

Review Article**PHARMACOECONOMICS: A REVIEW**

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ABSTRACT

'Pharmacoeconomics' is a new (and not altogether elegant) word; but economic interest in drug and other treatments of health problems is much older. Pharmacoeconomics is a sub-discipline of the field of health economics, which itself is a relatively new sub-discipline of economics, only formerly appearing in the economics scientific literature since the 1960s. Pharmacoeconomics is the description and analysis of the costs of drug therapy to healthcare systems and society. Pharmacoeconomic studies weigh the cost of alternative drugs and drug regimens against the outcomes they achieve to guide decisions and policies about which drugs should be used in general, which drugs should be paid for by the government or other third party payers, etc. The importance of pharmacoeconomic information to healthcare decision makers will depend upon the viewpoint from which the analysis is conducted. Pharmacoeconomics is needful in pharmaceutical industry, government, and in the private sector for comparing various cost consequences. The two fundamental components of pharmacoeconomic studies are measures of costs and measures of outcomes that are combined into a quantitative measure or ratio. It can be done using various methods like Cost-minimization analysis (CMA), Cost-effectiveness analysis (CEA), Cost-utility analysis (CUA), and Cost-benefit analysis (CBA). Cost involves all the resources that are used to produce and deliver a particular drug therapy. Outcomes may be positive or negative. Positive outcomes are a measure of the drug's efficacy; negative outcomes include side effects, treatment failure, and the development of drug resistance. The measures of costs and outcomes which costs to include and how outcomes are measured and valued depends on the perspective of the study. The results of pharmaceutical studies give a quantitative measure (cost/outcome achieved) that shows the most efficient allocation of limited resources among two or more competing alternative medications and services or where you can get the most improvement in outcomes for the money that is available to spend on drugs. Many problems limit our use of health economics in practice. The whole process may be open to bias, in the choice of comparator drug, in the assumptions made, or in the selective reporting of results.

INTRODUCTION

Health care funders (governments, social security funds, insurance companies) are struggling to meet their rising costs. They make many efforts to contain drug costs, by price negotiation, patient co-payments or dedicated drug budgets. Expenditure on drug therapy is a particular target for their attention for several reasons: the size of the drug bill (10-15% of most national health care budgets, and usually the second largest item after salaries); the ease of measurement of pharmaceutical costs in isolation, in contrast to most other health care costs; evidence of wasteful prescribing; and a perception that many drugs are overpriced and that the profits of the pharmaceutical industry are excessive.¹

'Pharmacoeconomics' is a new word; but economic interest in drug and other treatments of health problems is much older. Decisions about what treatments should be available within a health-care system have always been influenced by the resources available to pay for them.² Pharmacoeconomics can be defined as the branch of economics that uses cost-benefit, cost-effectiveness, cost-minimization, cost-of-illness and cost-utility analyses to compare pharmaceutical products and treatment strategies.³ Pharmacoeconomics is a part of the tool bag, pharmacist can be use to improve the efficiency of his profession.

Pharmacoeconomics adopts and applies the principles and methodology of health economics to the field of pharmaceutical policy. Pharmacoeconomic evaluation

therefore makes use of the broad range of techniques used in health economics evaluation to the specific context of medicines management.⁴

Pharmacoeconomics is the description and analysis of the costs of drug therapy to healthcare systems and society. The importance of pharmacoeconomic information to healthcare decision makers will depend upon the viewpoint from which the analysis is conducted (i.e., including only costs that are relevant to managed care). Pharmacoeconomic research in the managed care system is growing. It is currently being used to make formulary decisions (complementing clinical data), design disease management programs and measuring the cost-effectiveness of interventions and programs in managed care.⁵

BRIEF HISTORY

Over the last decade there has been tremendous interest in economic evaluations of healthcare programmes, especially in the pharmaceutical field. Economic evaluations started about 30 years ago as rather crude analysis, in which the value of improved health was measured in terms of increased labour production.⁶ The term pharmacoeconomics was used in public forum was in 1986, at meeting of pharmacist in Toronto, Canada, when Ray Townsend from the Upjohn company, used the term in presentation. Ray and few other had been performing studies using the term pharmacoeconomics within the pharmaceutical industry since the early eighties today pharmacoeconomics research is a flourishing industry with many practioners, a large research and application agenda, several journals and flourishing professional societies including the international society for pharmacoeconomics and outcomes research.⁷

NEED

Pharmacoeconomics is a subdivision of health economics and results from that discipline coming of age through

consolidation to diversification. Health Economics, as a branch of economics is itself relatively young. Basically the pharmacoeconomics is needful in following manner;

- In Industry- Deciding among specific research and development alternatives.
- In Government- Determining program benefits and prices paid.
- In Private Sector- Designing insurance benefit coverage.⁸

Pharmacoeconomics identifies measures and compares the cost and consequences of pharmaceutical products and services and describe the economic relationship involving drug research, drug production distribution, storage, pricing and used by the people. It runs through the thread of our socioeconomic system, which regulates and influences all the sectors involved in pharmaceuticals.

