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A Brief Review of Pharmacoeconomics and Its Importance in Healthcare

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ABSTRACT

Background: Assessing health interventions today requires the use of economic knowledge due to the growing complexity and high cost of healthcare. Pharmacoeconomics, a branch of health economics, assesses the value of pharmaceutical goods and services by weighing their costs and benefits. Pharmacoeconomic analysis plays a critical role in supporting evidence-based decision-making and policy-making as healthcare expenditures throughout the globe continue to grow.

Purpose: The objective of this study is to provide a concise overview of pharmacoeconomics, its primary methodologies, and its growing significance within healthcare systems.

Methods: This literature review, covering publications from 2014 to 2025, analyzed peer-reviewed articles, policy documents, and textbooks on pharmacoeconomics. The review employed comparative frameworks such as cost minimization, cost-effectiveness, cost-utility, and cost-benefit analyses.

Results: Pharmacoeconomic analysis is increasingly being included in national and international healthcare systems to ensure efficient resource management. It significantly influences the evaluation of rival treatment options and the judgments about medication reimbursement. Common methodologies encompass cost-effectiveness and cost-utility evaluations, among others. Countries such as the UK, Canada, and Australia have institutionalized pharmacoeconomic evaluations through the establishment of organizations like the National Institute for Health and Care Excellence (NICE), the Canadian Agency for Drugs and Technologies in Health (CADTH), and the Pharmaceutical Benefits Advisory Committee (PBAC).

Conclusion: Pharmacoeconomics is a crucial component of the modern healthcare landscape, facilitating the optimal allocation of limited financial resources to enhance health outcomes. It assists policymakers, physicians, and payers in making decisions informed by costs and clinical outcomes. As healthcare costs continue to rise, the role of pharmacoeconomics in policymaking and practice will become increasingly essential.

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1. Principles of Pharmacoeconomics

1.1. Introduction

India is one of the major providers of generic medications globally, fulfilling about half of the world's demand for vaccines. It also supplies 25% of all medicines in the United Kingdom and 40% of generic demand in the US. India ranks as the world's fourteenth-largest value manufacturer and the third-largest producer of medicines by volume. The domestic pharmaceutical industry consists of 10,500 production units and 3,000 medicinal firms. India's domestic pharmaceutical sector is projected to be valued at 42 billion dollars in 2021, growing to 120-130 billion dollars by 2030 (Guerin *et al.*, 2020). New pharmaceuticals enter the market daily, mostly created in industrialized nations such as the United States (US), France, the United Kingdom, Switzerland, and Japan. Intense pricing wars occur to capture market share for treatments of communicable and non-communicable diseases in rising nations like Latin America, India, and China (Tannoury & Attieh, 2017). Governments worldwide are grappling with the challenge of providing affordable healthcare. Many have struggled to control medication prices, risking the stability of the healthcare industry (Vincent, 2020).

As health technology develops and becomes more sophisticated, demand for and costs of health care are rising

in all nations. Better technology, greater life expectancy, increased demand for health care services and quality, and increasing standard of living are all factors driving up health care expenditure. These have all contributed to the rise in healthcare expenditure (Thwaites & Townsend, 1998). Medicines account for a tiny but considerable component of the entire cost of health care. The most frequent therapeutic intervention in medicine is the drafting of a prescription. The cost of medications continues to rise as new medicines are developed and promoted, as well as the preference for pharmacological treatment over invasive therapy, the discovery of new off-label applications for current pharmaceuticals, and illogical drug prescriptions (Antibacterial Prescribing for RTIs Varies Widely across Europe, 2013).

Pharmacoeconomics is the study of how to allocate health resources based on medicine safety, cost-benefit, and effectiveness. The key to success in a resource-scarce environment is the skill of delicately balancing the cost and availability of necessary pharmaceuticals. For issuing a license for the use of novel medications, factors including clinical safety, efficacy, and cost-effectiveness must be examined simultaneously as specified in Figure 1.

