# Chapter 9
# Applying Pharmacoeconomics in Community and Hospital Pharmacy Research

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**Abstract** Increasing pressure on maximising the output from limited resources has forced health-care policy makers to use health economic evaluation tools to evaluate the efficacy and efficiency of pharmacy services. Increasingly to evaluate these services, pharmacoeconomic evaluation is being used. This chapter introduces the concept of pharmacoeconomics and discusses different pharmacoeconomic methodologies. It also traverses literature covering economic evaluation studies in community and hospital pharmacy setting. The chapter discusses conducting economic evaluations and debates issues related to data sources, perspectives, costs, outcomes measures, sensitivity analysis and strengths, weaknesses and opportunities related to this research.

## 9.1 Introduction

Medicine expenditure is growing globally. This is well reflected by the fact that the prescription drug expenditures in the United States have more than doubled over the last decade; the US spent $120 billion on prescription medicines in the year 2000 compared with $263 billion in 2011 (CDC 2014). Similar trends have been observed across the world where pharmaceutical expenditures per capita in Organisation for Economic Co-operation and Development (OECD) countries have consistently increased over the period of 2008–2013 (OECD 2014).

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Z.-U.-D. Babar (ed.), *Pharmacy Practice Research Methods*,
DOI 10.1007/978-3-319-14672-0_9

Given the growing pressures of cost-containment initiatives, funding decisions are increasingly based on objective data. Funding bodies in the United Kingdom (UK) (Rawlins et al. 2010) and Australia (Committee PBA 2014) require pharmacoeconomic and budget impact analysis at the time of submission for new Health Technology applications. The majority of pharmacy practice research activities are geared towards new pharmacy services and aim to introduce the research as a routine professional practice (Martinez et al. 2013; Ottenbros et al. 2014). Nevertheless, new pharmacy services should demonstrate the value for money when competing with initiatives proposed by other disciplines such as medicine, nursing and allied health (Chan and Wang 2004). In this context, pharmacoeconomics (PE) research can be a useful tool for practising pharmacists, pharmacy managers and those who are involved in pharmacy practice research and in quality improvement projects.

## 9.2 Pharmacoeconomics

Pharmacoeconomics (PE) is an established discipline of Health Economics. It is a scientific discipline that compares the value of one pharmaceutical agent, service or program to another in an attempt to make conclusion about the preferred choice from payer, society or an individual perspective. Table 9.1 briefly describes the types of pharmacoeconomic analysis; however, a detailed description of the types and methodologies is beyond the scope of this chapter and has been described elsewhere (Drummond et al. 2005). The subsequent sections of this chapter will discuss the available PE research methods, drawing on examples from the existing literature and possible applications to the practice of pharmacy.

## 9.3 Relevance of Pharmacoeconomics to Pharmacy Practice Research

There are many applications of pharmacoeconomics in pharmacy practice research. Economic analysis of medicines prior to inclusion in hospital formulary, evaluation of unique pharmacy services, estimating willingness to pay for pharmacy services by consumers and cost consequence of various pharmacy models are few examples in this area. The most frequent application of pharmacoeconomics methodology in the pharmacy discipline is the evaluation of medicines to determine their relative cost-effectiveness to similar agents that are already available in the market. This is partly because such evaluations are often required by payers of pharmaceutical services (Rawlins et al. 2010; Committee PBA 2014). While a number of studies reporting pharmacy practice research have included costs associated with pharmacy services (Branham et al. 2013; Lucca et al. 2012; Desborough et al. 2012; Kopp

