	189
Cervical cancer	180	50
Ovary cancer	183	32
Prostate cancer	185	89
Other cancers genital organs	179, 181-182, 184, 186-187	151
Bladder and kidney cancer	188-189	94
Non-Hodgkin's disease	200, 202	65
Other lymphoid cancer and leukaemia	201, 203-208	99
Other cancers	140-149, 152, 155-156, 158-161, 163-172, 175-178, 190-199, 209, V76	506
Benign neoplasms of genital organs	217-222	95
Other benign neoplasms	173, 210-216, 223-239	279
Endocrine,nutritional and metabolic diseases	***240-279, 357.2, 362.0, 581.8, 582.8, 583.8, V77***	***1,118***

Disease group	Definition (ICD9)	Costs
Diabetes mellitus including diabetic complications	250, 357.2, 362.0, 581.8, 582.8, 583.8	686
Other endocrine, nutritional and metabolic diseases	240-249, 251-279, V77	432
Diseases of the blood and blood-forming organs	***280-289, V78***	***206***
Diseases of the blood and blood-forming organs	280-289, V78	206
Mental and behavioural disorders	***290-319, 758.0, V79***	***6,707***
Dementia	290, 311	2,359
Schizophrenia	295	402
Psychotic disorders excluding schizophrenia	297-298	140
Depression	296, 300.4	582
Anxiety	300.0, 300.10-300.15, 300.2-300.3, 300.5, 308, 309.8	251
Personality disorders	300.16-300.19, 301	141
Alcohol and drugs	291-292, 303-305	322
Other mental disorders	293-294, 299, 300.6-300.9, 302, 306-307, 309.0-309.7, 309.9, 310, 312-316, V79	2,215
Mental retardation, including Down's syndrome	317-319, 758.0	296
Diseases of the nervous system	***323-356, 357.0-357.1, 357.3-357.9, 358-361, 362.1-362.9, 363-389, V80***	***3,143***
Parkinson's disease	332	140
Multiple sclerosis	340	95
Epilepsy	345	184
Cataract	366	288
Disorders of accommodation and refraction	367	818
Blindness and low vision	369	85
Conjunctivitis	373-374	112
Other diseases of the eye and adnexa	360-361, 362.1-362.9, 363-365, 368, 370-372, 375-379	313
Ear disorders	380-389	594
Other diseases of the nervous system and sense organs	323-331, 333-339, 341-344, 346-356, 357.0-357.1, 357.3-357.9, 358-359, V80	514
Diseases of the circulatory system	***390-459***	***4,667***
Hypertension	401-405	612
Coronary heart disease	410-414	1,221
Heart failure	428-429	340
Other heart disease, including pulmonary circulation	390-398, 415-427	657
Stroke	430-438	1,217
Diseases of arteries	440-448	291
Other circulatory diseases	451-459	330

Disease group	Definition (ICD9)	Costs
Diseases of the respiratory system	***460-519***	***1,968***
Acute upper respiratory infections	460-466	293
Pneumonia and influenza	480-487	346
Asthma and chronic obstructive pulmonary disease (COPD)	490-496	708
Other respiratory diseases	467-479, 488-489, 497-519	620
Diseases of the digestive system	***520-572, 573.0, 573.2-573.9, 574-579, V58.5***	***4,383***
Dental caries	521.0	1,572
Periodontitis	523	149
Loss of teeth	525.1	471
Orthodontia	V58.5	227
Other diseases of teeth, jaw and salivary glands	520, 521.1-521.9, 522, 524, 525.0, 525.2-525.9, 526-529	198
Gastroduodenal ulcers	531-534	63
Appendicitis	540-543	80
Abdominal hernia	550-553	217
Inflammatory intestinal disease	555-556	86
Other intestinal diseases	557-569	502
Chronic liver disease and cirrhosis	571	27
Other liver diseases	570, 572, 573.0, 573.2-573.9	24
Gallbladder diseases	574-576	201
Other diseases of the digestive system	530, 535-537, 577-579	565
Diseases of the genitourinary system	***580, 581.0-581.7, 581.9, 582.0-582.7, 582.9, 583.0-583.7, 583.9, 584-629, V26***	***1,539***
Nephritis and nephropathy	580, 581.0-581.7, 581.9, 582.0-582.7, 582.9, 583.0-583.7, 583.9, 584-589	144
Acute renal and urinary infections	590, 595, 597, 599.0	170
Other renal and urinary diseases	591-594, 596, 598, 599.1-599.9	475
Hyperplasia of prostate	600	92
Other disorders of male genital organs	601-608	80
Disorders of female genital organs	610-627, 629	513
Female infertility	628, V26	64
Pregnancy, childbirth and the puerperium	***630-676, V20, V22-V24, V25, V27, V30-V39***	***1,403***
Pregnancy	630-648, V22-V23	432
Childbirth	650-669, V20, V27, V30-V39	440
Puerperium	670-676, V24	343
Contraception	V25	188
Diseases of the skin and subcutaneous tissue	***680-709***	***795***
Eczema	691-692	140
Decubitus	707	82