Pharmacoeconomics is a field of health economics that studies the best way to allocate health resources based on medication cost-benefit and effectiveness (Arenas-Guzman *et al.*, 2005). This discipline takes an evidence-based approach and intersects with medicine, economics, and the humanities. One of the main key objectives to success in healthcare for all is the skill of delicately balancing the availability and cost of important pharmaceuticals in resource-scarce locations. Because medicine is an ever-evolving discipline of research, the EDL (Essential Drug List) is updated on a regular basis to allow for the adoption of new technologies for the greater good. Due to cost considerations, adding new pharmaceuticals to the EDL is a significant problem for governments all across the globe (Hu & Mossialos, 2016). It is always necessary to keep a tight eye on cost management and to seek out the finest possible therapy.

In actuality, there are multiple distinct forms of pharmaco-economic analyses, which are relevant in various situations (Ellis *et al.*, 2002). A cost-effectiveness analysis compares the cost per standardized unit of effectiveness of two or more therapies with different results. Cost-minimization assessments evaluate the costs of treatments that achieve the same result, intending to determine the most cost-effective choice. While the cost-utility analysis compares the cost of two or more treatments with various outcomes in terms of cost per quality-adjusted life-year.

Pharmacoeconomics originated as an area of application. It was a hasty practical response to a surge of new products, mostly pharmaceuticals, hitting the market at an unprecedented rate before the beginning of the century, and to a growing perception that healthcare funding was being squeezed as a result of pharmaceutical spending surpassing other healthcare sectors. At the time of evaluating the right medication's affordability and access to the patient at the required time, comparing two products of the same therapeutic class or with alike mechanisms of action, and establishing accountability that a producer's claims about a drug are justified, pharmacoeconomics can certainly help. Pharmacy administrators and practitioners will be able to make better and more informed judgments about the goods and services they deliver if pharmacoeconomics is properly used.

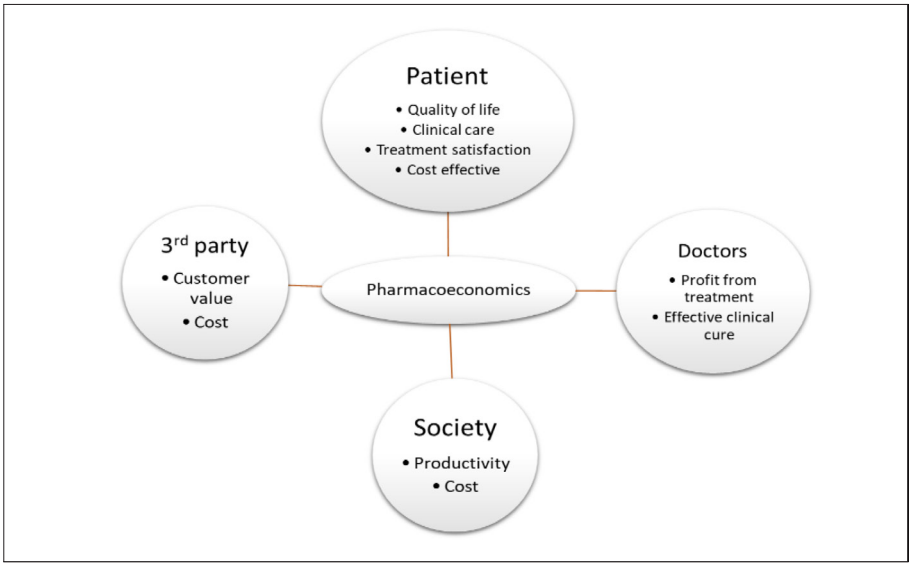

Figure 1: Pharmacoeconomics Perspective for Society

Despite the limitations, many nations now have a better understanding and use of pharmacoeconomic principles, and there is an opportunity to expand the use of pharmacoeconomics in poor countries. Nonetheless, more work has to be done in terms of training, support, and laws to help it expand. Knowing the obstacles to pharmacoeconomics application may aid in the creation of suitable solutions to overcome these obstacles and assist the spread of pharmacoeconomics in Jordan's healthcare system. Consequently, policymakers may be able to design the required laws or regulations to enhance pharmacoeconomics use.

