
Methods for Measuring and Estimating Costs

2

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Abstract

This chapter focuses on costing methods usually applied in cost analysis and health-related economic evaluations. The quality of an economic evaluation depends on the quality and precision of data collection and on transparency and comprehensiveness of costing resources. Costs, from an economic perspective, are related to opportunity costs; this economic conceptualization is different from a financial perspective. Costs are classified as direct, indirect, intangible, and total costs. In this chapter I focus exclusively on the measurement of direct costs. Costing involves multiple steps: choosing the perspective of the study; identifying the component of costs, collecting data on costs and services use, estimating the unit cost for each resource, and estimating costs. Although the majority of economic evaluations includes only direct costs, indirect costs correspond to the major parcel of diseases costs. Mental disorders, for instance, cause innumerable negative externalities and indirect costs, and the benefits of psychiatric and psychosocial interventions go beyond clinical improvement, leading to systematic recommendations for measuring costs in a comprehensive way, such as using societal perspective. There is a debate among health economists regarding the inclusion of indirect costs in the economic evaluation, though, their exclusion in assessing cost-effectiveness, for instance, might underestimate the economic impact of psychiatric intervention. Costing methods for indirect costs are discussed in another chapter in this book.

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Key Points Summary

- Definition and classification of costs
- Identification of costs components
- Measurement of direct costs
- Top-down and bottom-up approaches
- Unit costs
- Cost analysis and bias of cost estimation

2.1 What Is Cost?

The term *cost* is used in the literature in a heterogeneous way, with multiple meanings, hindering clear understanding by readers who are not familiar with the Economics field. In general, cost is the value of resources used to produce a good or a service. However, defining cost imposes the need to distinguish between “accounting costs” and “economic costs” [1].

Accounting costs are directly related to the monetary costs of all inputs used for producing a good or service. Usually, the price of acquiring a product is used for accounting costs. In the case of healthcare, accounting costs are equivalent to the costs of all resources for producing and delivering healthcare [1]. Accountants focus exclusively on financial costs in order to plan and to manage expenditures and the consumption of resources. Moreover, accounting databases usually do not provide detailed information of costs for one specific patient and all costs incurred by patients and families, such as out-of-pocket expenditures [2].

On the other hand, economic costs are related to opportunity costs; that is, when facing a choice between two alternatives, opportunity costs refer to the costs of losing the forgone benefits that would be gained if another alternative was chosen. In other words, to obtain a health gain, there are always opportunity costs when choosing to invest on a new medical technology or health services rather than in a current treatment [3, 4]. The main implication, then, from an economic perspective, is that costs are the value of opportunity costs; for

this reason, decision makers and health economists focus on the value of allocating resources efficiently, that is, maximizing benefits for patients. If a considerable investment is allocated for a treatment that is able to benefit 100 persons with depressive disorder instead of being allocated for another treatment that benefits 10 persons with schizophrenia, then the opportunity costs represent the benefits of those latter 10 people.

Therefore, these costs should be estimated taking into account whether “this investment” (opportunity costs) is more valuable in terms of producing more benefits than costs. Health gain is often expressed as increasing life expectancy and decreasing morbidity (see Chap. 3), but it also leads to the consumption of fewer health services and promotes increased productivity in the workplace. For instance, investing in research and development for a new drug and trading it into a market should not only allow profits for the pharmaceutical industry but also improve health and individual quality of life, ultimately maximizing utility and welfare [4] (see Chap. 1).

Once healthcare is not driven through free-market competition (see Chap. 1), costs are not similar to the prices of product or services [5]. The price of a service usually represents the average costs. In health economic analysis guiding decision-making for healthcare resources allocation, however, costs should be estimated using marginal analysis rather than the average costs used by accountants [1, 6]. Marginal analysis computes the costs of one additional unit; providing the intervention for 10 people is much more costly than providing it for more than 10 people because it maximizes use and the benefits provided by the intervention (e.g., lab test, program, group intervention), reducing the marginal costs [3, 4, 7]. While average costs cover fixed costs (FCs) and variable costs (VCs), marginal costs are estimated based exclusively on VCs, excluding all FCs [1, 5]. VCs vary according to the consumption of services (for instance, food, water, disposables, clothes, electricity, telephone). These costs are particularly addressed in economic evaluations comparing interventions in the same setting using a similar infrastructure. However, when comparing two interventions or programs under a

different infrastructure, it is recommended to estimate the average costs, which also include FCs [5]. FCs are regular costs not related to consumption, and they do not vary over the short term (<1 year), such as human resources.