Disease group	Definition (ICD9)	Costs
Other diseases of the skin and subcutaneous tissue	680-690, 693-706, 708-709	573
Diseases of the musculoskeletal system and connective tissue	***710-739***	***3,302***
Rheumatoid arthritis	714	132
Osteoarthrosis	715	471
Dorsopathy	720-724	738
Osteoporosis	733.0-733.1	94
Internal derangement of the knee	717	156
Unspecified musculoskeletal diseases or conditions	725-729	745
Other diseases of the musculoskeletal system	710-713, 716, 718-719, 730-732, 733.2-733.9, 734-739	966
Congenital malformations	***740-757, 758.1-758.9, 759, V28***	***252***
Congenital anomalies of nervous system	740-742	12
Congenital anomalies of circulatory system	745-747	46
Other congenital anomalies, excluding Down's syndrome	743-744, 748-757, 758.1-758.9, 759, V28	194
Certain conditions originating in the perinatal period	***760-779***	***331***
Disorders relating to premature birth	765	137
Selected conditions in newborns	764, 768, 771	52
Other conditions originating in the perinatal period	760-763, 766-767, 769-770, 772-779	141
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	***780-799***	***4,020***
Symptoms, signs and ill-defined conditions	780-799	4,020
Injury, poisoning and certain other consequences of external causes	***800-999***	***1,543***
Skull-brain injury	800-801, 803-804, 850-854, 950-951	84
Fractures of upper extremities	810-819	91
Hip fracture	820-821	374
Other lower extremity fracture	822-829	204
Superficial injury	910-924	46
Other injury	802, 805-809, 830-849, 855-909, 925-949, 952-999	745
Not allocated / Not disease related	***V10-V19, V21, V40-V57, V58.0-V58.4, V58.6-V58.9, V59-V62, V63-V64, V65, V66-V68, V70, V71-V72, V81-V82***	***6,529***

Disease group	Definition (ICD9)	Costs
Not yet allocated	V10-V19, V21, V40-V57, V58.0-V58.4, V58.6-V58.9, V63-V64, V66-V68, V71-V72, V81-V82 + unknown disease	6,198
Not disease-related	V59-V62, V65, V70 + non-medical costs	331

Table II-2 Cost by age and sex

Results for the Dutch COI-study 2003: Costs for age and sex, both total costs by age group (in million euro) and cost per capita (in euro). SHA definition of costs has been used. Also included; share of costs in age group which are attributed to reproduction costs (birth, pregnancy, anti-conception, abortion) or to gender specific diseases (genital diseases, breast cancer, cancers of male or female reproductive organs). This shows the importance of these costs especially for age-groups 15-40.

age group	total costs (million euro)			Cost per capita (euro)			% costs reproduction & gender specific disease	
	male	female		male	female		male	female
0	405	337		3,912	3,440		11	14
1-4	447	337		1,065	841		2	0
5-9	518	400		1,027	830		2	0
10-14	504	433		980	883		1	1
15-19	551	639		1,113	1,358		1	8
20-24	662	907		1,349	1,889		0	18
25-29	750	1,193		1,462	2,352		0	31
30-34	1,040	1,692		1,614	2,686		0	34
35-39	1,143	1,571		1,699	2,425		0	21
40-44	1,218	1,455		1,872	2,295		0	9
45-49	1,250	1,470		2,107	2,524		0	5
50-54	1,389	1,569		2,451	2,843		1	4
55-59	1,563	1,606		2,909	3,065		1	4
60-64	1,349	1,375		3,439	3,509		2	3
65-69	1,439	1,492		4,547	4,387		3	2
70-74	1,588	1,847		6,140	5,878		3	2
75-79	1,482	2,167		8,016	8,010		3	1
80-84	1,160	2,326		10,378	11,273		2	1
85-89	606	1,748		13,401	15,335		2	0
90-94	225	933		16,662	19,974		1	0
95+	46	279		19,426	24,891		2	0
total	19,335	25,778		2,408	3,146		2	8

Table II-3 Cost for provider and health care function

Results of the Dutch COI-study 2003: Costs for provider and health care function, in millions of euro. Provider definition from SHA. The definition of health care function is a specific Dutch definition. See main text (chapter 4) for details. Total costs add up to total costs using SHA cost definition.

	Health care Function (Dutch definition)			
Provider (ICHA-HP)	**Cure**	**Care+ other**	**Prevention**	**total**
HP.1 Hospitals	15,284	750	3	16,037
HP.2 Nursing and residential care facilities		5,313		5,313
HP.3 Providers of ambulatory care	7,788	1,307	884	9,980
HP.4 Retail sale and other providers of medical goods	4,630	1,090	1,509	7,229
HP.5 Provision and administration of public health programmes	112	292	368	772
HP.6 General health administration and insurance		1,837		1,837
HP.7 Other industries (rest of the economy)	853	218	214	1,284
HP.9 (Rest of the world)	442	2,220		2,662
	29,108	13,027	2,978	45,113

Table II-4 Cost comparison SHA and NHA providers

Results of the Dutch COI-study 2003: Cross tabulation of costs according to System of Health Accounts definition and according to Dutch National Health Accounts. This shows large differences exists between SHA and NHA.Costs for NHA includes almost 13 billion euro health care costs not included in SHA, and SHA 2.2 billion not included in NHA (but known from other sources).