1.2. Pharmacoeconomics in the Indian Healthcare Policy Landscape

In India, pharmacoeconomics is a key factor in closing the divide between the avid pharmaceutical manufacturing potential of the country and the requirement to have equitable and affordable access to healthcare. Being a leading generic exporting country, India is subject to special dilemmas in the quest to balance innovation, price wars, and resource limitation, where pharmacoeconomic analysis is reflected in evidence-based policies to maximize value at a low price. A good example of such an integration is the National Pharmaceutical Pricing Authority (NPPA) formed under the Drugs (Prices Control) Order (DPCO)-2013. NPPA controls ceiling prices of scheduled drugs that are necessities, including pharmacoeconomic information to quantify cost-effectiveness ratios (e.g., incremental cost-effectiveness ratios, ICERs) in the course of pricing. An example is in re-pricing life-saving medications such as insulin or antihypertensives; NPPA considers not only the cost in terms of purchase but also the overall economic effects, such as fewer hospital admissions, and makes sure that the costs remain affordable but without lowering quality. This practice has assisted in capping the prices of over 800 formulations, which have been used at the direct end of the objective of rational drug utilization in the face of increasing out-of-pocket spending, which continues to constitute approximately 60 percent of total health spending in India (Ahmad *et al.*, 2013). Major health insurance and coverage schemes are also based on pharmacoeconomics, which increases their sustainability. Pharmacoeconomic analyses inform the choice and updating of Health Benefit Packages (HBPs) under the Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (PM-JAY), which was introduced in 2018. These packages include secondary and tertiary care for over 500 million beneficiaries, and they are evaluated based on cost-utility indicators such as quality-adjusted life years (QALYs) to prioritize interventions—including cost-effective generics for chronic diseases such as diabetes or hypertension and using cost-efficient interventions—but abandoning less efficient interventions. A 2024 study noted how this type of assessment lowered avoidable spending by 15-20 percent in pilot projects, which set policy to limit catastrophic health spending. Likewise, in government insurance programs, such as the Central Government Health Scheme (CGHS) and Employees State Insurance Corporation (ESIC), pharmacoeconomic evidence is used to make decisions and reimbursement formularies. As a case in point, cost-minimization studies have been employed to prefer bioequivalent generics to branded ones, saving approximately 500-700 crore per year across these programs and leading to fair access (*Pharmacoeconomics and Its Impact on Ayushman Bharat Projects in Rural India*, n.d.). These applications prove the increasing institutionalization of pharmacoeconomics in India, in line with the guidelines of the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) adjusted to the local environment since 2016. It will help overcome the issue of affordability within a varied and price-sensitive marketplace and help more people make better decisions by integrating cost-benefit and effectiveness information into policy frameworks fordrug licensing, procurement, and universal health coverage efforts (*Peor Guidelines - Google Search*, n.d.).

1.3. Importance of Pharmacoeconomics in Healthcare

When assessing the affordability and availability of adequate medication for the right patient at the correct time, setting up accountability that a manufacturer's claims about a drug are justified, and comparing two drugs with similar mechanisms of action or in the same therapeutic class, pharmacoeconomics can certainly help. Pharmacy administrators and practitioners will be able to make better and more informed judgments about the goods and services they deliver if pharmacoeconomics is properly used (Ahmad *et al.*, 2013).

Pharmacotherapy choices have typically been based only on clinical outcomes such as safety and effectiveness, but according to pharmacoeconomics, there are three primary outcomes to consider in drug therapy: economic, clinical, and humanistic. All agree that today's medicine selection choices cannot be made only on the basis of acquisition costs. As a result, applied pharmacoeconomics may assist in determining the affordability of medications for patients, decision-making, comparing different products for illness treatment, and ensuring timely access to medicines. It will give proof that some sorts of high-cost medications and services should not be promoted (Alzarea *et al.*, 2022).

2. Methods of Pharmacoeconomics

2.1. Types of Pharmacoeconomics Analysis

The cost of medicines is significant because it accounts for a significant portion of total healthcare costs—typically up to 30% to 40% in developing countries and 10% to 15% in developed nations. Drug prices, on the other hand, are often inferred in the context of the health system's total (net) expenses. Drugs are expensive to purchase, but their usage may result in cost savings in other areas (Wang *et al.*, 2003).

To determine the genuine price of a drug for a health system, the cost of acquisition must be modified against cost savings resulting from the drug's use, as well as any additional health benefits that may occur (Ghinea *et al.*, 2016). However, both short- and long-term expenditures may be incurred as a result of adverse medication responses. When determining the cost for any drug, the additional health benefits must be compared against the additional net cost. This attainment of an additional health benefit over another treatment is commonly stated as an incremental cost-effectiveness ratio (ICER) (Zhao & Tian, 2001). Furthermore, all health systems are presently expressing worries about the cost of medical treatment in general and drugs in particular. The emphasis is on delivering high-quality treatment while working with limited budgetary resources. There are various types of pharmacoeconomic analysis (Figure 2) that have been explained further.