In summary, the differences between both approaches (accounting and economic) imply different costing methods. Accounting costing is not accurate for the majority of economic evaluations because nonmonetary costs are not included in accounting costs, as they are in economic evaluations using a societal perspective (for instance, informal care costs, productivity costs; see Chaps. 17 and 29). Also, accountant costing does not take into account the impact of a new technology on resource consumption [8]. In this book, we use the term *costs* always from an economic perspective (economic costs).

2.2 Classification of Costs

Again, the classification of costs varies, and the same term often has different meanings. In terms of components of costs, costs are traditionally divided in the following categories [7]: (a) direct costs, (b) indirect costs, (c) intangible costs, and (d) total costs. This classification of costs is often criticized, and many authors have adopted and developed other terminologies for this purpose [5], but we still use this classification because the majority of research articles use it, and for this reason, it is helpful for easy understanding by beginner readers.

Direct costs are costs that are closely related to healthcare and to any type of care because of sickness (nonhealth sectors) (see Box 2.1). Some authors divide direct costs into health direct costs and nonhealth direct costs (see Chaps. 14, 15, and 16). Mental healthcare encompasses multiple sectors and nonhealth interventions [6, 9–11], for example, costs for accommodation such as residential facilities (housing for mental disabled people who have no social or family support) (see Chap. 16), costs of criminal justice (in the case of offenders or drug misuse), and costs for educational interventions (in the case of attention-deficit/hyperactivity disorder and autism).

Box 2.1 Direct Costs

Capital costs – land and buildings (or rent);

Capital costs – equipment and medical devices

Capital costs Building maintenance and repairs

Capital costs Maintenance, depreciation and repairs costs – equipment

Furniture – renewal and maintenance

Human resources

Clinical staff (psychiatrists, psychologists, social workers, occupational therapists, nurses, psychiatric nurses, nonpsychiatric doctors, physiotherapists, music therapists, art therapists, counselors, health visitors, other therapists)

Nonclinical staff (nonhealth sectors)

Overhead (general management and administrative costs)

Nonhealth services (cleaning, diet, security, electricity, water, telephone, waste)

Medication and interventions (surgery)

Lab tests and imaging

Consumables (materials, clothes, disposables)

Transportation (ambulance)

Accommodation (residential facilities)

Criminal justice (in some cases)

Educational interventions or services specific for people with mental illness (e.g., autism)

*Patient and family expenditures for treatment and travel, including informal caregivers (depending on the perspective)

Future medical costs related to a current intervention (e.g., clozapine use requires blood tests controls)

Voluntary services

Training and supervising mental health professionals

Depending on the perspective of the study (e.g., a societal or patient viewpoint), costs incurred by families and patients can also be included in direct costs; these include costs for transportation (travel to a health service), of

medication and disposables, for hiring a caregiver, or for refurbishing a house to adapt to specific health needs) [7]. Informal care by family represents a sacrifice of benefit (this time spent caring could be spent in leisure activities or working) – that is, opportunity costs – and should be measured, though some studies consider them to be indirect costs [7]. For example, mothers with children with autism disorders frequently quit their jobs to caring the child (see Chap. 17). Future medical costs related to a current treatment should be also considered [12] in an economic evaluation; for instance, in the case of clozapine, it requires weekly blood tests control. However, there is still a debate over the inclusion or exclusion of future costs incurred in prolonging life and that are not related to a current treatment [13].

Most economic studies do not include transfer payments in their cost analysis. Transfer payments such as social and disability benefits, work compensation, and taxes are not considered costs because they are not resources available for consumption and they are not “produced” like a good or service; they are considered by economists as income redistributions [7, 11, 14]. However, these “costs” could be included in economic evaluation for those studies using Government perspective.

Indirect costs are related to social and economic costs such as a decrease in workplace production, suicide rate, early retirement, accidents, income losses, and loss of years of education [15]. Indirect costs are usually called “productivity costs” because the majority of studies covering indirect costs focus on productivity losses (see Chap. 29). Intangible costs are “invisible” costs that are not directly measured, such as the pain of losing a son or the pain of watching a son’s suffering because of a treatment or disease. Total costs are the sum of all above-mentioned costs.