	Provider (Dutch National Health and Social Care Accounts)										
Provider (ICHA-HP)	**Hospitals**	**Ambulatory care**	**Medical goods**	**Care (handicapped)**	**Care (mental)**	**Nursing care**	**Transport**	**Social care**	**Other providers**	**Public health**	**Outside NHA**
HP.1 Hospitals	13,132				2,906						
HP.2 Nursing and residential care facilities				425		4,889					
HP.3 Providers of ambulatory care	1,840	5,286	293		56	1,515	212		717	61	
HP.4 Retail sale and other providers of medical goods		353	6,876								
HP.5 Provision and administration of public health programmes							112			660	
HP.6 General health administration and insurance											
HP.7 Other industries (rest of the economy)				60			229		967	28	
HP.9 (Rest of the world)									442		2,220
Outside SHA	487	208	326	4,304	924	5,868		2,348	171		

Appendix III: example of a utilisation key

The table shows the full utilisation key for the cost-unit 'influenza vaccination'. This cost-unit is a specific government budget for the vaccination of vulnerable groups against influenza. The product indicator used in this case is the number of people vaccinated distributed over age and gender. Numbers were converted to fractions by dividing the number of people vaccinated for every age/gender combination by the total number of vaccinations. The first column is a counter, the next six are used to describe the six dimensions in the Dutch 2003 COI-study, in order of appearance: provider/cost unit, funding, function, disease, gender and age. The last column gives the share of production for this cost-unit. Shares add up to 100%, indicating the utilisation key is complete (all costs accounted for) and lines are non-overlapping (prevents double-counting of cost in final result).

Shares are converted to costs by multiplying with total costs for this cost-unit (~33 million euro). The cost-unit (or subprovider) 'influenza-vaccination' has been used on the analysis level, because of its specificity. It is part of both national and SHA framework. In the SHA it is included in 'providers of ambulatory care', because general practitioners administer the vaccination, and get paid out of this budget.

#ID	Cost-unit (~provider)	source of funding	health care function	disease group	gender	age	fraction
1	influenza vaccination	government	prevention	pneumonia & influenza	male	10-14	0.8%
2	influenza vaccination	government	prevention	pneumonia & influenza	male	15-19	0.7%
3	influenza vaccination	government	prevention	pneumonia & influenza	male	20-24	0.3%
4	influenza vaccination	government	prevention	pneumonia & influenza	male	25-29	0.8%
5	influenza vaccination	government	prevention	pneumonia & influenza	male	30-34	1.2%
6	influenza vaccination	government	prevention	pneumonia & influenza	male	35-39	1.2%
7	influenza vaccination	government	prevention	pneumonia & influenza	male	40-44	2.3%
8	influenza vaccination	government	prevention	pneumonia & influenza	male	45-49	2.8%
9	influenza vaccination	government	prevention	pneumonia & influenza	male	50-54	4.0%
10	influenza vaccination	government	prevention	pneumonia & influenza	male	55-59	4.9%
11	influenza vaccination	government	prevention	pneumonia & influenza	male	60-64	7.5%
12	influenza vaccination	government	prevention	pneumonia & influenza	male	65-69	7.3%
13	influenza vaccination	government	prevention	pneumonia & influenza	male	70-74	5.2%
14	influenza vaccination	government	prevention	pneumonia & influenza	male	75-79	3.1%
15	influenza vaccination	government	prevention	pneumonia & influenza	male	80-84	1.3%
16	influenza vaccination	government	prevention	pneumonia & influenza	male	85-89	0.4%
17	influenza vaccination	government	prevention	pneumonia & influenza	male	90-94	0.1%
18	influenza vaccination	government	prevention	pneumonia & influenza	male	95+	0.4%
19	influenza vaccination	government	prevention	pneumonia & influenza	female	10-14	0.7%
20	influenza vaccination	government	prevention	pneumonia & influenza	female	15-19	1.0%
21	influenza vaccination	government	prevention	pneumonia & influenza	female	20-24	1.6%
22	influenza vaccination	government	prevention	pneumonia & influenza	female	25-29	0.8%
23	influenza vaccination	government	prevention	pneumonia & influenza	female	30-34	0.8%
24	influenza vaccination	government	prevention	pneumonia & influenza	female	35-39	1.2%
25	influenza vaccination	government	prevention	pneumonia & influenza	female	40-44	1.9%
26	influenza vaccination	government	prevention	pneumonia & influenza	female	45-49	2.0%
27	influenza vaccination	government	prevention	pneumonia & influenza	female	50-54	3.2%
28	influenza vaccination	government	prevention	pneumonia & influenza	female	55-59	3.7%
29	influenza vaccination	government	prevention	pneumonia & influenza	female	60-64	2.7%
30	influenza vaccination	government	prevention	pneumonia & influenza	female	65-69	8.0%
31	influenza vaccination	government	prevention	pneumonia & influenza	female	70-74	9.2%
32	influenza vaccination	government	prevention	pneumonia & influenza	female	75-79	7.9%
33	influenza vaccination	government	prevention	pneumonia & influenza	female	80-84	6.0%
34	influenza vaccination	government	prevention	pneumonia & influenza	female	85-89	3.3%
35	influenza vaccination	government	prevention	pneumonia & influenza	female	90-94	1.4%
36	influenza vaccination	government	prevention	pneumonia & influenza	female	95+	0.3%

Appendix IV: Calculation Examples Dutch COI study 2003

In this section some 'real life' example of actual calculations for a general COI analysis for direct medical costs using a prevalence based method will be given.