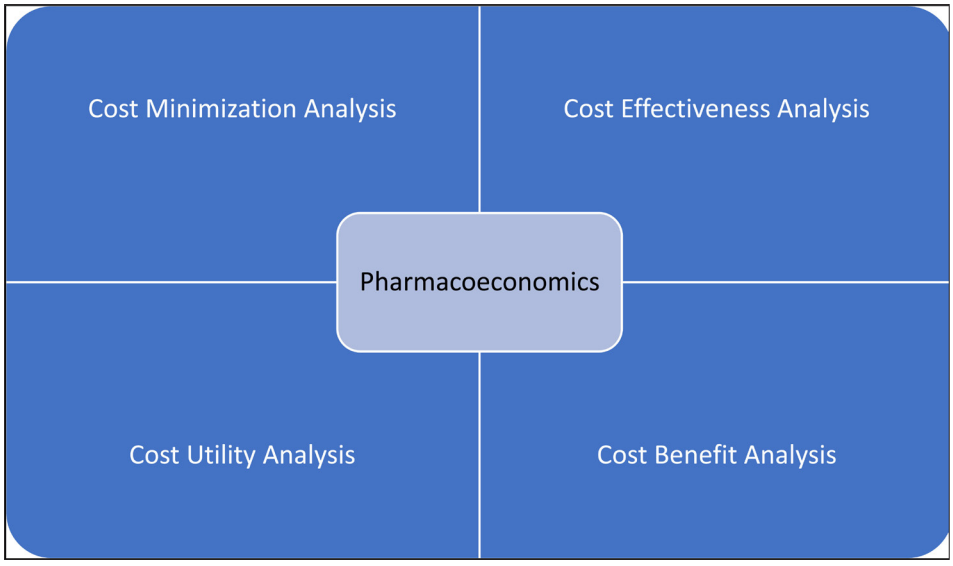

Figure 2: Various Types of Pharmacoeconomics Analysis

2.1.1. Cost Effectiveness Analysis

When two or more therapy options have varying efficacy, cost-effectiveness analysis (CEA) is utilized. The numerator includes all direct medical expenditures for treating the ailment, including the indirect costs (work effect) as well, while the denominator includes the unit of benefit at the patient level assessed in temporal units. In addition, incremental cost-effectiveness studies look at the differences between the two treatments.

It examines medication costs in a wider sense. Cost is expressed in monetary terms, whereas efficacy is expressed in terms of a clinical result, like lives saved, problems avoided, or illnesses cured (Lam & Fresco, 2015). As a result, CEA calculates the increased cost of delivering an additional health benefit stated as a specific health outcome that changes on the basis of the drug prescribed.

The ultimate purpose of CEA is to produce a single metric, the ICER, that connects the amount of benefit gained from choosing an alternative treatment option to the cost difference. The following formula is used to calculate the ICER when two choices are compared:

$$Cost(treatment\,2) = Cost(treatment1)/Effectiveness(treatment\,2) - Effectiveness(treatment\,1)$$

2.1.2. Cost Minimization Analysis (CMA)

When the outcomes of two or more therapies are almost identical, CMA is performed to find the most cost-effective solutions. CMA comprises evaluating drug costs in order to choose the least priced medication or treatment choice. It also takes into consideration the administering and cost

of preparing a dose. This is the most common method of cost estimation used to calculate the price of a drug. This approach is only used to evaluate two products that have been proved to be therapeutically effective in the same way. As a consequence, this technique is the most useful when comparing generic and therapeutically equivalent drugs. Because there is often no credible comparison between two products, cost-minimization analysis is inappropriate if therapeutic equivalence cannot be established.

The CMA is sometimes regarded as the "poor relation" of health economic techniques, with its seeming simplicity rendering it undeserving of comparison with more conceptually rigorous health economic approaches (Hlatky *et al.*, 2006).