2.3 Costs Measurement

The quality of economic evaluations and cost analysis studies depends on the quality of the measurement of costs and outcomes [16]. The level of detail and accuracy vary from one study and purpose to another. “Gross costing” is used in cost analysis to provide an overview of the

effects of costs, but it is not appropriate for economic evaluation because it lacks accuracy and detail [12], though it is easier and less time consuming. Some examples are available using diagnosis-related groups (DRG), in which national tariffs are used as the units costs in order to estimate costs of resources consumed by a diagnostic group, ignoring cost variation among individuals and opportunity costs. These estimates are calculated using the mean of accounting costs among patients with the same diagnosis; these estimates are proxies for reimbursement [17]. Some countries have national tariffs for reimbursement, and the method for estimating them varies by country. However, these national reimbursement tariffs might not represent good estimates of real costs, depending on the country and on the financial public health system. Some reports show cost estimate discrepancies between diagnosis-related groups and micro-costing, ranging between 9% and 66% [17].

Beecham and Knapp [10] recommend as a general rule that costs be measured in a comprehensive manner to avoid bias in economic evaluations. According to this rule, the broader and the most accurate approach is collecting individual data through a micro-costing bottom-up method (see item 2.3.3). Costs vary among individuals, and this variation should be analyzed carefully when guiding public policies [10]. Moreover, these authors emphasize the necessity of comparing costs in “like-to-with-like basis”, that is, comparing similar services and with the same infrastructure and public profile [10]. Likewise, medication costs and effects should be compared head-to-head.

Several costing guidelines have emerged [1, 4, 6, 11, 18], but detailed methodology on costing is still lacking. The International Society for Pharmacoeconomics and Outcomes Research has published a series of task force reports on methodological issues in costing methods to be used in economic evaluation, because many studies were flawed in this regard [18–20]. However, guidelines vary in terms of recommended methods, and costing variations among economic evaluations affect the validity, comparability, and transferability of results, as well as decision-making [21, 22].

Of note, multiple factors affect cost estimation, and for this reason, the description of methods used to measure and estimate costs should be transparent, detailed, and accurate, with a well-defined costing time frame, justifications for the exclusion or inclusion of components of costs, and explicit demonstration of how uncertainty and variation of data are handled [16, 19, 20] (see Chap. 7). Last but not least, the unique rationale to measure costs must be put it into a context aligned with outcomes, because isolated numbers are useless and meaningless for allocating resources and guiding health policies [10, 23, 24] (see Chaps. 10 and 11).

In this chapter, I focus on methods for measuring direct costs; indirect costs and informal care costs are discussed in Chaps. 17 and 29. Some basic steps must be taken into account before starting to measure costs [6, 7, 9–13, 25]. The first step is to define the study perspective, because it defines which costs should or should not be included in the cost analysis. The second step is to identify all components of costs related to a program, service, or group of services. The third step is to collect data regarding the frequency and the amount of services consumed. The fourth step is to define and estimate the unit cost for each component of costs. The fifth step is to estimate and analyze the costs.

2.3.1 Study Perspective and Costs

The first step when conducting an economic evaluation is to define the study perspective and, consequently, to determine which costs should be included in the study [7, 8]. When adopting a comprehensive perspective, such as a societal viewpoint, all relevant costs related to the illness should be collected, including costs related to production sectors [7]. A societal viewpoint includes time costs, opportunity costs, and community preferences [4]. Although public health systems in different countries do not adopt this perspective, some health economists strongly recommend using a societal viewpoint for economic evaluation when possible [7, 10, 26, 27]. In general, a societal perspective is adopted as a rule in cost-benefit analysis (see Chap. 4) and rarely in

cost-effectiveness analysis; instead, cost-effectiveness analysis and especially cost-utility analysis use mainly health provider viewpoint.

The implication of choosing one perspective [4, 26, 28] therefore not only affects the components of costs to be included in the analysis; it mainly influences decision-making under misleading conclusions [4, 9–12, 25, 26, 28]. Take depressive disorder as an example. It is known that depression causes high costs to society and to the healthcare system because it is strongly related to productivity losses (absenteeism, presenteeism, early retirement, sick leave), suicide, lost school years, and greater use of the healthcare system when compared with people with no mental illness (see Chaps. 25 and 26). Therefore, it is important to collect data not only on direct costs but also in other sectors involved, such as the workplace (see Chap. 28), and to measure absenteeism and productivity losses (see Chap. 29). For instance, if one intervention is superior to another in reducing absenteeism due to depression, then it may be the most cost-effective alternative. Conversely, if adopting a narrower perspective, such as a public health provider viewpoint, only direct costs would be included in the study; supposing that the new intervention is not superior to the current alternative in improving clinical outcome, even though it is superior for reducing absenteeism, it might be not considered a cost-effective option. Moreover, adopting a narrow perspective does not take into account intangible suffering and societal preferences for treating depression (see Chap. 3), though these are matters of extensive debate. For instance, a study using cost-benefit analysis found that people with depressive disorders were willing to pay 10% of their household income [29], representing greater monetary value for the benefits of treating depression than the real costs of treatment (see Chap. 4).