Example (1) screening cervical cancer

An easy example of cost allocation in a COI study is the allocation of costs for the screening on cervical cancer. In the Netherlands a special screening programme exists, which targets all women aged 30-60. Be aware that in some COI-studies these costs would not be included because it is not personal health expenditure. However, in the Netherlands we also include public health expenditure in the study, and attribute costs to the target population participating, and the diseases which should be prevented.

First step is to identify the total screening expenditure as a homogeneous cost unit in the national health accounts. This is easy, because cervical screening has a specific budget, which covers both the actual screening as well as the management costs of the programme. This cost unit is actually homogeneous for all three dimensions: there is one provider (the screening programme) There is also one source of finance: in 2003 a budget of 23.8 million euro provided for by Exceptional Medical Expenses Act (AWBZ). All insured persons in the Netherlands pay an income-dependent contribution under this law. Finally all costs belong to the health care function 'prevention' (using our Dutch definition of prevention, which differs from the current ICHA-HC definition). Remark that a 'goal-directed' view on health care function is taken, so we attribute all costs within the programme to the final goal: prevention of disease.

Second step is to construct of a utilisation key for the top-down allocation of costs over disease, age and gender. For this we have to select a suitable production indicator from a register of production data for this provider. In this case both gender (female) and disease (cervical cancer) are known in advance. So we only have to find a way to allocate costs over the five-year age-groups in the study. Typically for every women turning out after a call for participation, a Pap smear is made. This accounts for the bulk of the costs within the program. So as an indicator for production in the programme we could simply count the women participating, classify by age, and allocate proportionally. We have several alternatives for getting these numbers.

- Alternative 1: Simply use national population statistics. All women between the ages 30 and 60 get a regular call for participation, so if we count the women within these age groups we should get a fairly good estimate of the age distribution. However, there will be some error because actual turn-out for the screening may differ with age.

- Alternative 2: Use a population survey. The Dutch national bureau of statistics (Statistics Netherlands) surveys the health of the population on a continuous base. Every year ~10,000 citizens (~0.064% of the population) are questioned (house-visits). Participation in the screening programme is part of the questionnaire. So results should give insight in actual turnout. However, there is also a disadvantage: the questionnaire is concerned with self-reported health, and this introduces some errors, for instance recall bias or response bias.

- Alternative 3: Use a specific health register. The programme management monitors turnout continuously, and classifies this to age groups. This is of course the best indicator to use, because it measures 100% of the real turnout.

The third step is to multiply the share of the allocation key with the costs for the program. In table IV-1 results are shown. The real turnout (alternative 3) has been used as allocation key. In this case the key is

very simple, because it is uniform for all dimensions, except age, and consists of only seven lines. Other keys for other providers are sometimes much bigger (several thousands of lines) but the principle is the same: total shares add up to 100% of the costs attributed with the key, and every line refers to a distinct combination of our six dimensions (provider, finance, function, disease, gender, age). As shown, in this case the share of population (alternative 1) would have given a good approximation of the age distribution as well.

Finally the results of the partial COI analysis for this provider were added to those of the other providers to get a total COI- analysis for Dutch national health accounts.

Table 2. Commonly encountered indicators of health care utilisation

age	Alternative 1: share of population	Alternative 3: share of actual turnout	Cost distribution(million euro) (based distribution turnout
30-34	16%	14 %	3,3
35-39	16%	17 %	4,0
40-44	16%	18 %	4,3
45-49	15%	15 %	3,6
50-54	14%	14 %	3,4
55-59	13%	13 %	3,2
60-64	10%	9 %	2,1
total		100 %	23,8

Source: #: numbers of the indicator.

Example (2) prescription drugs for out-patients

A more difficult example is the partial cost of illness analysis for prescription drugs for out-patients by dispensing chemist. In this case multiple registers have to be used in the construction of a utilisation key.

First step is to identify the costs for this provider. In Dutch national health accounts expenditure for dispensing chemists were in 2003 about 5.3 billion euro. This includes both medical and non-medical sales (for instance liquorice). Because non-medical sales are not part of the SHA, and we want to be able to report a COI analysis for both national and SHA cost definitions, we have to split the costs for this provider in two groups, and analyse these separately. Fortunately this could be done fairly easy, because Statistics Netherlands keeps these two types of sale separate. Non–medical sales are attributed to a special disease group: 'not disease related', because these sales are unrelated to any disease. In this example we will focus on the analysis of the medical sales.