**Table 9.1** Types of Pharmacoeconomics analyses and relevant examples

| Type of analysis | Brief description | Unique practical applications |
|---|---|---|
| Cost-minimisation analysis (CMA) | Analysis to identify the most economical option when efficacy of comparison is similar | Choosing generics of a same medicine; selecting medicine from the same class; selecting dispensing software for pharmacy |
| Cost-effectiveness analysis (CEA) | Analysis to identify the most economical option when efficacy is not similar. Outcomes are measure as increase effectiveness delivered for each $ invested | Choosing model of care such as hospital admissions vs. day care admissions; service delivery such as Pharmacist vs. nurse run asthma clinic; choosing medicine with same outcome: Atorvastatin vs. Rosuvastatin<br>Above mentioned examples are CEA if outcomes are presented as incremental effectiveness per $ invested OR CBA if outcomes are presented as net $ benefit |
| Cost–benefit analysis (CBA) | Analysis to identify the most economical option when efficacy is not similar like CEA. Outcomes are measure as net $ benefit | |
| Cost–utility analysis (CUA) | Analysis to identify the particular option that will deliver the best utilisation of existing resources. Outcomes are measured in terms of utility measures such as Quality Adjusted Life Years (QALYs) for each $ invested | Allocation of resources across various clinical areas such as funding a smoking cessation program or allocating resources for staff lounge. Choosing an antiemetic for hospital formulary for cancer patients or a new analgesic for chronic pain |

et al. 2007; Hilleman et al. 2004; Zaidi et al. 2003; Crowson et al. 2002; Devlin et al. 1997; Dranitsaris et al. 1995), the robust use of pharmacoeconomic analysis is limited (Saokaew et al. 2013; Rubio-Valera et al. 2013; Aspinall et al. 2013; Weant et al. 2009; Chisholm et al. 2000).

### *9.3.1 Economic Evaluations of Pharmacy Practice Research*

A number of pharmacy practice studies have reported economic evaluations as a part of their methodology. Applying economic evaluation to pharmacists' interventions was common in early studies (Kopp et al. 2007; Zaidi et al. 2003; Crowson et al. 2002; Devlin et al. 1997; Chuang et al. 1994; Cooper 1997; Cowper et al. 1998), whereas recent studies focus more on disease-specific contribution of the pharmacists' role (Rubio-Valera et al. 2013; Aspinall et al. 2013; Weant et al. 2009; Cies and Varlotta 2013; Gray et al. 2007; van Boven et al. 2014; Johnson 2009; Klepser et al. 2012; Perraudin et al. 2013; Thavorn and Chaiyakunapruk 2008). A bulk of published economic evaluations of pharmacists' interventions have been conducted within hospital settings (Kopp et al. 2007; Zaidi et al. 2003; Crowson et al. 2002; Devlin et al. 1997; Chuang et al. 1994; Cooper

1997; Cowper et al. 1998) as opposed to community settings (Branham et al. 2013; Desborough et al. 2012; Marciante et al. 2001; Avery et al. 2012). A brief discussion of available studies according to the area of investigations will be presented in the following section.

#### 9.3.1.1 Economic Evaluations of Pharmacists' Interventions

A number of studies have evaluated the cost impact of pharmacist's interventions in critical (Lucca et al. 2012; Kopp et al. 2007; Zaidi et al. 2003; Devlin et al. 1997; Chuang et al. 1994) and noncritical care settings (Crowson et al. 2002; Cooper 1997). Most of the critical care setting studies have focused on direct cost savings associated with a pharmacist's intervention to justify the additional cost of having a clinical pharmacist on board (Zaidi et al. 2003; Devlin et al. 1997; Chuang et al. 1994). These studies are of shorter duration, ranging from 4 to 13 weeks. An important aspect of pharmacist's presence in critical care settings is related to educating prescribers and nurses about medicines use. This fact is highlighted by a Malaysian study that demonstrated a relative decrease in the number of interventions over a four-week study period (Zaidi et al. 2003).

Studies evaluating pharmacists' interventions in non-critical and community settings are of a comparatively longer duration (Branham et al. 2013; Desborough et al. 2012; Cooper 1997; Cowper et al. 1998; Avery et al. 2012; Wallerstedt et al. 2012). Furthermore, studies from community settings are mostly multicentred and often have large number of patients. This gives them sufficient power for data analysis and also makes findings generalizable (Branham et al. 2013; Desborough et al. 2012; Avery et al. 2012). Following the trend from critical care-related studies, most studies of pharmacists' interventions in community settings have focused on direct cost savings. These studies also have placed little emphasis on the cost impact of patients as well as on process-related outcomes such as length of hospital stay, quality of life, educational impact and prevention of Adverse Drug Events (ADEs).