CHALLENGES

The main challenges for pharmacoeconomics continue to be:

- Establishing guidelines or standards of practice.
- Creating a cadre of trained producers and consumers of pharmacoeconomic work.
- Continuing education on the relevant features of this discipline for practitioners, government officials, private sector executives.
- Stable funding to support applied pharmacoeconomic research.⁸

PHARMACOECONOMIC EVALUATION

Issues in pharmacoeconomic evaluation⁴:

All economic evaluation has common structure which involves explicit measurement of inputs (costs) and measure

outcomes. The common issues in pharmaco-economic evaluation are,

Perspectives

Perspectives are the key point that is to be considered for any economic evaluation. Here it is mandatory from whose point of view the evaluation should be considered, from the health service perspective (involve direct cost) or the societal perspective (involves indirect cost.). Generally the societal perspective is considered but the health managers facing problem of low budget concentrates on health service perspective. In the pharmaco-economic evaluation of back pain treatment health perspective is much more costly and has limited benefit but the societal perspective is beneficial as it enhances working ability of the workers by reducing the working hours.

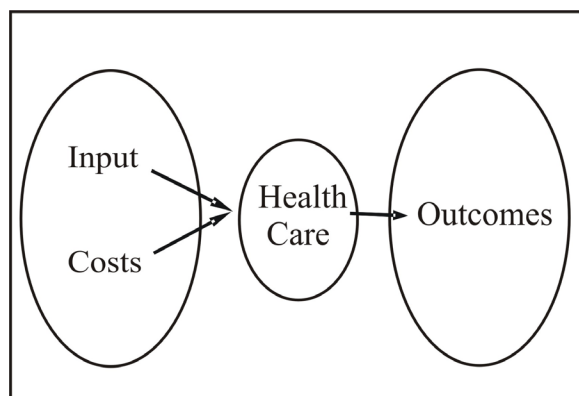


FIG 1: Issues in Pharmaco-economic evaluation

Costs

Costs involved in pharmaco-economic evaluation can be mainly divided into financial cost (mandatory cost) and economic cost (resource for which no mandatory payment is made) opportunity cost is the benefit foregone when selecting one therapy alternative over the next best alternative. Measuring cost: several costs can be measured when weighing up the cost of any invention. This cost may be, Direct: paid by the health service (including staff costs, capital costs, and drug acquisition costs).

Indirect: cost experienced by patient (family, friends).

The cost can be measured in following ways,

- Cost / unit (cost/tab, cost/vial)
- Cost / treatment
- Cost / person
- Cost / person / year
- Cost / case prevented
- Cost / life saved
- Cost / DALY (disability-adjusted life year)

Outcomes (benefits):

The second fundamental component of a pharmaco-economic study is outcomes. What is the effect of alternative drug therapies on disease progression, survival, quality of life?

In assessing outcomes, it is also important to take into account both positive and negative outcomes. Positive outcome is a measure of the drug's efficacy. Negative outcomes include side effects, treatment failure, and the development of drug resistance.

METHODS OF PHARMACOECONOMIC EVALUATION⁹

There are basically 4 categories or types of pharmaco-economic studies. These are presented here in order of detail,

1. Cost-minimization analysis (CMA)
2. Cost-effectiveness analysis (CEA)
3. Cost-utility analysis (CUA)
4. Cost-benefit analysis (CBA)

Cost minimization analysis (CMA)

This involves measuring only costs, usually only to the health service, and is applicable only where the outcomes are identical and need not be considered separately. An example would be prescribing a generic preparation instead of the brand leader (lower cost but same health outcomes).

Cost effectiveness analysis (CEA)

The term cost effectiveness is often used loosely to refer to the whole of

In practice this is not so easy since the QALY is not a well defined fixed unit transferable from study to study. We

Table 1: Methods of Economic Evaluation.