Second step is to construct a utilisation key for the top-down allocation of costs over disease, age and gender. For this we have to select a suitable production indicator from a register of production data for this provider. Several registers which could be useful exists

- Register 1: a survey among general practitioners, in which a nationally representative selection registers which prescriptions are given to patients. The advantage of this register is that it contains both patient information (age, gender, disease) and information about prescribed drugs, using the internationally recognized Anatomical Therapeutic Chemical Classification System (ATC-code) developed by the WHO. The register has also several disadvantages: disease is not coded using the ICD system, but uses the International Classification of Primary Care (ICPC),which is less specific. A more important disadvantage is that it records prescriptions and prescribed doses, but it does not log the time the prescription is used or every change in the dose. It also does not contain information about prices and actual use. Another disadvantage is that prescriptions of other medical professionals are only partially included.

- Register 2: a cost register for expenditure which is based on the medical sales for >90% of all dispensing chemists. It logs some patient information (age and gender) and detailed prescription information (ATC-code, dose, sales). The advantage of this register is that it measures actual sales, which is a much better indicator for production than the number of prescriptions, because it takes in to account both price differences between prescriptions as well as the duration of the use. A second advantage is that it is an almost complete registration. The disadvantage is that it does not contain information about the actual disease.

- Register 3. A register of insurance declarations exists. Main disadvantage is that contains only data for compulsory insured, which in 2003 covered only 60% of the population, mostly low-income groups and elderly. It also does not contain diagnostic data.

- Register 4. A specialized scientific registration among GP's for detecting adverse effects of drugs. The advantage is that this source can provide detailed information on both patients and prescriptions. The main disadvantage is that it does not contain information on sales, and is regionally oriented.

- Register 5. A commercial database which registers data on drug use on GP-level, using a representative selection. It contains both patient and prescription information, including sales. Main disadvantage is the fairly high costs involved in using this source.

Problem here is that none of these registers are ideal for use. Therefore we decided to use a combination of register 1 and 2. Register 2 is vastly superior to the others in registering the complete sales, but does not contain a diagnosis. However, most drugs have a fairly narrow spectrum of use in medical terms. From register 1 we were able to construct a distribution of prescriptions classified by drug type over diseases. Costs were allocated to other diseases in proportion to the share of prescription. Table IV-2 shows an example for a particular class of drugs (NO6A, Antidepressants). About 44% of its prescriptions was for patients diagnosed with depression, and therefore 44% of sales were attributed to depression. Actual allocation was a bit more complicated as in this example, because we also did take age and sex into account (available in both registers) in the construction of the disease distribution for particular classes of drugs.

By this method we could construct a utilisation key by age, gender and diagnosis.

Allocation to the dimensions of function and finance proved more problematic. Allocation to the functional dimension was based on the type of drug prescribed and the disease for which it was used. The

large majority were attributed to the curative function, some drugs (notably those for hypertension) were attributed to prevention, because the main use of these drugs is to prevent future health care problems. Note that this differs from the view SHA takes on health care functions, which would allocate all costs to 'supply of medical goods'. The financial dimension could not be fully resolved in the Dutch payment system. It is difficult to make a division between insurance-based payments and co-payments. Only on an aggregated level these costs can be separated. This implies that construction of a distinct key for the allocation of these two sources of finance over the other dimensions is not possible. In this situation it is not useful to separate co-payments from insurance-based payments because no difference would show up in the use of these two costs. In the Dutch study therefore these two types of sources of finance are combined, and all sales were attributed to 'insurance-based payments including individual co-payments'. Remark that this is an example of a country-specific problem. In other countries it might be much easier to separate these costs within health registers itself, and therefore it could be possible to construct a different allocation key for both these types of cost.

Table IV-2 example linking prescriptions-diseases for ATC-group N06A (antidepressants)

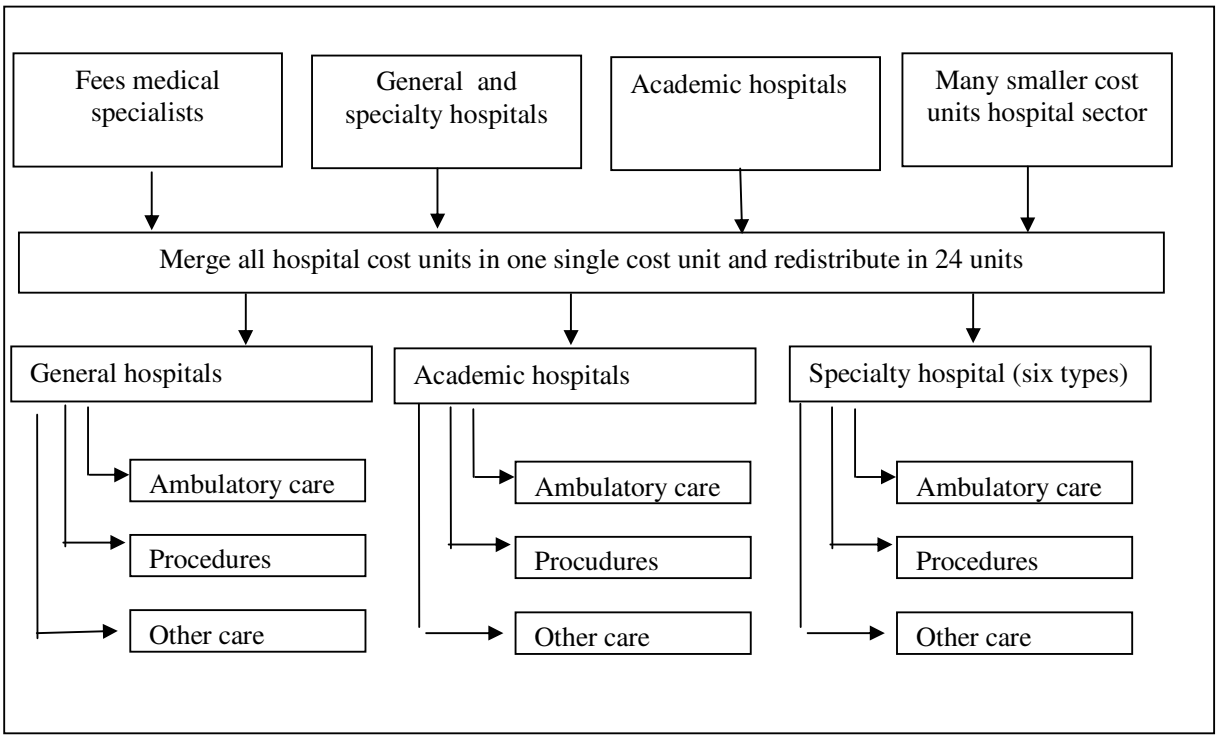
Disease	proportion	cumulative proportion
depression	44.3	44.3
anxiety disorder	17.0	61.3
other psychic disorder	14.0	75.4
symptoms	7.1	82.5
All other diseases	17.5	100