Other than the direct cost savings resulting from pharmacists' interventions, there are also benefits in patient health outcomes. These are important for two reasons: first, cost savings resulting from such heath outcomes are often greater than the direct cost savings from medicines use and, therefore, omitting such outcomes can significantly underestimate the economic impact of pharmacists' interventions. Second, such outcomes can contribute to administrative decision making and help convince decision makers about the importance of pharmacists' role in a given area. Adverse drug events are often associated with an increase in a patient's length of stay and morbidity and mortality (Gyllensten et al. 2014; Kane-Gill et al. 2010). It has been estimated that the cost of managing ADEs can be as high as around 10 % of the total health-care cost (Gyllensten et al. 2014). One particular study of interventions made by clinical pharmacist in surgical ICU reported cost avoidance of more than US$200,000 over a 5-month period (Kopp et al. 2007).

#### 9.3.1.2 Economic Evaluations of Disease Management by Pharmacists

Earlier reports of economic evaluations of pharmacists' role in the management of a disease or condition can be found as early as 50 years ago (Mutchie et al. 1979). However, most older studies were focused on a particular aspect of disease management instead of on the pharmacist solely managing a disease or condition (Dranitsaris et al. 1995; Mutchie et al. 1979). A number of recent studies have investigated the cost-effectiveness of pharmacist-managed care for a variety of disease states such as pharmacist-managed smoking-cessation clinics (Thavorn and Chaiyakunapruk 2008), asthma program (Chan and Wang 2004), diabetes and heart disease (Branham et al. 2013), depression clinics (Rubio-Valera et al. 2013) and anaemia management in end stage renal disease (Aspinall et al. 2013).

Compared to the economic evaluations of pharmacists' interventions, most recent studies evaluating pharmacists' impact on disease management have employed formal pharmacoeconomic analysis including sensitivity analysis (Rubio-Valera et al. 2013; Aspinall et al. 2013; Thavorn and Chaiyakunapruk 2008). Sensitivity analysis is where researchers modify the cost of different study variables to assess the cost-effectiveness of a particular intervention under different scenarios (Drummond et al. 2005). This allows policy makers to assess risks involved in funding a particular service or health technology. This is because as individual costs and the probability of attaining intended outcomes may vary from one practice settings to other or from one health-system to another.

Another feature of published pharmacoeconomic studies in pharmacist-managed disease states is the detailed description of cost-effectiveness modelling and associated costs and consequences estimations (Rubio-Valera et al. 2013; Aspinall et al. 2013; Thavorn and Chaiyakunapruk 2008). An overarching aim of publishing scientific research is to contribute to the existing scientific literature so others can benefit from the literature. Unfortunately, apart from few well-conducted pharmacoeconomic studies, the majority of studies have methodological limitations thus making it difficult for other investigators to either adopt the reported methodology or to compare their own results with that of published literature (Elliott et al. 2014). Future studies evaluating the economic impact of pharmacist's interventions and pharmacist-based care models should focus on direct and indirect costs associated with patients' and process-based outcomes. This would then be helpful to assess the true nature of pharmacist contributions.

The discussion so far has been focused on introducing readers to the various types of pharmacoeconomic analyses, their application in pharmacy practice research and the limitations of the existing literature. The following section will briefly discuss some key considerations in designing a pharmacoeconomic analysis.