Method of economic evaluation	Measurement of outcome (Health Benefits)	Synthesis of costs and benefits
Cost minimization analysis	Assumed to be equivalent and can take any form (e.g. number of cases detected, reductions in cholesterol levels, years of life saved)	Additional costs of therapy A relative to B
Cost effectiveness analysis	Health benefits across therapies are measured in similar natural units	Cost per life year gained Cost per patient cured, Cost per life saved, etc.
Cost utility analysis	Health benefits across therapies are valued in similar units based on individual preferences	Cost per QALY gained Cost per HYE gained

economic evaluation, but should properly refer to a particular type of evaluation, in which the health benefit can be defined and measured in natural units (e.g. years of life saved, ulcers healed) and the costs are measured in money. It therefore compares therapies with qualitatively similar outcomes in a particular therapeutic area. For instance, in severe reflux oesophagitis, we could consider the costs per patient relieved of symptoms using a proton pump inhibitor compared to those using H₂ blockers. CEA is the most commonly applied form of economic analysis in the literature, and especially in drug therapy. It does not allow comparisons to be made between two totally different areas of medicine with different outcomes.

Cost utility analysis (CUA)

This is similar to cost effectiveness in that the costs are measured in money and there is a defined outcome. But here the outcome is a unit of utility (e.g. a QALY). Since this endpoint is not directly dependent on the disease state, CUA can in theory look at more than one area of medicine, e.g. cost per QALY of coronary artery bypass grafting versus cost per QALY for erythropoietin in renal disease.

should be particularly wary of attempts to draw up league tables of QALYs to allow comparisons between ranges of therapies. The values in such tables have usually been derived at different times and in different ways and are not comparable.

Cost benefit analysis (CBA)

Here, the benefit is measured as the associated economic benefit of an intervention (e.g. monetary value of returning a worker to employment earlier), and hence both costs and benefits are expressed in money. CBA may ignore many intangible but very important benefits not measurable in money terms, e.g. relief of anxiety. CBA may also seem to discriminate against those in whom a return to productive employment is unlikely, e.g. the elderly, or the unemployed. However the virtue of this analysis is that it may allow comparisons to be made between very different areas, and not just medical, e.g. cost benefits of expanding university education (benefits of improved education and hence productivity) compared to establishing a back pain service (enhancing productivity by returning patients to work). This approach is not widely used in health

economics, although many economists like it on theoretical grounds and because it removes some of the “sacred cow” protection which surrounds health care. They argue that health should be another commodity, and not necessarily valued more than other possible uses of the resources.

HANDLING THE RESULTS OF ECONOMIC EVALUATIONS⁹

Consider the four possible results arising in a CEA (FIG 2). First, if costs are lower and health benefits higher for one drug relative to another, the former is said to dominate and would be the preferred treatment (quadrant II). Second, the opposite applies, i.e. the new drug is more expensive and less effective, and thus is considered inferior and not recommended (quadrant IV). The third and most common case is where the new drug is both more effective and more expensive than the standard (quadrant I); on the basis of ICERs, a judgment must be made regarding whether the additional benefits are worth the extra costs of the new drug and, therefore, whether it is ‘cost-effective’. This might be defined by a previously agreed ICER threshold value. The fourth case is similar to the third, with the roles of the new therapy and the standard reversed (quadrant III); the question now is whether the extra benefits provided by the standard justify the additional costs of retaining it as the preferred treatment when the option of a new, cheaper but less effective drug exists (FIG 2).