Yet, a health provider perspective does not take into account patient or family expenditures (out-of-pocket) for treatment and other related negative externalities. Out-of-pocket payments may represent catastrophic health costs [30] because they can represent a substantial amount of income, leading to impoverishment (see Chaps. 24 and 25). If one intervention is supposed to

Table 2.1 Components of costs according to perspective

Costs	Society	Public health provider	Private health provider/health insurance company	Patient and family	Employer
Direct costs					
Capital equipment	x	x	x		
Health services use, human resources, interventions	x	x	x	Out-of-pocket	?
Medication and lab tests	x	x	x	Out-of-pocket	
Transportation	x	x	x		
Travel expenses (patients)	x			x	
Informal care	x			x	
Paid caregivers	x			x	
Criminal justice services	x				
Accommodation	x	x			
House refurbishment because of illness (place adapted)				x	
Social benefits		x			
Patient/family time	x			x	
Voluntary services	x			x	
Indirect costs					
Work losses (absenteeism, presenteeism, worker replacement costs) [32]	x			x	x
Accidents	x			x	x
Sick leave	x				x
Early retirement	x				
Early death (suicide)	x				
Expenditures on drugs and alcohol	x			x	
Education losses	x			x	
Impoverishment (job losses, homeless, income)				x	

decrease healthcare consumption under a public health provider perspective, it might also increase out-of-pocket costs paid by individuals and families. On the other hand, a patient and family perspective would lead to the inclusion of costs due to illness, such as costs for caregivers, drugs, transportation, work and income losses, and time spent caring (see Chap. 17). Although interest in studies using a patient and family perspective has been growing, a systematic review showed that all costs relevant to patients and families were not included satisfactorily [31]. Other costs such as

productivity losses are estimated (see Chap. 29) mostly when studies use an employer viewpoint or, ultimately, in broader studies adopting a societal perspective (see Table 2.1).

2.3.2 Identification of Components of Costs

Each scenario involves different components of costs because each entails a different level of care and services. Before collecting data, it is impor-

tant to know which services are available, how the services work, and which components of costs are incurred upon delivery of the services (see Chaps. 13, 14, 15, and 16). It is useful to map all process involved in services delivery and interventions in order to identify all relevant costs.

Unlike other medical specialties, few expensive health medical technologies are available for treating mental disorders. Despite some expensive medications (such as antipsychotics), the great parcel of direct mental healthcare costs is due to human resources from multiple sectors (health, social care, education, criminal justice). Therefore, costing mental healthcare is not easy because the identification of such components it is not always straightforward [10, 24, 25, 33]. For instance, treatment for schizophrenia disorders is not based only on administering medication to ameliorate symptoms, but on providing psychosocial interventions and all sorts of services and supports to include these patients in society and to boost their autonomy and skills for better performance in social and personal roles (see Chaps. 20 and 25). Also, families need support for expenditures and caring for patients; in the case of patients without family support, public health and social sectors also have to provide them accommodation (see Chap. 16). Psychosocial rehabilitation process, then, requires use of both health and non-health sectors, and this may generate costs to families and other sectors, the so-called spillover effect [34]. A study of costs of schizophrenia in England by Mangalore and Knapp [35] included, for example, the following costs: health services, social care, other public expenditures, private expenditures, informal care costs, costs of productivity losses, costs of premature mortality, and criminal justice system costs.

Autism is another disorder that requires multiple services such as support for families, accommodation, special educational interventions (educational psychologists), and healthcare. It is a high-cost disease not only for services but also for families [36] (see Chap. 23), and for this reason an economic evaluation of autism should include all these costs [37, 38]. For instance, a study of the costs of autism in England included

costs for education, accommodation, medication, healthcare, community and social sectors, out-of-pocket expenditures, and productivity losses [37]. Costs for education are not always easy to measure and depend on the country's educational system. An instrument is available for this purpose, the Child and Adolescence Service Use Schedule, and includes educational costs [6].