### 9.3.2 Designing a Pharmacoeconomic Analysis

A detailed description of a step-wise approach to designing a pharmacoeconomic analysis is beyond the scope of this chapter. Guidance on designing PE studies is available from the experts in the field (Drummond et al. 2005). Furthermore, World Health Organisation (WHO) has developed guidelines on generalised cost-effectiveness analyses that provide excellent commentary on some of the methodological issues on the subject (Tan Torres Edejer et al. 2003). The purpose of this particular section is rather to introduce readers to some of the considerations and background work required for designing and conducting a pharmacoeconomic analysis. Although most of this will be applicable to general economic analysis, the discussion will focus on pharmacy practice research. In order to keep this discussion relevant to the practice of pharmacy, two distinct case studies are chosen, one from hospital pharmacy and the other from community pharmacy settings (Box 9.1).

### 9.3.3 Scope of the Study

Defining the scope of a study is one of the first key steps. The scope of the study needs to be realistic and should feed into one's own practice setting.

Being realistic means conducting the study within the context of available data sources. For example, it might be desirable to measure long term patient-related outcomes such as mortality, morbidity and hospitalisations while measuring the cost-effectiveness of a pharmacist managed Chronic Obstructive Pulmonary Disease (COPD) clinic. However, this may not be realistic as these are long term outcomes requiring substantial time to show improvements. Hence, the researchers in this particular case may want to focus on direct cost savings, length of stay and concordance data, for example. Though the data may still be collected on long term outcomes from hospital medical records, any association found would be most likely unreliable where the duration of intervention is shorter. Contrarily, if the proposed intervention is planned to be delivered over at least 6–12 months, to not include clinical outcomes data would be inappropriate.

**Box 9.1. Case Studies of Hospital and Community Pharmacy Settings**
Hospital case study:

*Poor compliance to antibiotic prescribing guidelines at your hospital is a chronic problem. As such, there is a plan to implement an electronic decision support system to streamline restricted antibiotics approval prior to prescribing in an attempt to improve physician's compliance to the prescribing guidelines. You are the project pharmacist and the hospital administrator*

(continued)

**Box 9.1** (continued)

*wants to know if the cost of implementing an electronic decision support is justifiable?*

Community case study:

*You are the newly appointed strategic planning manager of a company that manages a brand of chains of pharmacies. Under increasing competition, the board of directors is considering better engagement with patients to ensure their loyalty to the company. There is a plan to roll out a memo-care program that will incorporate prescription reminders, active communication with patients at each repeat dispensing and monitoring of compliance and adverse effects by pharmacists, so as to ensure patients experience a visible difference that may translate into long term loyalty with the pharmacy brand. The board wants you to evaluate the cost-effectiveness of this strategy.*

Considerations to the relevant practice settings are also vital, as the scope for both community and hospital settings would be different. This is due to differences in the operations and priorities of each health-care setting as well as the way in which these services are funded. Hospital-based interventions are likely to have complex indirect costs such as loss of productivity due to illness, opportunity cost due to funding of the studied intervention, expensive diagnostic procedures, to name a few (Locatelli and Marazzi 2013; Jackson 2000). Whereas in community-based economic evaluations, it is likely to be less complex as fewer indirect costs need to be incorporated.

Using the hospital case study from Box 9.1, the overall aim of the intervention is to improve a physician's concordance to the prescribing guidelines and therefore the scope is focused on concordance rather than clinical outcomes. However, the community case (Box 9.1) will be broader in scope as it aims to implement multiple interventions such as prescription reminders, close communication, monitoring of compliance and adverse effects. While such complexity will play an important role in measuring costs and deciding which variables to include in the economic evaluation, the scope of this evaluation is reasonably straightforward. The primary aim of this intervention is to increase customer loyalty, and therefore the scope of the intervention focuses on customer satisfaction, proportion of repeat dispensing and long term loyalty. It does not take in account other meaningful but irrelevant outcomes (in context of the evaluation) such as hospitalisation attainment of target clinical measures and health-related quality of life.

### *9.3.4 Choosing Perspective*

Pharmacoeconomic analysis can be carried out from a variety of perspectives such as patient's perspective, insurer's perspective, government perspective or societal perspective. Perspective refers to the funder of a particular intervention or service in question. While the choice of perspective appears to be simplistic, in reality choosing a perspective can be a complex process (Tan Torres Edejer et al. 2003).