2.1.3. Cost Utility Analysis

Changes in the quality (morbidity) and quantity of life (mortality) are combined into a single 'unit of health' measure in cost–utility analysis. Health economists created the idea of health-adjusted life years (HALYs), and the two most used metrics of this sort are the disability-adjusted life year (DALY) and quality-adjusted life year (QALY) (Gold *et al.*, 2002), which is widely used as a measure of health gain from treatments. The DALY is a statistic that compares a person's present health status to an ideal state, making it an excellent match for disease burden. Unlike CBA, cost-utility analysis is used to analyze 2 distinct medications/treatments with potentially varying benefits (Hlatky *et al.*, 2006).

2.1.4. Cost Benefit Analysis (CBA)

A CBA is a kind of economic study in which the costs and outcomes are both stated in monetary terms. The cost-benefit analyst totals the potential advantages of a condition or action and then subtracts the total cost of that activity. A CBA comprises quantitative financial measurements such as income generated or costs saved as a result of the decision to implement a project. It allows for a direct estimate of the net monetary cost of obtaining a desired health outcome (Choi *et al.*, 2013).

3. Applications in Diseases

3.1. Allergy

Allergic illnesses are among the most prevalent chronic diseases in the world (Asher & Pearce, 2014). Allergic rhinitis (AR) imposes a significant financial burden, which makes it critical in its treatment to minimize the disease's clinical severity and consequently its expenses.

Any pharmacological therapy must be assessed in terms of its cost-effectiveness from a pharmacoeconomic standpoint, with the cost referring to the resource expenditure for the intervention, which is commonly defined in monetary terms. For example, in AR, first-generation antihistamines may disrupt mental function more than in untreated patients (due to their sedative effects), raising indirect costs. Any preventative technique targeted at lowering the severity of the rhinitis is expected to reduce its expenses under a worldwide therapeutic approach to AR, and this is especially true with allergen immunotherapy (AIT) (Kawauchi *et al.*, 2019).

In a 2023 study, Thokala *et al.* highlighted the importance of so-called living HTA frameworks to update cost-effectiveness models of allergen immunotherapy (AIT) in LMICs such as India to enhance the agility of decision-making (Thokala *et al.*, 2023). Di Bona *et al.* (2020) compared sublingual (SLIT) and subcutaneous immunotherapy (SCIT) over nine years, during which SLIT was more cost-effective (ICER EUR15,212 vs. EUR17,318 with SCIT) when indirect costs, such as travelling, were considered (Di Bona *et al.*, 2020). Dranitsaris and Ellis (2014) discovered that Oralair® was cheaper than SCIT in Canada (948-2471), but U.S.-based pricing could not be applied to India [24]. The affordability of AIT is pegged on the local infrastructure, which is vital in the Indian resource-based environments (Dranitsaris & Ellis, 2014).

3.2. Hypertension

In both industrialized and developing nations, uncontrolled hypertension is a major medical and psychological issue (Pereira *et al.*, 2009). The global burden of illness is rising rapidly, and spending on hypertension in industrialized nations, as well as possibly in emerging ones, is on the rise. Al Meslamani *et al.* (2024) emphasized the use of digital health data integration to conduct cost-effectiveness analyses in the LMICs, with telemonitoring decreasing the cost of hospitalization (10-15% reduction) in hypertension management (Al Meslamani, 2024). Amlodipine monotherapy was more affordable than Telma H combination therapy ($p<0.05$), thereby decreasing the financial burden on Indians (John *et al.*, 2020). With the backing of NPPA prices, pharmacoeconomic analyses reveal a preference for affordable generic drugs, which is essential in India because of the high out-of-pocket expenditures (~60 percent) (Joshi *et al.*, 2019).

3.3. Fungal Diseases

The incidence and severity of invasive fungal infections are becoming more well recognized, and novel antifungal medications have broadened the therapeutic toolkit available to treat them. Antifungal medicines account for a considerable amount of antibiotic spending at major medical

centers, requiring cost-cutting strategies and treatment standards to be implemented (Doron & Davidson, 2011).

In 2023, an HTA tutorial targeting LMICs promoted the use of open-source R software to perform cost-utility analyses to improve the assessment of the antifungal drugs in such areas as India (Simangolwa *et al*., 2024). According to a study, amorolfine nail lacquer was the most cost-effective onychomycosis cure choice, depending on the cure rates and dosing (Arenas-Guzman *et al*., 2005). According to Humphrey *et al*. (2014), there were inaccuracies in retrospective data, which influenced the cost-effectiveness conclusions (Humphrey *et al*., 1998). According to the results, terbinafine was the most cost-effective choice after factoring direct treatment expenditures and clinical cure rates. However, there was a fault in this research that led to an inaccurate result. India requires local research on its generic market.