Similarly, economic evaluations of alcohol and drug use disorders should consider that criminal costs account for almost two-thirds of costs for alcohol use disorder in the United Kingdom [6], for 42% of homicides in the United States [39], for one-fifth of accidents in the workplace, and for an annual 1.2 million deaths in traffic accidents in Brazil (see Chap. 26). Including such components of costs is worthwhile for guiding health policies in terms of reducing violence, accidents, and other negative externalities. Criminal justice costs related to alcohol and drug use should be included in economic evaluations as nonhealth direct costs. Moreover, criminal justice costs are extremely relevant when estimating costs among people with challenging behavior [38]. On the other hand, some extremely debilitating disorders such as dementia may need full-time informal care or require a paid caregiver, which are not usually provided by public health systems (see Chaps. 17 and 22). Health economists have been warned for the need of conducting economic evaluation taking into account costs with informal care and productivity losses, addressing studies targeting vulnerable population (mental disorders in children and the elderly), and adopting broader perspective enabling to include relevant components of cost in the analysis. Also, there is need of studies verifying how the narrow measurement of costs affects resource allocation and equity [10, 24–26, 33, 40–42] (see Chap. 10). In the case of mental disorders, because a large proportion of total costs are due to indirect costs and nonhealth direct costs [23–25, 38, 43], effects of interventions might be underestimated, misleading decisions on resource allocation and favoring inequality [44] (see Chaps. 8, 9, 10, and 11). It is not possible to measure all costs incurred, but the most relevant costs should not be omitted in a

costing analysis. The main question is, “What is a relevant cost?” In this regard, Knapp and Beecham [33] noted that it was possible to determine the core services predicting the major proportion of total costs among mental health services, allowing a smaller list of services to be costed. Byford et al. [11] noted that two patterns of services inclusion usually occur: one linked with the inclusion of all possible services and programs involved, some of which are not relevant, and the other linked with the exclusion of important services and programs leading to cost underestimation. The recommendation, in this case, is to ask experts which programs and services are relevant to the topic of research (See examples in chaps. 14–16).

2.3.2.1 Classifying Components of Costs

After choosing the components of costs to be included in the study, it is necessary to classify them as direct or indirect costs in order to choose the method and the instrument with which to measure them. Direct costs compose three major types of components of costs: capital costs (land, buildings, equipment), treatment costs (interventions, clinical staff, medications), and revenue costs (support services, overhead, utilities, and other nonhealth costs). Treatment costs and some nonhealth costs are the core of an individual’s costs variation, whereas capital costs, support services, and overhead are usually not closely related to an individual’s variation of costs. Therefore, these costs can be classified into VCs and FCs, allowing for the use of different methods suitable for estimating them.

However, the classification of costs as VCs and FCs is not straightforward, depending on the characteristics of the services and the costing system, and on the presence of physical comorbidities. For example, we could consider the use of a transportation service as a VC because it is used according to the need of patients, and needs vary from one patient to another. Conversely, if a hospital and a third party (for instance, a rental car company) agree on monthly FCs, then these costs would be the same even if the service is not

used, and therefore they could be classified as FCs (see Chap. 14).

Of note, classifying costs implies focusing on variation by individual, that is, is a cost variable or fixed according to the individual’s consumption pattern. Sometimes it is necessary a pilot study to verify the relevance of this variation.

2.3.2.2 Time Horizon: Long-run Versus Short-run costs

In economic evaluation it is important to set a follow-up long enough to observe costs variations and effects, that is, time horizon. Then, costs can be measured over the short-run term or the long-run term. Costing measurement according to Economic principles should be based on long-run marginal opportunity costs [10]. A long-run term basis is appropriate for identifying an individual’s variation and for marginal costs, which are especially important in economic evaluation and in planning service expansions. For instance, Hallam and Trieman [45] evaluated outcomes of and costs for patients with persistent challenging behaviors who were discharged from a psychiatric hospital in London to community services; they found an important reduction on the costs 5 years afterward, though no remarkable difference in psychiatric outcomes occurred during this period. Also, while implementing a new intervention, a learning period may be required, and costs are usually higher in the beginning of the new intervention implementation than some period afterwards. Therefore, the choice of time horizon can substantially affect costs and the estimation of the cost-effectiveness of an intervention, especially if the follow-up is not long enough to allow outcomes and benefits to occur [5].

Short-run marginal costs usually includes only revenue costs and for this reason, it is not recommended for costing services where targets are expanding or creating new services. However, it is acceptable to use short-run average costs when including revenue and capital costs as proxies of long-run marginal costs. Therefore, in the long run, average costs are close to marginal costs. Usually, it is recommended costing services and programs for at least 3–6 months,

though a longer time might be required [24]. However, the majority of economic evaluations running with clinical trials collect short-run costs. Then, they should include average revenue costs, overhead, and capital costs to be approximately equivalent to long-run marginal costs [9, 10].

2.3.3 Data Collection and Costs Measurement

Once all services and supplies are identified, it is important to verify the nature of each item and its payment process in order to choose the costing method and the unit cost.