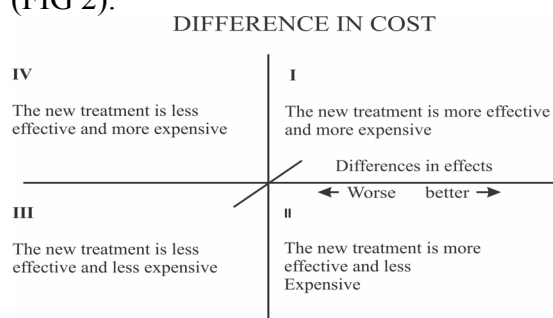


FIG 2 It shows handling the results of economic evaluations

LIMITS OF PHARMACOECONOMIC EVALUATION

Many problems limit our use of health economics in practice. The whole process may be open to bias, in the choice of comparator drug, the assumptions made, or in the selective reporting of results. This suspicion arises because most studies are conducted or funded by pharmaceutical companies. Difference in costs, difference in effects work better obviously are interested in the results, and there is a publication bias towards those studies favorable to sponsoring companies.¹⁰ Health economics is therefore sometimes misused as a marketing ploy. The same problems may however arise in studies funded by health care payers. To a specialist, this is not such a problem since the almost inevitable biases are usually clear. But since economic evaluation is less well understood by doctors and others, bias needs to be minimized. Doctors may tend to equate health economics with rationing or cost cutting, and many therefore reject on principle the whole process as unethical. Since resources are limited within health services, wasting them by inefficiency is wrong, as it reduces the clinician’s ability to give the best possible care to his patients. It therefore seems unethical not to consider the economics of a medical intervention. A key problem is our ability to implement the results of a study. No matter how good a study is, and how cost effective a therapy compared to existing treatment, it may not be possible to achieve its potential benefits because of the existing cumbersome management structures. Three problems are common: first, a short term outlook which limits the application of economic evaluations showing long term savings for the health service in return for increased spending now. Second, many budgets operate in isolation, and it is not easy to move money between them: for instance, prescribing in primary care is often funded separately from hospital services, so any increased spending on drug therapy in primary care cannot be simply funded

from a future reduction in hospital admissions. Third, a new intervention may simply not be affordable no matter how cost effective it might be. Finally, health economics and pharmacoeconomics is a young science and is slowly developing and testing its methodologies. We do not have space to address all of these concerns here but many of the details of the methods described above are academically and practically controversial.¹¹ There have been many guidelines developed for the conduct of economic evaluation, recognizing the possibilities of bias and the poor understanding of many potential users about the whole process.

RECENT STUDIES

One of the studies showed the efficacy of Sildenafil, its adverse effects and drug interactions, and socioeconomic factors involved in its use, with a focus on specific patient populations (prostate cancer, diabetes mellitus, ischemic heart disease, spinal cord injuries, neurological disorders). Sildenafil is an effective first-line therapy for erectile dysfunction in men. The decision to prescribe this agent should include such considerations as the cost-risk benefit balance, patient access, drug distribution pathways, and prescription drug coverage.¹²

In other case they compared the efficacy, complications, and costs associated with low-dose (<2mg/h), Alteplase (tissue plasminogen activator [t-PA]) versus Urokinase for the catheter-directed treatment of acute peripheral arterial occlusive disease (PAO) and deep vein thrombosis (DVT). Outcome variables included initial and total drug doses, infusion time, success rates, complications, and estimated drug costs, which were compared with the Student t test for continuous data and analysis for dichotomous data. The regression analysis of thrombolytic complications showed the P value of less than 0.05 which was considered to be statistically significant. Pharmacoeconomic analysis showed t-PA

was nearly 15 times less expensive than Urokinase overall. The safety, efficacy, and pharmacoeconomics of low-dose Alteplase compared with Urokinase for catheter-directed thrombolysis of arterial and venous occlusions.¹³

A great deal of previous work from the United States, Canada, Europe and Asia on the pharmacoeconomics of alcohol, tobacco and illicit drug abuse indicates that as cost decreases, abuse increases and vice versa. One of the studies of opioids suggests that the introduction of generic products did not increase the abuse of ER Oxycodone or Fentanyl products.¹⁴

The concept that lowering the price of prescription drugs with abuse liability will increase their therapeutic use has never been tested, but there is a significant world-wide literature on the influence of price on the use of prescribed medications. For example, it has been shown across the world (e.g. Europe, North America and Japan) that price limits the therapeutic use of 15 different non-opioid classes of therapeutic agents to a very significant extent.

Also there was an investigation on the use of resources and cost implications of stroke prophylaxis with Warfarin in patients in clinical practice. Anticoagulation with Warfarin for prevention of ischemic stroke appeared to be cost-saving relative to the costs of stroke. According to survey the mean total cost of Warfarin treatment per patient per year was 159.4 pounds.¹⁵

An overview of how health economic analysis are used in the decision making process and how cost-effectiveness is balanced against the other criteria will be presented.