The societal perspective is the preferred perspective within WHO guidelines (Tan Torres Edejer et al. 2003) and experts in the field support its use as well (Byford and Raftery 1998). Nevertheless, the societal perspective has its own limitations. First, the concept that society (or tax payers at large) is paying for health-care services or the intervention in question may only be applicable in public health-care system and it is challenging to apply the same concept to private insurance system or in developing countries where patients often pay for their own health expenses. Second, an estimation of all possible costs related to the societal perspective can be challenging and may not always be quantifiable (Mason and Mason 2006). Third, a societal perspective may not be applicable to some economic analysis. This third limitation is quite relevant to pharmacy practice research specifically during the initial phase of the studies.

Pharmacy practice research often proposes models of care that are collaborative in nature, where pharmacists are offering their services in collaboration with other health-care professionals such as nurses or doctors (Zaidi et al. 2003; Cooper 1997; Avery et al. 2012). Having said that, a number of pharmacist-based patient care interventions can and should be evaluated from a societal perspective, especially while being considered for a wider implementation. Particular examples of such services are pharmacists undertaking government-subsidised home and residential aged care medicine reviews in Australia (Sorensen et al. 2004) and similar program known as Meds-Check in Canada (Grindrod et al. 2013).

Most single site hospital-based or small scale community-based economic evaluations can choose a non-societal perspective. However, in large scale intervention studies, using societal perspective may be a better option. Referring back to Box 9.1, the specific aim of the electronic decision support is reasonably narrow and a societal perspective may not be suitable for this evaluation regardless whether the hospital is funded from public or from private resources. However, if the same system is found to be economically feasible and there is a will to expand the system to a number of public hospitals, then a societal perspective will be worth exploring. Given the obvious commercial nature of the community pharmacy example (Box 9.1), a company or payer perspective will be perhaps the most reasonable choice.

## 9.4 Choosing Particular Analysis

Most economic analyses are applicable to pharmacy practice research. Cost-minimisation analysis is more applicable to in-house projects where pharmacy departments within hospitals or community pharmacy organisations can look into different service delivery models, for example, or choosing generics for a given drug. Cost-effectiveness analysis is more likely to be used for intervention studies (Branham et al. 2013; Avery et al. 2012) and studies evaluating pharmacist-based care model for chronic diseases such as asthma (Chan and Wang 2004) and smoking-cessation programs (Thavorn and Chaiyakunapruk 2008). The limited use of cost–benefit analysis compared with cost-effectiveness analysis can be explained in the context of technical challenges in defining the cost of clinical outcomes. As shown in Table 9.1, cost–benefit analysis (CBA) requires all consequences of a particular intervention to be translated into monetary value and there are ethical concerns in putting a monetary figure on certain humanistic and clinical outcomes (Drummond et al. 2005; Mason and Mason 2006). Nevertheless, CBA can be reasonably applied for most interventions especially while evaluating a new pharmacy model (Desborough et al. 2012; Zaidi et al. 2003; Chisholm et al. 2000), while cost–utility analysis (CUA) can be applied for different intervention in isolation to another (Drummond et al. 2005). However, this is rare in pharmacy practice research as mostly a direct comparator is available.

Considering the example of electronic decision support from Box 9.1, CEA as well as CBA are equally applicable in this scenario. Nevertheless, CBA will simply provide the net benefit ratio of the intervention and will not be able to summarise the relative increase in guideline adoption. Conversely, CEA will be able to provide the relative increase in guideline adoption as incremental cost-effectiveness ratio with varying degrees of physicians' concordance with the guidelines, and hence this would be more applicable.

With regard to the community pharmacy intervention (Box 9.1), CBA is preferred. This is because CBA will provide a clear indication of return on investment in terms of relative financial gains. Though CEA will provide information on customer-retention rates and may be considered a suitable method, it will not provide information about the net financial benefit. Given the payer's perspective in the scope of Memo-Care program, to retain and grow business in the competing environment, CBA will be preferred over CEA in this particular example.