In general, two main approaches are used to measure healthcare costs: the top-down and the bottom-up approach [13, 46, 47]. The top-down approach (or gross costing) starts from the total costs of resources consumed, which are obtained retrospectively from administrative databases, and it estimates the average costs of consumption per person. The bottom-up approach (or micro-costing approach) is based on collecting all individual data of consumption of resources and then aggregating all individual costs, summing them to achieve the total costs. The latter method is more accurate, though also more time-consuming, than the former because it takes into account cost variability among individuals.

Economic studies usually combine the two methods (top-down and bottom-up approaches), creating a mixed approach, depending on data availability and the feasibility of estimating costs.

2.3.3.1 Top-Down Approach

A top-down approach is useful and easier for estimating FCs, such as human resources, over the short term. Estimating costs on the consumption of variable items is much more complex.

However, depending on the degree of the difficulty in estimating costs, it is important to bear in mind that consuming too much time for measuring irrelevant costs is useless [7]. For example, if the electricity costs of an entire hospital are paid in one bill, it is difficult to determine what amount of electricity was consumed by each unit of the hospital. And it is not possible to determine

the amount of electricity consumed by each patient in the psychiatric unit, for example. Different methods are available to estimate these costs, but the direct allocation method is commonly applied in hospital costing studies, in which the total costs are estimated, after which it may be possible to estimate the average costs when not considering variation among units; if considering such variations, the proportional ratio per unit may be used (see Chap. 14). Once costs per unit are estimated, it is possible to estimate the average costs per patient. When information on the occupation rate of a hospital unit is not available, it is usually arbitrated with a value of 80% of the total occupancy rate [7].

On the other hand, items such as medications vary too much from one patient to another; for this reason the average costs are not accurate. In this case, using a micro-costing approach for estimating individual costs is more appropriate [7].

2.3.3.2 Bottom-Up Approach

Micro-costing involves collecting data on the frequency of consumption of services directly from the patient, family, health professionals, or medical records. No gold standard exists, and each source of data has advantages and disadvantages.

Collecting data from patients and families is useful, especially for reporting the use of several services (outpatient, emergency care, primary care), because each health service is not able to provide information on the consumption of services outside its unit [48]. The main disadvantage is recall bias (see Chap. 13). In this regard, diaries are more accurate and minimize recall bias [11].

On the other hand, health services, health professionals, and medical records are able to provide more accurate data on the frequency of visits to services and about the type and the number of procedures and interventions delivered. However, health professionals and medical records are less reliable in a hospital context because missing information is common [48].

A few questionnaires and inventories address the measurement of mental health services utilization (see Chap. 13). One of the most used questionnaires to collect data on direct costs, including

mental healthcare, is the Client Sociodemographic and Services Receipt Inventory, developed by Knapp and colleagues [10, 49] in the United Kingdom. This tool is designed to collect data on sociodemographics, benefits, occupational and work statuses, work days lost because of a mental disorder, healthcare utilization (including mental healthcare), medication, intervention by mental health professionals, accommodation, emergency unit use, hospital use, primary and outpatient care, and criminal justice use. These tools are discussed in detail in Chap. 13. The Database of Instruments for Resource Use Measurement is an open database to support health economists and researchers in this field to find questionnaires and resources in order to collect data on costs and health services utilization (available at <http://www.dirum.org>).

2.3.4 Estimation of Unit Costs

Overall, the estimation of costs is the product between the frequency of resources consumed and the unit costs. In micro-costing, data collection is addressed to measure the frequency of resource utilization, such as the number of visits to a psychiatrist in the past month or the number of days spent in a hospital. However, it is necessary to estimate the unit costs, that is, the cost of one visit to a psychiatrist or the daily costs per person in a hospital.

Different methods, perspectives, and purposes are used to estimate the unit costs, and each leads to different results [1, 7, 50]. Some countries deliver national unit costs with the average costs for each unit cost, like the United Kingdom (Unit Costs of Health and Social Care; <http://www.pssru.ac.uk/project-pages/unit-costs/2015/>), the Netherlands (the Dutch Manual for Costing in Economic Evaluation) [18], and Austria (<http://healtheconomics.meduniwien.ac.at/science-research/dhe-unit-cost-online-database>).

In the absence of national data, it is obligatory to estimate the unit cost of each relevant resource. The World Health Organization provides a database (<http://www.who.int/choice/country/country-specific/en/>) of the average values of unit costs

for 191 countries, which is useful when there are no national data, but micro-costing and accurate estimation of unit costs are preferred in cost-effectiveness analyses.

Some detailed guides are available to estimate unit costs, but a lack of consensus exists about the methods to estimate them [21]. In this chapter we present a global overview of how to estimate unit costs of the main resources consumed in healthcare. Detailed methods are described elsewhere [10, 51–53].