3.4. Rheumatoid Arthritis (RA)

It is an inflammatory disease that causes inflammation of the inner (synovial) lining of joints and injury to the bones, cartilage, ligaments, and tendons that make up the joint, as well as internal organ damage (McInnes & Schett, 2011). The inclusion of pharmacoeconomic data for RA pharmacotherapy in health-care activities will ensure that the sequence of drug circulation is properly organized at all stages of storage, prescribing, quality control, accounting, release, transportation, licensing, and destruction in accordance with current medical and pharmaceutical legislation. Rheumatoid arthritis (RA) must be treated with cost-effective pharmacotherapy to control the damage of joints.

Hayduchok *et al*. (2020) conducted an ABC/VEN analysis, where vital drugs (63.73% of costs) to treat the RA were given priority, but still supply chain problems continue in India (Hayduchok *et al*., 2021). Thokala *et al*. (2023) reviewed the work, proposing dynamic HTA models that enhance the prioritization of RA drugs in LMICs with updated cost-utility data (Thokala *et al*., 2023). Pharmacoeconomics assures an appropriate flow of drugs in India according to the medical standards and is in line with the objectives of cost-saving of Ayushman Bharat (*NHA | Official Website Ayushman Bharat Digital Mission*, n.d.). According to the findings of the VEN study, category V (Vital) pharmaceuticals represented 63.73 percent of total prices, while category E (Essential) drugs accounted for 36.27 percent. A matrix of the combined ABC/VEN analysis for medicines INN was established to determine priority for RA treatment (Meena & Mathaiyan, 2025).

3.5. Diabetes

Type 2 diabetes (T2DM) is a serious and concerning chronic disorder that affects almost half of the world's population and about 30 million people in the US (Rawal *et al*., 2012). SGLT-2 inhibitors are a relatively new family of drugs that have a unique mechanism of action, strong glycemic effectiveness, and renal and cardiovascular advantages (Ekanayake *et al*., 2020).

T2DM is a disease that occurs in millions of people and has to be addressed in a cost-effective way. In 2024, IMARC Group estimated the pharmaceutical market size of India to reach US$130 billion by 2030, stating that SGLT-2 inhibitors are cost-effective in treating T2DM because of their cardiovascular advantages (*India Pharmaceutical Market Size, Share and Growth, 2033*, n.d.). Rahman *et al*. (2019) discovered that SGLT-2 inhibitors are cheaper when compared with insulin in LMICs, but rural access to diagnosis is still a problem (Rahman *et al*., 2019). ABDM (2023) provides digital health data to support the real-world cost-effectiveness modelling, which lowers the cost of T2DM (*NHA | Official Website Ayushman Bharat Digital Mission*, n.d.).

3.6. Critical Appraisal of Pharmacoeconomic Studies

Pharmacoeconomic studies mentioned in allergic rhinitis, hypertension, fungal infections, rheumatoid arthritis, and diabetes are limited in the way they can be used in the real world. In methodology, some of the studies, such as Dranitsaris *et al*. (2014) apply hypothetical models on the assumption of unrealistic adherence in resource-constrained environments in India (Di Bona *et al*., 2012; Dranitsaris & Ellis, 2014). Small samples do not allow much generalization to the diverse population of India. Some studies (such as industry-funded ones) are biased toward proprietary drugs, and U.S.-based pricing does not match with the generic Indian market (Angello *et al*., 1997; Dranitsaris & Ellis, 2014). The applicability to the mixed healthcare system in India is low because research tends to be in high-income environments. Effective policy requires locally based transparent research and consideration of the socioeconomic realities.

4. Challenges

4.1. Problems Associated with Health Economics

In health economics, drug rationing is a major issue. The rationing of pharmaceuticals creates a gap between the treatments that are now accessible for therapy and those that are technologically feasible (Buyx *et al*., 2011). This gap is widening all the time, and governments are finding it difficult to close it. Value-based rationing is the method for resolving these discrepancies. Patients will pay more for pharmaceuticals that improve their quality of life, such as Sildenafil, but less for drugs that save their lives, such as insulin or adrenaline (Bodrogi & Kaló, 2010).