### *9.4.1 Estimating Costs*

Costs and outcomes are the essential part of any pharmacoeconomic analysis. A number of factors are related to the estimation of direct and indirect costs of the particular intervention being evaluated. The direct cost of delivering a health-care intervention include the cost of intervention and indirect cost may include the cost

of delivering, accessing, maintaining and any associated opportunity cost ( which is being lost due to providing the intervention in question) (Drummond et al. 2005; Tan Torres Edejer et al. 2003). As described earlier, most studies evaluating the economic impact of a pharmacist's interventions have not used formal pharmacoeconomic methods and therefore have not included a number of relevant costs in their analyses (Elliott et al. 2014). However, there are few formal pharmacy practice pharmacoeconomic studies in which direct and indirect costs-associated interventions have been studied (Rubio-Valera et al. 2013; Aspinall et al. 2013).

Most notable is the cost-effectiveness analysis of pharmacist's intervention in depression (Rubio-Valera et al. 2013). Authors of this particular study have considered all relevant costs related to not only implementing the intervention but also indirect costs associated with service utilisation, training health-care professionals, resource utilisation and lost productivity (Rubio-Valera et al. 2013). An important issue in estimating costs is that some costs overlap between different categories. A practical and easy to understand example could be the cost of preparing training materials for the delivery of intervention. Although training may differ for different health-care professionals, allocating material preparation costs repetitively will overestimate costs associated with training. Therefore, it is important to avoid such duplication wherever possible. WHO guidelines on generalised CEA clearly recommend avoiding such mistakes (Tan Torres Edejer et al. 2003).

Referring to our examples from Box 9.1, cost estimates for decision support should not only consider cost of procuring and initial implementation of the system but should also include costs for ongoing maintenance and for staff training. Other costs worth considering are costs related to ongoing training of new staff, cost of updating the decision support knowledge base, cost of integration with other system and cost of measuring outcomes of interest to demonstrate its value. Another rather difficult to measure cost will be the cost of proportional share of using existing technology infrastructure. Equally important are the costs of comparator in this example. Clinical governance framework in modern health-care requires that all health-care institutions have appropriate systems in place to provide guidance to clinicians about the standard of care. As such, the cost of implementing antibiotic-prescribing guidelines as well as initial implementation and monitoring should be measured. Similarly, the cost of updating such guidelines and ongoing dissemination and monitoring of concordance are important considerations. Contrary to the matters discussed earlier in this chapter, decisions regarding costs are often complicated and are often made according to the availability of existing data sources available to researchers. Costs such as opportunity cost are beyond the scope of this particular example but may be applicable if a broader perspective such as societal perspective has been adopted (Drummond et al. 2005).

Common costs across community pharmacy and hospital examples (Box 9.1) will be costs of training and initial rollout of the 'Memo-Care' program, ongoing training of staff, ongoing monitoring to assess pharmacists' compliance and costs associated with measuring outcomes of interest.

### 9.4.2 Estimating Benefits or Outcome Measures

Estimating outcome measures and benefits associated with a particular intervention can be tedious. With the exception of pharmacist's based care models of disease management, outcome measures for most pharmacy practice research projects can be measured directly from the existing data sources. For example, studies evaluating specific pharmacist's interventions can measure direct cost savings associated with accepted recommendations (Zaidi et al. 2003). Benefits such as cost of preventing ADEs can not only be complicated but can also be measured from the probability of resultant harm and cost resulting from preventing such harm (Gyllensten et al. 2014). Studies on disease management models require patient-specific outcome measures such as Disease Adjusted Life Years (DALYs) or Quality Adjusted Life Years (QALYs) as well as estimation of years of life saved due to improvement in mortality where applicable (Drummond et al. 2005). A detailed description of these measures is beyond the scope of this chapter; nevertheless, DALYs and QALYs are time-based measures of health that assess the effect of intervention on years of life (Tan Torres Edejer et al. 2003).