Rigorous evaluations of the clinical and economic consequences of drug cost-sharing policies are few, and evaluations of such policies within the same population are especially needed for a fair comparison of several options. Existing evidence suggests that the choice of policy is important with respect to unintended outcomes such as hospitalization and

mortality. Cost-sharing and delisting policies can yield savings without adverse outcomes when there are generous exemptions. Less flexible policies (e.g. prescription caps, high premiums, deductibles) can lead to undesirable consequences, whereas the effects of 3-tier co-payment policies are debated. Evaluations of drug cost-sharing policies within the same population are needed for a fair comparison of different options. According to economic theory, the shift from full coverage to the co-payment and coinsurance plus deductible policies for older individuals (i.e., those aged >65 years) would have caused patients to purchase fewer inhalers if those patients were sensitive to prices. It seems plausible that older patients with chronic obstructive pulmonary disease (CORD), emphysema, or asthma, who reduced their use of inhaled medications, may be at increased short-term and long term risk of health-related outcomes that lead to increased physician use, hospitalizations, and mortality. The costliness of inhalers (particularly steroids) and the potential for short-term adverse outcomes made CORD and asthma patients an ideal high-risk group in which to study the early effects of the policy changes. It appears that structuring coverage according to income reduced treatment cessation among inhaled steroid users with lower incomes which is a concern with other drug policies. Older inhaled-steroid users were more resistant to cessation treatment than were younger patients, which may have been the result of incomplete adjustment for disease severity in the model.¹⁶

Ettinger et al presented the abstract of a cost effectiveness study of Ibandronate, Alendronate, and Risedronate in the treatment of postmenopausal osteoporosis at the 2005 Annual Meeting of the American Society for Bone and Mineral Research.¹⁷ They incorporated rates of persistence with medication into a cost-effectiveness analysis. The persistence rates used for the weekly Bisphosphonates Alendronate and Risedronate were 36% in

year 1 and 24% in years 2 and 3; the persistence rates used for monthly Ibandronate were 51% in year 1 and 39% in subsequent years. The model was based on a 10-year horizon and 3-year duration of therapy. All 3 Bisphosphonates were assigned a class effect for vertebral, hip, and wrist fracture reduction. Based on these assumptions, the analysis indicated that Ibandronate was associated with a lower fracture-care cost per patient compared with Alendronate and Risedronate. These authors considered persistence to be an important component of the pharmacoeconomic analysis, and the effectiveness results were influenced by the relative persistence rates. However, the analysis employed assumptions that have yet to be confirmed.¹⁸

The business case for developing new therapies for Alzheimer disease and related disease (ARD) is compelling. The most rapidly growing population in developed societies is the 75+ age group, 25% of whom have cognitive impairment. In the USA alone, there are an estimated 4 million sufferers of ARD. The potential market has expanded with the recognition of more subtle forms of cognitive impairment in old age.

The economic impact of ARD is considerable. ARD is the third most costly disease to society after heart disease and cancer, costing the USA alone over US\$100 billion dollars

In 2002 in direct and indirect costs. ARD is estimated to cost US businesses US\$33 billion per year, US\$26 billion going to employed caregivers suffering depression, lost days of work and increased healthcare costs. Mild cognitive impairment (MCI) is a recently described entity affecting perhaps 8 million older people in the USA with isolated memory loss who do not suffer the more global cognitive impairments (such as disorders of language and abstract reasoning) that characterize dementia. Fifteen percent of MCI patients progress to AD each year, making MCI an important advance for drug development as a model for prevention and rate of

progression clinical trials. Even more common, and estimated to affect 16 million people over 50 years of age in the USA, is age-associated memory impairment (AAMI), which is a syndrome that generally describes normal cognitive aging. AAMI is important because it provides a clinical paradigm for drug development to develop therapeutics to treat the slowed speed of processing, word retrieval and other cognitive difficulties associated with normal aging, just as we treat presbyopia.

Immune globulin intravenous (IGIV) therapy has been reportedly used in the management of patients with autoimmune mucocutaneous blistering disease (AMBD) refractory to Conventional Immune Suppression Therapy (CIST). IGIV has shown to be more clinically beneficial than CIST by bringing about long-term clinical remission and less recurrence. The high cost of the IGIV is of concern to patients, physicians, and insurance companies. In this report, we compare the cost of IGIV to that of CIST in treating a cohort of 15 Mucous Membrane Pemphigoid (MMP), 10 Ocular Cicatricial Pemphigoid (OCP), 15 Bullous Pemphigoid (BP), and 32 pemphigus vulgaris (PV) patients. In each cohort of patients, CIST had significant side effects, many of which were hazardous and required prolonged and frequent hospitalizations. Some of these side effects were severe enough to require discontinuation of the treatment. We consider the total cost of CIST to be the actual cost of the drug, plus the cost of management of the side effects produced by CIST. In the same patient cohort, no significant side effects to IGIV were observed. None of the IGIV treated patients required physician visits, laboratory tests, or hospitalizations specifically related to IGIV therapy. Hence, the total cost of the IGIV therapy is the actual cost of the IGIV only. The mean total cost of treatment of IGIV therapy is statistically significantly less than that of CIST during the entire course of the disease and on an annual basis.¹⁹