2.3.4.1 Capital Costs

Capital costs compose land, buildings, and equipment, and methods for costing them are based on measuring the opportunity costs, lifetime use, and interest rate (see Table 2.2). Building Rent can be considered a proxy of capital costs in some cases. Repair and maintenance of buildings and equipment are included in this item.

Multiple methods can be used to estimate capital costs, but one of the methods most recommended by Drummond et al. [7] is equivalent annual costs (or equivalent annual annuity). This method considers the current price, the discount rate, and the period of time related with lifetime use. The discount rate (interest rate) is a concept related to the value of a benefit over the time, that is, the so-called time preference. Usually, people prefer getting a benefit now rather than in the future, and for this reason, its value decreases over time. The costs of one good or service now are, for instance, much higher than they would be within 5 or 10 years, not considering depreciation (for equipment). Therefore, the costs of a new health program in the first year are higher than in the fifth year. When estimating costs of goods and services over the long term (>1 year), it is a paramount to apply a discount rate from 3% to 5% of the current cost.

Moreover, costs of buildings and equipment depreciate because their lifetime use decrease over time. A useful life for buildings varies from 8 to 40 years; the average number used in the majority of economic studies is 20 years. For equipment, useful life can vary from 3 to 8 years, with an average of 5 years. In the case of rent, it is possible to use its value as a proxy for capital costs.

Table 2.2 Estimation of unit costs and costing methods

	Item	Method to estimate unit costs
Capital costs	Land	Opportunity costs (interest) Interest rate (discount) Nondepreciable
	Buildings	$\text{rateEAA} = r \text{ (NPV)} / (1+r)^n$ EAA= Equivalent annual annuity, r= discount rate, n = lifetime use in years NPV=net present value Depreciation rate = $(1 + \text{discount rate})^n \text{ years}$
	Equipment	Current price and depreciation or Cost of acquisition and EAA
Human resources	Health and nonhealth professionals	Professional time (by hour or by minute) Total costs (wages + charges and taxes) divided by working time For professionals not directly assisting the patient, the average cost per patient can be used. When the same professional serves two units or departments, it is important to determine the ratio of time spent in each one to derive the unit of cost
Overhead	Administrative management	Direct allocation (does not consider simultaneous use of resources or use of resources external to the unit) Step-down allocation (hierarchical costs centers) Multiple allocation (proportional use of resources by unit of service)
	Sharable services/Support services (laundry cleaning, laboratory, etc.)	
Medication	Variable costs	Micro-costing per patient: the unit costs depend on whether the service is public or private
Interventions, vaccines, and lab tests	Variable costs	Micro-costing per patient

For more details consult references [1, 6, 7]

2.3.4.2 Human Resources

In healthcare, human resources can be divided in two main categories: those linked directly to assisting patients (e.g., psychiatrists, psychologists, nurses, occupational therapists) and those linked to supporting professionals and services (e.g., administrative functions, cleaning, cooking, security). Work agreements vary widely, and costing methods vary accordingly. Moreover, the costing method depends on the healthcare setting— for instance, whether a hospital or outpatient care.

Roughly speaking, costs with no direct health-related professional may not vary too much among mental health patients from the same unit or with the same condition; for this reason, a top-down approach using average costs per patient is far more useful and less time-consuming than bottom-up approach. Costs are estimating based on the salaries and fees of each category, on the job time scale, and on the number of patients assisted. The main problem is estimating costs of professionals working in two or more units in a hospital (shared

costs), or perhaps for professionals working on laboratory tests for the entire hospital.

However, situations in which micro-costing is preferred depend on the purpose of the study and on the patient profile. Some patients consume services from multiple service units in a hospital, such as surgery rooms, emergency department, intensive care unit, whereas others remain in one unit, consuming only local interventions and professionals. In psychiatric wards, especially wards caring for patients with chronic mental illness, lower use of other units and interventions is expected than in clinical or surgical wards. If the consumption of services from other units of a hospital is low, it may be better to estimate the costs for a procedure, costing the entire process to deliver the intervention alone (professional plus material and equipment plus time required for the intervention) (active-based costing method). On the other hand, costs for health-related professionals vary depending on the need and profile of each patient.

2.3.4.3 Overhead (Administration Costs)

This term addresses those costs related to administrative services covering multiple units of a hospital or other health services. Drummond et al. [7] emphasize that there is not only one right way to estimate overhead costs, and it is not clear whether one method is better than another. The items included in the overhead costs can vary from institution to another; the usage of services and the method of cost allocation can vary as well. Overhead can be broken into two categories: (a) overhead related exclusively to management and administrative services, (b) overhead not directly related to health intervention or “hotel costs” (catering, cleaning, laboratory, dietary, security, gas, water, and so on).