In our hospital example, the outcome measure of interest would be antibiotic expenditures, physician's concordance rates with guidelines and physician's acceptance of interventions. Clinical outcomes relevant to the diagnosis being treated can also be considered with some limitations. This is because the intervention here is only changing the mode of guidelines delivery and not the contents of the guidelines per se. However, a case can be made because the intervention is likely to increase the concordance rates with antibiotic prescribing guidelines and perhaps evidence suggests that guideline based care can improve clinical outcomes (McBride et al. 2014). Outcome measures related to community pharmacy would be customer retention, repeat business, patient compliance and customer satisfaction.

### 9.4.3 Sources of Data

Data on costs and benefits related to an intervention can be collected in a number of ways. Data sources can be classified as routinely collected data and data that require collection for the study purpose. Most medium-to-large organisations are required to record and report financial data based on regulatory requirements. Countries with welfare approach to public health such as Australia, the United Kingdom and a number of European countries often have substantial contribution of public funding to health care. In these countries, financial reporting on each clinical activity is often mandated by the government. Health-care expenses for OECD countries are easily accessible from the organisation's website (OECD 2014) and such data is often created from individual reports from each institution within a particular country.

It is important to review the existing dataset available while conducting an innovative service delivery project in community pharmacies. Measuring and recording baseline data are also pertinent, given in the context that the outcome measures will most likely be affected by the intervention. Apart from individual data sources, researchers can also rely on published model to conduct economic analysis. A number of published pharmacoeconomic studies are available and if the topic of research is similar to a published study then adaptation of an existing model can not only save time but also can provide validity to the research (Sanchez and Lee 2000). Also, in cases where researchers have to estimate their own costs, it is important to define cost as total acquisition cost rather than the unit cost of a particular item.

The examples from Box 9.1 can further explain the use of existing vs. -non-existing data sources. Considering the case of electronic decision support, cost will need to be calculated for this intervention. The relevant information technology and finance departments may also be able to provide practical insights on this cost calculation. The costing data may also be available about training of staff from other projects. In the first instance, researchers undertaking economic analysis like the one in the hospital example (Box 9.1) should contact their safety and quality office to see if an existing dataset may be available and is relevant to their study. Hospitals in most countries are accredited by various quality-related organisations. Typical examples are Joint Commission in the US, Care Quality Commission in the UK and Australian Commission on Safety and Quality in Healthcare in Australia. Hence, there is a possibility that some relevant data might be available.

Given the commercial nature of the project related to community pharmacy (Box 9.1), most data related to cost and benefit will already be available in pharmacy records. The bulk of this project cost lies within the project manager whose salary is already taken into account. The time costs of individual pharmacist across the network can also be accessible through human resource department of the organisation. Health benefits of patient compliance are the most difficult outcome to measure if the project has adopted a societal perspective. Nevertheless, published literature on pharmacist's role in disease management can provide useful insights in this area (van Boven et al. 2014; Johnson 2009).

## 9.5 Discounting and Sensitivity Analysis

Discounting and sensitivity analysis are two different yet inter-related concepts in pharmacoeconomics. Discounting is when researchers adjust for underlying inflation in economy by increasing the cost of a project by certain percentage. This is often correlated to the inflation rate. Sensitivity analysis is when researchers modify the values of costs and benefits in a given economic model to test the performance of the intervention under study. Sensitivity analysis is carried out because of the presence of the uncertainty with economic modelling. Prices can go up or down

depending upon the demand of a particular intervention; same is true for the values of a particular benefit as factors other than the interventions may affect the associated benefits. Typical examples can be the availability of superior dispensing software, poor patient compliance or emergence of new adverse effects.