There was a community-based survey in order to emphasize the importance of therapeutic appropriateness of antibiotic prescription by local physicians and the close connection between pharmacotherapy and pharmaco-economics. Twenty general practitioners belonging to the local sanitary firm of Paola (CS, Italy) provided information, including their prescription, regarding 64 patients, both male and female, presenting clinical symptoms of uncomplicated acute cystitis. The data collected were compared with those of a previous trial performed in the same setting and documenting the effectiveness and advantages associated with the use of amoxicillin against community-acquired uncomplicated urinary tract infections (UTI). By comparing the prescriptive behavior of physicians between the first and the present survey, we detected a significant increase in the use of amoxicillin (from 0 to 26.56%), paralleled by a decrease in prescribing Aminoglycosides (from 18.18 to 1.56%). In addition, this resulted in a significant reduction in the costs of treatment (from \$ 23.06 to \$ 12.75). Therefore, given the vast consensus concerning the adoption of empirical treatment for the eradication of UTI, the present survey underlines the crucial role of local antibiotic resistance monitoring in order to optimize the use of these drugs. Moreover, we have also observed a significant reduction in treatment costs associated with an appropriate and effective treatment of UTI.²⁰ Medications constitute a substantial proportion of the healthcare costs of countries. National drug policies and attitudes toward medication use may play a role in irrational prescribing and consumption of medicines, leading to drug wastage. The limited resources of developing countries warrant more careful assessments of current national drug policies.

A study was done on the amounts and types of medications that are stored in a sample of urban Iranian households and estimated the extent of drug wastage in

these families. Study documented a large amount of drug storage in urban Iranian fatuities, resulting in appreciable drug wastage. Although the economic impact of stored medications in Iranian households may not seem high, the subsidization of inexpensive medications may not last forever. Policy makers and international organizations must take a serious look at current national drug policies and identify various factors that lead to drug wastage in households.²¹

A study was done to compare the patterns of pharmacotherapy, rates of adverse events and the utilization costs among patients treated with the available CBZ formulations (i.e., generic and branded IR-CBZ, and extended-release CBZ). In summary, this economic analysis retrospectively evaluated the patterns of care, adverse events, and epilepsy-related direct costs for the available CBZ formulations. Carbatrol was associated with a lower incidence of common CNS adverse events relative to Tegretol-XR and generic or branded IR-CBZ in patients initiating therapy. The rate of discontinuation of therapy was significantly lower for ER formulations (Tegretol-XR and Carbatrol); patients also switched off ER-CBZ at a lower rate relative to generic IR-CBZ. No significant differences in epilepsy-related health care services at 1 year were found between treatments in these patients. More studies are needed to determine why patients are more likely to continue taking ER-CBZ relative to IR formulations.²²

Clinical studies have shown efficacy of cholinesterase inhibitors (e.g. donepezil) in mild to moderate Alzheimer's disease (AD). However, there are limited studies examining the impact on health care costs of cholinesterase inhibitors prescribed in routine clinical practice.

The purpose of this study was to estimate the impact of donepezil use on health care costs and utilization in patients with mild to moderate AD and related dementias. A patient's prescription-drug coverage might affect health care costs by two

mechanisms. First, more comprehensive coverage would be expected to increase prescription-drug use and, in turn, overall cost. Second, more comprehensive coverage would be expected to increase access to prescription drugs, which, in turn, would decrease total cost by preventing hospitalizations and other health care utilization that would occur without treatment. In this case-control study in patients with predominantly mild to moderate AD and related dementias enrolled in a medicare managed care plan, patients receiving donepezil therapy prescribed in routine clinical practice had lower total health care costs compared with a control group of matched patients not receiving therapy over a period of 12 months. Although donepezil-treated patients had higher costs or utilization as measured by outpatient hospital costs, prescription-drug costs, and physician's office visits, these costs were substantially offset by the lower costs for hospital, post acute SNF, and home health care services. Thus, in addition to improved clinical outcomes, donepezil use might reduce health care costs and utilization.²³

There is information available on the new recombinant human parathyroid hormone Teriparatide (hPTH), including its clinical pharmacology, mechanism of action, pharmacokinetic properties, clinical efficacy, safety profile, potential drug interactions, contraindications and warnings, dosage and administration, and pharmacoeconomics.