Availability and affordability of high-quality critical health care are also issues that people face all across the globe (Kruk *et al*., 2018). However, each country's method of tackling the issue is unique. In comparison to developing nations, the demand for high-quality healthcare is strong in industrialized countries. The cost of providing such modern healthcare is likewise rather considerable. Unfortunately, no global regulation exists in the globe to regulate and equalize the cost of pharmaceuticals and therapy.

4.2. Implementation of Pharmacoeconomics in the Health Sector

The ideas of pharmacoeconomics are difficult to put into reality. Pharmacoeconomics is still in its infancy, and underdeveloped nations cannot afford to invest in the healthcare industry in order to get accurate and consistent data on medication consumption, safety, and cost. Pharmacoeconomics is a discipline of medicine that focuses on making rational choices based on data (Rahman *et al*., 2019). A robust data collection system should be in place for enough favorable evidence to build with the usage of a drug. Data collection should be an ongoing, dependable, and transparent process. Because the government lacks a solid data collection infrastructure, judgments about medicine selection are based on faulty logic, and the system ends up spending more for little advantage in illness treatment (Augustine *et al*., 2017).

It is critical to introduce pharmacoeconomic curricula to health-care personnel. Healthcare students should be provided an understanding of the motto of health economics so that they can act as fully informed personnel of the system, not just quiet onlookers. The beginning of a new age in recognizing the demands and constraints of the future health care system and health economics will be marked by public health promotion (Kumar & Preetha, 2012). Another option to integrate the most effective medicine into the healthcare system is via legislation that formalizes the drug selection process. It is necessary to bridge the gap between academics, healthcare professionals, the pharmaceutical business, and policymakers.

Another problem for these groups is allocating funds where they are most needed. The provision of lifetime pharmaceuticals to persons with chronic conditions has the potential to bankrupt the country's finances. As the economics of drug development and discovery, manufacturing of product, and profit-making guidelines of manufacturers of oral antifungals indicated for the treatment of onychomycosis: griseofulvin, itraconazole, and terbinafine. do not support the system; high-priced pharmaceuticals are difficult to get at reasonable prices except in an emergency (Kumar & Preetha, 2012).

5. Future Perspectives

There are several areas in the field of pharmacoeconomics that need additional development in order to cope with the real challenges that arise in choices, such as resource allocation. This may necessitate assessing the overall extra costs of an intervention across the whole population of patients impacted, rather than the per-patient costs. The assessments will have a greater emphasis on the short term, which is the most relevant time span for real choices. This will also have to take into account how fast and which patients are willing to participate in the intervention. Real cost offsets that can be anticipated by the healthcare system, rather than hypothetical ones that may occur under perfect conditions, will be used in the assessments. The projected benefits may be associated with the intervention for patients who use it, as well as reasonable estimations of adoption based on genuine data. It will also be necessary to evaluate the effect profile and cost impact of the proposed intervention compared to those of the other therapies available for the condition in question. The maturation of pharmacoeconomics will have a number of ramifications, including not just methodological advancements but also impacts on other research disciplines like effectiveness clinical trials and even the organization of pharmaceutical businesses.

5.1. Recent Developments in Pharmacoeconomics

Recent innovations have reshaped the field of pharmacoeconomics through the inclusion of digital health data, optimization of HTA frameworks, and modification of guidelines for LMICs to meet resource limitations and post-COVID priorities. In India, Ayushman Bharat Digital Mission (ABDM), launched in 2023 in six Union Territories, had created a database of more than 450 million health accounts by September 2023, including real-world data to analyze costs effectively. The digital infrastructure is used to aid the pharmacoeconomic modelling by connecting electronic health records with the outcome to minimize out-of-pocket expenses by using evidence-based pricing under the National Pharmaceutical Pricing Authority (NPPA). The 2023 PRIP scheme (US$675 million) encourages HTA-based R&D, which is biosimilars and complex molecules, and market expansion (US$130 billion by 2030). Also, the 2023 National Medical Devices Policy focuses on pharmacoeconomic analysis of equitable access, which is consistent with the WHO Global Strategy on Digital Health 2020-2025 (*Indian Pharmaceutical Industry: Creating Global Impact | Pharmaceutical Engineering*, n.d.; *Strategy Document on National Medical Devices Policy, 2023 | Department of Pharmaceuticals*, n.d.; *WHO's Global Strategy on Digital Health 2020–2025. - Google Search*, n.d.). With an integration of AI into HTA, economic modeling of epilepsy and chronic diseases is improved, and such challenges

as the digital divide are still present in LMICs, where only one out of four people have access to the internet (Ramezani *et al.*, 2025; Thokala *et al.*, 2023). In LMICs, collaborations such as R for HTA tutorials encourage open-source tools to conduct transparent cost-utility analyses.