2.3.4.4 Nontreatment Services (Supportive Services)

In this category of costs is included all necessary services for running and maintaining health services, such as diet, clothing, laundry, cleaning, security, administration services, informatics, pharmacy, and repair. These services can be subdivided as human resources, catering, transportation, external or third-party services (repairing services), utilities (e.g., electricity, telephone, internet, water, gas), and administrative services (overhead) (see Chaps. 14, 15, and 16).

2.3.4.5 Disposables and Suppliers

Disposable costs cover the consumption of all materials, and they can be estimated using a top-down approach considering the same unit with the same routine for interventions and similar diagnoses. If consumption varies extensively among patients, then micro-costing would be preferable. In psychiatric hospitals with patients who have few clinical comorbidities, low variation in the consumption of such suppliers is expected. However, the consumption of suppliers may be different in psychiatric units in a general hospital because the profiles of patients may be different with regard to the degree of psychiatric severity and on presenting clinical comorbidities; then, micro-costing would be more appropriate. For instance, patients with delirium tremens may

need multiple clinical interventions and might consume more suppliers than patients in an acute psychotic episode who have no clinical comorbidities.

2.3.4.6 Medications

Medication costs vary substantially, adding substantial difficulties in estimating their costs in economic evaluation studies [4, 54, 55]. Three different types of drug costs may be used, according to the perspective of the study [4, 54, 55]: (a) production costs (costs for companies), (b) market costs (consumers), and (c) costs for public health sector (government). In addition, issues related to drug patents and investments in the research and development of new drugs affect how these costs are estimated.

Regarding a government and public health perspective, drug costs usually are lower than costs for consumers in a free market; in some countries, such as Brazil, the government pays drugs up to 24.38% (price adjustment coefficient) less than factory prices [56]. However, drug costs vary among public services, as can be observed in the Brazilian public medication price database, and it might be difficult to obtain accurate values of drug acquisition [57]. In some countries, consumers have to pay for medications at their market price (out-of-pocket costs) or are partially subsidized (copayment). Excess profit from drug costs may also be a factor in overestimating costs in cost-effectiveness studies. Depending on the study perspective, such as health managed care, a dispensing fee should be included and copayments by patients should be excluded [55]. However, drugs often have multiple manufacturers, hindering costing exercises. More details are described in the International Society for Pharmacoeconomics and Outcomes Research Task Force guidelines [4].)

2.4 Costs Analysis and Cost Estimation Bias

The aggregation and estimation of total costs involve some common obstacles that might result in biased cost estimations: the nature of cost data,

the accuracy of cost data, and the variability of unit costs. Bias should be adjusted in statistical analysis (see Chap. 7). Cost data are always skewed, that is, they have a non-normal distribution. This has some implications in terms of the low power of a study, and the use of nonparametric tests and regression models with bootstrapping. Accuracy is another important problem related to data validity. Several biases exist regarding the validity and reliability of questionnaires assessing services use and in the methods used for estimating unit costs (see Chap. 13). Item costs vary from one setting to another, and the range of this variability should be taken into account through sensitivity analysis. Data uncertainty should be addressed in statistical analysis, which is discussed in detail in Chap. 7. In epidemiological studies, randomized controlled trials are the gold standard, in particular because baseline differences are avoided by randomization. However, randomization does not work for cost data. Other statistical strategies are available to deal with these limitations.

Cost data are not generalizable because they depend on the setting and region; in terms of comparability among countries, costs should be converted to purchase power parity (see Chap. 11). Drummond and Sculpher [19] described in detail the main methodological flaws in reporting costs analysis in economic evaluations. All these issues are discussed in the following chapters, especially Chap. 7.

Key Messages

- Methods for defining, classifying, and estimating direct costs vary across guidelines, hindering data validity and accuracy.
- Costing depends on the perspective and goal of the study, on the identification and measurement of components of costs, on the costing approach for estimating unit costs, and on costs analysis.
- Costing in mental health should encompass costs from other sectors such as

criminal justice, social care, education, and informal care, and include them in the economic evaluation. Not considering these costs might underestimate mental health intervention effects.

- A bottom-up approach, long-run marginal costs, a broader perspective, and comprehensive data collection are key elements recommended for costing in economic evaluation.
- Methodological flaws are common in costing studies, and transparency and a detailed description of the methods used to estimate costs are paramount to avoid misleading decisions on resource allocation.

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