The average wholesale cost of Teriparatide is \$20.81/d. Therefore, the estimated total 2-year cost of Teriparatide is >\$15,000.11 Compared with other medications that are currently on the market for the management of osteoporosis, Teriparatide exceeds the monthly amount a patient would pay compared with the other medication alternatives. Teriparatide is calculated as costing 8-fold more a month than other available medications, which can be a growing concern for many patients who choose this as a treatment option.²⁴

New technology for the treatment of end-stage renal disease will need to be pharmaco-economically persuasive in reducing the life-cost of treatment to obtain entry into the market. Increased automation, with closed-loop sensing technology, will occur in the near term. Clearance-based terminology for quantifying performance of equipment will give way to direct quantification of toxin removal. In the short term (5 years), there will be a steady progression toward more user-friendly and efficient blood cleansing methodology, with commonality of need drawing the equipment into a single multifunctional device. On-line preparation of sterile pyrogen-free dialysis fluid will be extemporaneously compounded, with closed-loop sensors driving the system to provide the prescribed quantity and composition of dialysate to achieve prescriptive goals of body content of important solutes, such as sodium, hydrogen, etc. Longer-term molecular biological tools will permit a far more convenient solution to the problem of ESRD. Access problems for hemodialysis will yield to a short-term fix that will involve novel shunt hardware. Longer-term biomedical engineering of tissues (vascular endothelium) with a return to fistula technology will occur. Peritoneal access improvement will involve improvement of the rosthesis-tissue interface. Initially, this will result from material selection and surface configuration changes. Subsequently, these changes will be coupled with tissue engineering to provide increased infection resistance and decreased atheroma formation. In conclusion, the future for renal replacement therapy is bright with promise. Our revolutionary new tools for creating biological/physiological change have clear applications to the problem of ESRD and can be expected to provide a much needed improvement in its treatment.²⁵

The pharmaco-economics of IGIV will also need to be studied in greater depth and detail, especially as more patients are

treated and economic data is analyzed. The present data indicates that the IGIV is cheaper than conventional immunosuppressive therapy, especially when the cost of treating side effects of conventional immunosuppressive therapy is included in the total cost of medical care. If such studies are conclusive and universally accepted, IGIV alone or in combination with adjuvants may become the first line of therapy, especially for patients with relative (not absolute) contra-indications to conventional immunosuppressive therapy that may exist.²⁶

Some paper provides an overview of the use of pharmaco-economic analysis in the process that governs drug reimbursement decisions in Australia. It discusses the methods by which drugs are evaluated, both clinically and economically, and the means by which these two facets are amalgamated; the types of pharmaco-economic data submitted in support of requests for reimbursement; the methods and standards used to assess these data; some of the more commonly encountered flaws in the data submitted; and how the different types of data influence reimbursement decisions.

In assessing a drug, we first examine therapeutic effect. When a new drug's performance is equivalent to that of an existing drug, under cost minimization the 2 drugs will attract the same price. If a drug appears to have a therapeutic advantage over another drug, we need to determine the magnitude of that advantage and whether it is worth paying for. The economic aspects of a submission are not considered until the clinical relativities have been established. All relevant direct costs are included in economic analyses; indirect costs are currently viewed with some ambivalence, particularly when they relate to assumed productivity gains. Our preference is to see productivity gains measured rather than merely assumed. In addition, we must consider the societal viewpoint; for example, many of the people who receive drugs subsidized through the program are not employed.

Therefore, we can only speculate on how a drug effect will translate into a productivity gain. This is founded on the principle that drug prices and expenditures should be coupled to some consideration of performance rather than to the cost of production.²⁷

CONCLUSION

As the healthcare sector progressing day by day the need to develop Pharmacoeconomics area is must. Healthcare sector is not just a small area but it became an industry now. It has more dimensions to explore. Patients also get benefit out of Pharmacoeconomics findings. Pharmacoeconomic is acts as socioeconomics too. It relates patients, society, and economy, to drug therapy.