6. Applications of Pharmacoeconomics

Historically, pharmacoeconomic ideas have been used in hospital pharmacy operations. The data on cost-effectiveness was used to justify the inclusion or removal of a medicine from a hospital formulary. Many pharmacy and therapeutic committees now include pharmacoeconomic analysis of formulary actions as a normal component of their work (Ahmad *et al.*, 2013).

It is utilized in drug pricing and reimbursements, in which cost-effectiveness and budget impact analyses are used to identify the least expensive but effective therapies. Pharmacoeconomic appraisals in formulary management help hospitals and other insurance companies to choose antidotes with maximum therapeutic effect and the least amount of expense. On the policy level, it facilitates health technology assessment (HTA) to make sure that the interventions with the highest value in terms of money to be spent on in the public health programs are prioritized. Clinically, it helps to inform treatment decisions through comparison of alternative therapies in terms of cost-utility or cost-minimization analysis. Also, pharmacoeconomics plays a role in the design of insurance schemes with the aim of establishing coverage packages that are both accessible to patients and financially viable. In emerging economies such as India, it contributes to negotiating the use of generic drugs, the selection of essential medicines, and government schemes such as Ayushman Bharat, making healthcare use affordable, available, and equitable.

7. Limitations

Despite the comprehensive overview provided in this review, several limitations must be acknowledged. First, the study relies heavily on secondary data from peer-reviewed publications, policy documents, and textbooks, which may not fully capture real-world applications or emerging trends in pharmacoeconomics. The review does not address the ethical dilemmas associated with pharmacoeconomic decision-making, such as value-based rationing and equitable access to medications.

8. Conclusion

Pharmacoeconomics is an essential tool in the modern healthcare landscape, offering a framework for evidence-based decision-making that balances cost, safety, and effectiveness. This review highlights its growing significance in optimizing resource allocation, improving health outcomes, and guiding policy decisions. However, the field remains underdeveloped in many regions, particularly in developing countries, due to challenges such as inadequate infrastructure, lack of training, and limited data collection systems. Addressing these limitations through education, legislation, and collaboration among stakeholders is crucial for the effective implementation of pharmacoeconomics. As healthcare costs continue to rise globally, the integration of pharmacoeconomic principles into practice will be vital for ensuring sustainable and equitable healthcare systems.

Given the ever-increasing healthcare expenditures, we must further investigate the value-added care that particular healthcare institutions deliver to their patients. Despite the rapid rise of clinical research in India, the field of pharmacoeconomics is still in its infancy. Many Western nations locate India to be a cheap place to undertake clinical research. We believe that clinical pharmacists, especially PharmD graduates, would be more valuable in India than traditional pharmacists since they can apply economic ideas to everyday practice in community and hospital pharmacies.

Abbreviations

EDL: Essential Drug List, **CEA:** Cost-Effectiveness Analysis, **ICER:** Incremental Cost-Effectiveness Ratio, **CMA:** Cost Minimization Analysis, **HALYs:** Health-Adjusted Life Years, **DALY:** Disability Adjusted Life Year, **QALY:** Quality-Adjusted Life Year, **CBA:** Cost Benefit Analysis, **AIT:** Allergen Immunotherapy, **SCIT:** Subcutaneous Immunotherapy, **SLIT:** Sublingual Immunotherapy

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Arti Saini and Shivam Sharma both contributed equally to the study idea, design, data collection, and manuscript writing.

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Ethical Approval

Ethical approval was not required for this cross-sectional survey study as data were collected via Google Forms with participants' informed consent.

Declaration

It is an original article and has neither been sent elsewhere nor published anywhere.

Conflict of Interest

The authors declare no conflict of interest.

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