In this way a table distributing all sales over the dimensions of the study was constructed. As in the previous example every line contains a different combination of dimension-classes, and the share in the total costs. Total shares added up to 100% . This distribution was multiplied with total costs for this provider. As in the previous example total costs for dispensing chemists were multiplied with the share to get a cost distribution over the dimension-classes. Finally the results of the partial COI analysis for this provider were added to those of the other providers to get a total COI- analysis for Dutch national health accounts.

Example (3) hospital costs

One of the most complex partial COI analysis in the Dutch COI analysis was made for the hospital sector (excluding mental care hospitals). The total budget (about 25% of total health care costs in the Netherlands) is fairly well known, but it is distributed over many providers and no overall registration which links costs to health care use exists for these providers. Partially because of the complexity, an allocation model is used to pay hospitals and medical specialists, mostly based on number of beds and other parameters based on production in previous years. A positive is that some very good and detailed registration exist for some production parameters (like hospital days, procedures performed), but these registers could not be directly linked to individual providers. For instance, separate registrations for in-hospital care and ambulatory hospital care exist in the Netherlands. However, hospital costs are not separately known for these types of care. The same problem exists for other providers like the fees of medical specialists.

Figure IV-1 Rearranging hospital costs in artificial units



In the first step all costs for providers in the hospital sector were pooled together. (see figure IV-1) The pooled costs were used to make an estimate for costs in artificial costs units in such a way that existing registers could be used. Input for this estimation was given by a Dutch research institute for the hospital sector. In this estimation about 30% of all hospital costs were attributed to ambulatory care, and 10% of hospital costs were attributed to the performance of operational procedures. The remainder, 60% was attributed to the costs of in-hospital care and all other running costs of the hospital (diagnostic laboratory, in-hospital drug prescription, maintenance, cleaning etc). For each of these three groups a suitable indicator was selected:

- Ambulatory care: A register of the number of ambulatory patient visits to medical specialists was used. Age and sex of the patient were known, as well as the total number of first time visits. Also available was an (anonimized) hospital identifier, the type of hospital and the type of specialist visited by the ambulatory patient. For about 45% of all hospital visits the number of subsequent visits was also known. These data were used to make an estimation of total visits to specialist, by age, sex and type of specialist. A direct diagnosis was not known, but this could be estimated using referral data from general practitioners. These referral data contained age, sex, type of specialist and diagnosis. Final result was an estimated distribution of visits of age, sex and disease. This was used as utilisation key.

- Procedures: A nation-wide register of all operational procedures was used. This covered 99% of all hospitals. Procedures were described in detail, using a Dutch classification (CMSV). For every procedure, age, sex and diagnosis were known, as well as the type of hospital. Total number of performed procedures was used as an utilisation key, weighted by the standard price of procedures. For many procedures a standard price was known, for those procedures for which a standard tariff was unknown, the tariff of a similar procedure with known price was used. A

bottom-up calculation of total costs for procedures by aggregating weighted costs was found to be in good agreement with the 10 % of total hospital costs a priori assigned in a top-down fashion.

- Other care: The remainder of hospital costs were for the largest part of costs connected to the length of stay in the hospital, and therefore the number of hospital days by age, gender and disease was used as utilisation key. Data were derived from the same register as data on procedures. Hospital days were weighted with the estimated price of the two main types of hospital care: day care and clinical care. In-hospital use of medical goods like drug prescriptions could not be separated from the other costs of hospital care, and were also allocated using this key based on length of stay. For diseases with high in-hospital drug costs (like some cancers or endocrine diseases) this means total costs attributed will be slightly underestimated. However, this is only a small error, because costs of in hospital drug prescriptions aggregate to about 3% of total hospital costs.