Traditionally, discounting is applied when the intervention under study is implemented over more than a year (Rubio-Valera et al. 2013; Aspinall et al. 2013); nevertheless, WHO guidelines on generalized cost-effectiveness analysis recommend to include discounting in all studies. This is to make them more applicable to practice settings (Tan Torres Edejer et al. 2003). As often publications of results take time, this also helps those considering similar intervention in their own practice settings. Various methods of discounting are available but the most common approach is to use a fixed rate across several years in the proposed economic model (Chan and Wang 2004; Hilleman et al. 2004; Chisholm et al. 2000; Avery et al. 2012). WHO guidelines recommend a fixed rate of 3 % as a baseline for CEA and 6 % for sensitivity analysis. Often discounting is not as universally applied to health outcomes/benefits as it is applied to costs (Chan and Wang 2004; Hilleman et al. 2004; Chisholm et al. 2000; Avery et al. 2012; Tan Torres Edejer et al. 2003)

Sensitivity analysis provides much needed information for decision makers about an intervention in the presence of uncertainty. The other significant reason to conduct a sensitivity analysis includes differences in population studied and population of interest (for a particular intervention), uncertainty in the values of variables in the economic model and uncertainty in study variables (costs as well as benefits) (Tan Torres Edejer et al. 2003).

Researchers undertaking a pharmacoeconomic analysis within pharmacy practice research perform sensitivity analysis by modifying one (one-way) or multiple variables (multi-way) at a time. Existing pharmacoeconomic studies on pharmacy practice research lacks specific sensitivity analysis and where sensitivity analysis has been performed, it lacks appropriate details about the methodology (Elliott et al. 2014). Advanced methods are available for the estimation of sensitivity analyses, and pharmacy practice researchers should pay more attention to such methods to make their research more meaningful (Tan Torres Edejer et al. 2003).

Given the limited scope of both of our practicing examples from Box 9.1, the WHO recommendations on discounting and sensitivity analysis can be used for both projects (Tan Torres Edejer et al. 2003). This means a discounting rate of 3 % for all the costs and a variable rate of 0–3 % for benefits. Sensitivity analysis can use a range of 3–6 % for costs and 0–3 % for benefits.

### *9.5.1 Reporting Pharmacoeconomic Analysis*

Despite the availability of clear recommendations and checklists related to the reporting of pharmacoeconomic analysis (Drummond et al. 2005; Tan Torres Edejer et al. 2003), published reports have been criticized due to limitations in

the conduct, analysis and reporting of results (Elliott et al. 2014). There are few plausible explanations for this observation. First, studies reporting pharmacoeconomic evaluations are often published in non-specialty journals, and reviewers available to a particular journal may not have relevant expertise to critically evaluate pharmacoeconomic evaluation. Second, there is a scarcity of economic evaluations of pharmacy practice research and therefore any study reporting pharmacoeconomic evaluation is being looked at favourably. Lastly, the scope of pharmacy practice research carried out in an individual institution is more of a local nature, they are not aimed at global audience hence they are open for criticism.

Fortunately, International Society of Pharmacoeconomics and Outcomes Research (ISPOR) had commissioned a taskforce on developing a consolidated statement on the reporting of pharmacoeconomic evaluations. The taskforce has recently developed and published a statement on the reporting of pharmacoeconomic evaluations. The Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement is a 24 items checklist and is freely available from the ISPOR website. The checklist provides clear descriptions about each step of a pharmacoeconomic evaluation (http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp) (Husereau et al. 2013).This statement has been endorsed by 12 leading health-care journals including British Medical Journal (Husereau et al. 2013). Researchers interested in publishing the results of their economic evaluations are highly recommended to follow this statement to ensure the quality of their reports as well as maximising the chances of publication.

## 9.6 Summary

Health-care policy makers require clear information about the relevant costs and benefits associated with new pharmacy services, and pharmacoeconomic evaluations provide the much needed information. However, most studies evaluating the economic impact of pharmacist's interventions have not used formal pharmacoeconomic methods. This chapter aims to improve the understanding about the use of pharmacoeconomics and has attempted to elaborate some of the practical issues surrounding pharmacoeconomic evaluations.

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