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REFERENCES

- Walley T, Davey P. Pharmacoeconomics: a challenge for clinical pharmacologists. *Br J Clin Pharmacol* 1995;40:199-202.
- Taylor D, Knapp M, Kerwin R. *Pharmacoeconomics in psychiatry*, 1st ed. Martin Duniz Ltd. 2002.
- Arenas-Guzman R, Tosti A, Hay R, Haneke E. Pharmacoeconomics – an aid to better decision-making. *JEADV*, 2005; 19 (Suppl. 1): 34–39.
- Wally T, Haycox A, Bolond A. *Pharmacoeconomics*, 1st edition, Churchill Livingstone publication:1-14.
- Purkiss R, Hospital Pharmacist, *Pharmacoeconomics – the importance for pharmacist* 2006; 13: 34.
- Blumenschein K, Johannesson M. Economic evaluation in healthcare. A brief history and future directions, *Pharmacoeconomics*. 1996; 10 (2):114-22.
- Mauskopf JA, Why Study Pharmacoeconomics, *Expert. Rev. Pharmacoeconomics outcomes Res.* 2001; 1(1): 1-3.
- Lyles A. Recent trends in pharmacoeconomics: Needs and unmet needs. *European journal of pharmaceutical sciences*. 2008; 34: S7–S24.
- Walley T, Davey P. Pharmacoeconomics: a challenge for clinical pharmacologists. *Br J Clin. Pharmacol.* 1995; 40: 199-202.
- Hillman A, Eisenberg J, Pauly M et al. Avoiding bias in the conduct and reporting of cost effectiveness research sponsored by the pharmaceutical companies. *New Eng J Med.* 1991; 324: 1362-1365.
- Cull R, Wells N, Miocevick M. Economic costs of migraine. *Br J Med Econ.* 1992; 5: 103-115.
- Boyce EG, Umland EM. Sildenafil citrate: A therapeutic update. *Clinical Therapeutics*, 2001; 23 (1): 2-23.
- Koji S., Hofmann LV, Razavi MK, Kee ST, Sze DY, Dake MD. *Journal of Vascular Surgery.* 2003; 37, (3): 512-517.
- Cicero TJ, Inciardi JA, Surratt H. Trends in the use and abuse of branded and generic extended release oxycodone and fentanyl products in the United States. *Drug and Alcohol Dependence.* 2007; 91: 115–120.
- Abdelhafiz AH, Wheeldon NM. Use of resources and cost implications of stroke prophylaxis with warfarin for patients with nonvalvular atrial fibrillation. *The American Journal of Geriatric Pharmacotherapy.* 2003; 11(2): 53-60.
- Dormuth C., Brookhart A. Impact of two sequential drug cost-sharing policies on the use of inhaled medications in older patients with chronic obstructive pulmonary disease or asthma. *Clinical Therapeutics.* 2006; 28 (6): 964-978.
- Ettinger et al. Economics, pharmacoeconomics and drug discovery for dementias *DDT* 2002; 7 (15)
- Pyon E. Once-monthly Ibandronate for postmenopausal osteoporosis: review of a new dosing regimen. *Clinical Therapeutics* 2006; 28 (4): 475-490.
- Daoud YJ, Amin KG. Comparison of cost of immune globulin intravenous therapy to conventional immunosuppressive therapy in treating patients with autoimmune mucocutaneous blistering diseases. *International Immunopharmacology.* 2006; 6: 600–606.
- Amanteaa AD, Levatoa A, Arone F. Outcomes of a pharmacoepidemiological survey on the antibiotic treatment of uncomplicated acute cystitis in community. *Pharmacological Research.* 2006; 53: 193–196.
- Zargarzadeh AH, Tavakoli N, Hassanzadeh A. A survey on the extent of medication storage and wastage in urban iranian households. *Clinical Therapeutics.* 2005; 27(6): 970-978.

22. Garnett WR, Gilbert TD, O'Connor P. Patterns of care, outcomes, and direct health plan costs of antiepileptic therapy: A pharmacoeconomic analysis of the available carbamazepine formulations. *Clinical Therapeutics*. 2005; 27(7): 1092-1103.
23. Lu S, Hill J, Fillit H. Impact of Donepezil use in routine clinical practice on health care costs in patients with alzheimer's disease and related dementias enrolled in a large medicare managed care plan: a case-control study. *The American J of Geriatric Pharmacotherapy*. 2005; 3(2): 92-102.
24. Quattrocchi E, Kourlas H. Teriparatide: A Review. *Clinical Therapeutics*. 2004; 26(6): 841-854.
25. Henderson LW. Future developments in the treatment of end-stage renal disease: a north american perspective, *American Journal of Kidney Diseases*, 2000; 35, (4), (Suppl 1): S106-S116.
26. Razzaque Ahmed A.. Future horizons. *International Immunopharmacology*. 2006; 6: 607– 609.
27. David Henry, Ruth Lopert. *Pharmacoeconomics and Policy Decisions: The Australian Health Care System*.