These derivations of utilisation keys were repeated for every type of hospital (general, academic and six specialty hospitals). A consequence of the procedure followed is that it is not possible to report separate COI estimates for the original group of hospital providers. Therefore, in the final reporting the results of the 24 artificial cost units were aggregated to a COI estimate for all hospital providers combined.

Appendix V: description of all cost units in Dutch COI study 2003

Because of the size, this table has been put in a separate document.

The Dutch national Health Accounts for 2003 lists costs for 81 providers. These have been subdivided in 204 units for the COI study. This was necessary to create outcomes for three different cost frames: National Health Accounts, SHA and the Budget responsibility framework of the Dutch Ministry of Health, welfare and Sport. In this table 204 different cost units - for each of which a utilization key has been developed- are listed. About 30-40 of these cost units have a purely technical background: they have been added to make an exact match between frameworks possible, and correct for accounting differences between systems used by Statistics Netherlands and the Dutch Ministry of Health (which sometimes close accounts on different days). This are usually very tiny cost-units (some less than a million euro). For these cost units the same utilization key has been used as for the associated larger units.

Appendix VI: Suggested presentation of outcomes within international comparisons in Dutch COI study 2003

This appendix is based on a comparison of Dutch COI data with those of other countries. See report for full details on comparisons and data(8).

An international comparison first of all requires understanding of the organization of health systems in different countries. Second the structure and methods of (reported) health expenditures and COI should be known. In order to verify COI results with results from other countries possible (influential) differences in these two points should be taken into account. Only then COI results can be compared. Important is furthermore the choice of exchange rate and showing health expenditure per capita and in relation to national income.

It would first of all be useful to compare the general levels of health expenditure and how they are divided over providers. This is shown in Table VI-1 and VI-2.

Table VI-1: Make a brief comparison of health systems in the countries studied.

	AUS	CAN	FRA	GER	NETH
	2000	1998	2002	2004	2003
Total health exp in NCU[1] million	61,661	83,738	165,214	233,983	57,529
OECD total health expenditure[2]	60,368	82,48	155,035	233,983	45,113
per capita health exp (1) in US$	1872	1870	2612	3502	3984
per capita health exp (1) in US$ PPP[3]	2458	2326	3075	3043	3854
per capita health exp (2) in US$	1833	1842	2451	3502	3124
per capita health exp (2) in US$ PPP	2406	2291	2886	3043	3022
health exp (1) as % of GDP	9.20%	9.30%	10,70%	10,60%	12.70%
health exp (2) as % of GDP	9.00%	9.20%	10,00%	10,60%	9.90%
Total COI in NCU mln.	60,897	83,955	129,547	224,941	45,113
(9) in US$ million	33,312	56,726	122,214	277,705	50,689
ICD-version used in COI study	ICD-10	ICD-9	ICD-10	ICD-10	ICD-9
Number of (main)sectors	(7) 20	(5) 24	(5) 20	(7)15	(21)81
Number of age groups	10	6	-	6	21
Male/female ratio in expenditure[4]	44/56	45/55	-	42/58	42/58
Age structure[5]	12,7	12,3	16,2	18,3	13,7

Table VI-2: Compare health systems in the provider dimension

		AUS 2000	**CAN** 1998	**FRA** 2002	**GER** 2004	**NETH** 2003
HP.1	Hospitals	33,8	32,8	38,1	28,9	35,5
HP.2	Nursing and residential care facilities	6,9	9,7	2,2	7,6	11,8
HP.3	Providers of ambulatory care	31,9	27,7	23,6	29,4	22,1
HP.4	Retail sale and other providers of medical goods	17,1	17,8	21,8	19,9	16,0
HP.5	Provision and administration of public health	-	6,3	3,1	0,9	1,7
HP.6	General health administration and insurance	4,4	1,8	7,8	6,2	4,1
HP.7	Other industries (rest of the economy)	-	0,3	1,1	3,3	2,8
HP.9	Rest of the world	-	-	-	-	1,0
Total current expenditure on health care		94,0	96,5	97,6	96,1	95,1
	Capital formation of health care provider institutions	6,0	2,8	2,3	3,9	4,9
	Undistributed	-	0,7	-	-	-
Total health expenditure		100,0	100,0	100,0	100,0	100,0

Next expenditures per main disease chapter can be shown. If necessary specific providers should be selected in order to make more detailed comparisons (8).

Table VI-3 Compare distribution over diagnosis between countries

Cost of illness for five countries, as percentage of their total health expenditure

	AUS 2000	CAN 1998	FRA 2002	GER 2004	NETH 2003	Var. Coeff.
Infectious diseases	2,1	1,1	2,1	1,7	2,4	26,8
Neoplasms	5,1	2,9	6,4	7,9	5,0	25,5
Endocrine, nutritional and metabolic diseases1	4,2	1,9	4,2	5,3	2,6	41,4
Diseases of the blood / blood-forming organs	-	0,3	0,7	0,5	0,5	20,9
Mental and behavioural disorders	6,5	5,6	9,0	10,1	15,6	35,0
Diseases of the nervous system	8,6	3,4	8,6	8,2	7,3	31,0
Diseases of the circulatory system	9,6	8,1	11,4	15,7	10,9	26,0
Diseases of the respiratory system	6,5	4,1	6,5	5,2	4,6	18,9
Diseases of the digestive system	10,9	4,2	11,0	14,8	10,2	35,2
Diseases of the genitourinary system	3,6	3,1	4,8	3,8	3,6	20,7
Pregnancy and childbirth	2,3	1,5	2,3	1,4	3,3	33,9
Diseases of the skin and subcutaneous tissue	2,4	1,8	1,4	1,6	1,9	19,1
Diseases of the musculoskeletal system	8,1	3,2	7,4	10,9	7,7	39,0
Congenital malformations and chromosomal abnormalities	0,4	0,2	0,4	0,5	0,6	38,9
Certain conditions originating in the perinatal period	0,6	0,4	0,4	0,4	0,8	32,8
Symptoms, signs and ill-defined conditions	9,7	2,1	4,0	4,6	9,4	55,6
Accidents	-	-	-	-	3,6	-
Injury and poisoning	7,0	3,8	5,8	4,9	-	25,6
Additional categories	-	6,9	5,5	2,5	0,8	67,3
Unallocated	12,5	45,4	8,0	-	9,3	88,3
Total	100,0	100,0	100,0	100,0	100,0	

Table VI-4 Example of more detailed comparison for selected care providers

Expenditures on nursing and residential care facilities (HP.2).

	AUS		CAN		FRA		GER		NETH		Var
	%	p.c.	%	p.c.	%	p.c.	%	p.c.	%	p.c.	
Neoplasms	0,9	1	-	-	-	-	10,0	21	1,6	6	118
Mental disorders	58,2	97	-	-	-	-	29,2	63	51,7	184	30
Dementia		81	-	-	-	-		45		154	
Nervous system	6,8	11	-	-	-	-	8,6	18	6,2	22	15
Circulatory system	13,5	22	-	-	-	-	27,0	58	15,6	56	25
Respiratory system	2,3	4	-	-	-	-	1,0	2	2,4	9	34
Digestive system	0,9	1	-	-	-	-	0,8	2	2,4	9	66
Musculoskeletal	12,4	21	-	-	-	-	3,8	8	2,1	7	79
Genitourinary	0,4	1	-	-	-	-	0,3	1	0,5	2	25
Subtotal	95,4	158					80,7	173	82,5	294	
Total		166		222				214		356	

Table VI-5 Example of more detailed comparison for hospital providers

Adjusted COI: sum of COI for hospitals (HP.1), physicians (HP.3), prescribed medicines (HP.4) and dentists (HP.3)

	Aus	2000	Can	1998	Fra	2002	Ger	2004	Neth	2003	
	%	p.c.	%	p.c.	%	p.c.	%	p.c.	%	p.c.	*Var*
Infectious diseases	2,6	39	1,6	25	2,4	39	2,0	33	3,0	51	*23,3%*
Neoplasms	6,3	97	4,5	67	7,1	118	8,1	136	6,0	103	*20,9%*
Enodcrine diseases	5,3	82	2,9	44	4,3	71	6,0	101	2,9	50	*32,6%*
Blood diseases	-	-	0,4	6	0,5	8	0,6	10	0,6	11	*18,2%*
Mental disorders	6,1	95	8,7	132	10,9	181	7,5	126	13,1	225	*30,0%*
Nervous system	4,5	70	5,2	79	6,1	102	6,4	107	5,9	101	*13,6%*
Circulatory system	11,3	175	12,6	191	13,6	226	15,1	254	12,2	210	*11,2%*
Respiratory system	7,7	118	6,4	97	7,1	119	6,0	101	5,6	96	*12,9%*
Digestive system	14,7	227	18,2	276	13,4	222	18,6	313	13,9	240	*15,6%*
Genitourinary	4,9	76	4,8	73	5,3	89	4,5	76	4,0	69	*10,3%*
Pregnancy / childbirth	3,2	50	2,4	37	2,8	46	1,7	28	3,3	57	*24,4%*
Skin diseases	2,6	40	2,7	42	1,6	27	1,9	32	2,4	41	*21,1%*
Musculoskeletal	8,0	124	4,9	74	7,1	118	9,8	165	7,6	131	*23,6%*
Congenital malform.	0,4	7	0,3	5	0,5	8	0,6	10	0,7	11	*31,6%*
Perinatal diseases	0,9	13	0,6	9	0,5	9	0,6	10	1,1	19	*33,9%*
Symptoms, ill-defined	12,4	191	3,3	50	4,4	73	3,2	53	10,8	186	*64,9%*
Accidents	-	-	-	-	-	-	-	-	-	-	
Injury, poisoning	9,0	138	6,0	91	6,0	99	4,8	81	4,1	70	*31,3%*
Additional category	-	-	10,8	163	5,9	97	2,9	48	-	-	*61,0%*
Unallocated	-	-	3,6	54	0,5	8	-	-	2,7	47	*70,4%*
Total 4 provider groups	100,0	1543	100,0	1512	100,0	1659	100,0	1685	100,0	1719	
All SHA-groups		2406		2291		2451		2727		3022	
Percentage included		64%		66%		68%		62%		57%	

Age/gender comparisons based on per capita expenditure can clarify international differences further:

Figure VI-2 Health expenditure on circulatory disease by age and gender.