



Health economics – a global review and prospection

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Abstract

Health systems are increasingly affected by the convergence of public-health, economic, demographic, technological, and environmental pressures, including non-communicable diseases that account for more than 70% of global deaths and antimicrobial resistance, which is projected to cause 10 million annual deaths by 2050, with economic losses comparable to the 2008 financial crisis. This article aims to review health economics as a framework for understanding and improving the allocation of scarce healthcare resources, with emphasis on efficiency, equity, sustainability, and global health-system resilience. Using a narrative global review and prospective policy analysis, the paper synthesizes evidence from international organizations, academic literature, policy reports, and comparative case studies of different healthcare financing models and national systems. The review identifies major theoretical foundations of health economics, including supply and demand, opportunity cost, cost-effectiveness analysis, market failure, information asymmetry, externalities, and the role of government intervention. It also highlights global disparities in healthcare expenditure, universal health coverage, workforce capacity, disease burden, and emergency preparedness. The findings suggest that sustainable health-system reform requires stronger global health governance, equitable financing, expanded universal health coverage, health-workforce investment, improved pharmaceutical access, and responsible integration of digital health and artificial intelligence. The article contributes by connecting health economics with sustainable policy design and by outlining practical directions for more efficient, equitable, and resilient healthcare systems.

Keywords

health economics; universal health coverage; healthcare financing; market failure; global health; sustainable health systems; digital health; artificial intelligence in healthcare; health equity; healthcare policy

1. Introduction

1.1. Global health and economic crises

The contemporary global health landscape is shaped by the convergence of several public-health, economic, demographic, and environmental pressures. Health systems are no longer challenged only by the treatment of disease, but also by the allocation of limited financial, human, technological, and institutional resources in conditions of rising demand. Non-communicable diseases, including cardiovascular diseases, diabetes, cancers, and chronic respiratory illnesses, represent one of the largest long-term pressures on health systems. These diseases account for more than 70% of global deaths and require sustained expenditure for prevention, diagnosis, treatment, and long-term care. At the same time, antimicrobial resistance is projected to cause 10 million annual deaths by 2050, creating economic losses comparable to the 2008 financial crisis (WHO, 2025a; O'Neill, 2016). Also, the COVID-19 pandemic exposed weaknesses in emergency preparedness, supply chains, workforce capacity, and international coordination, showing that health crises can rapidly become macroeconomic crises (Bloom et al., 2018).

These pressures are especially severe in low- and middle-income countries, where health systems frequently operate with limited public financing, shortages of medical personnel, fragile infrastructure, and high dependence on out-of-pocket payments. In many regions of Africa and South-West Asia, infectious diseases, maternal and child mortality, malnutrition, and vaccine-preventable conditions remain major public-health challenges. Sub-Saharan Africa continues to carry a

disproportionate share of global maternal mortality, accounting for approximately 66% of global maternal deaths, while Africa also accounts for around 95% of global malaria cases. Malaria, HIV/AIDS, and tuberculosis remain endemic, and countries affected by political instability and underfunded healthcare systems face additional barriers to service delivery. South-West Asia, including countries such as Afghanistan and Pakistan, faces similar pressures, as political instability and underfunded health systems compound infectious disease, malnutrition, and child mortality risks. In these contexts, approximately 1 in 10 children die before the age of five, mainly because of vaccine-preventable diseases and malnutrition (World Bank, 2023a; WHO, 2023e).

The economic dimension of these crises is visible in the persistent gap between high-income countries and the Global South, a division geographically shown in Figure 1. While high-income countries often spend between 10% and 18% of GDP on healthcare, many low- and middle-income countries allocate less than 5%, creating structural shortages in personnel, medicines, infrastructure, and preventive services (OECD, 2023b; WHO, 2023b). This underfunding contributes to workforce migration, also known as brain drain, as doctors and nurses often move from poorer health systems to wealthier ones, deepening capacity gaps in the countries that need health workers most (International Organization for Migration, 2024). In addition, reliance on out-of-pocket payments exposes households to catastrophic health expenditure and can push vulnerable populations into poverty (WHO, 2023e).

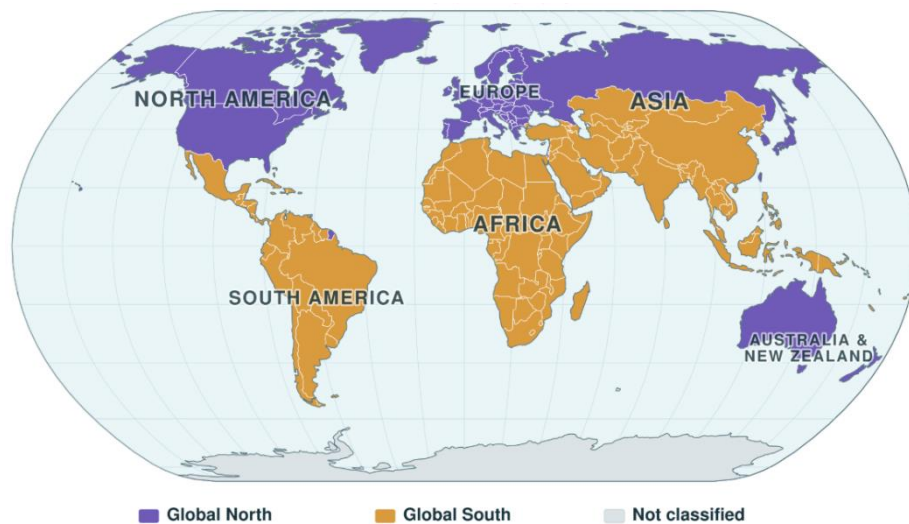


Figure 1 Global North and Global South division
(based on *Encyclopaedia Britannica* (n.d.))

This underfunding produces has concrete consequences for the workforce and for financing. The World Health Organization (WHO, 2023e) estimated a global deficit of 11 million healthcare workers by 2030, while reliance on out-of-pocket payments pushes approximately 100 million people into extreme poverty each year. These figures show why healthcare financing is not only a technical issue, but also a poverty, equity, and development issue.

However, health-economic pressure is not limited to low-income settings. In high-income countries, healthcare can also become a major source of financial insecurity. The United States illustrates how high expenditure does not automatically generate equitable access or efficient outcomes. Despite very high per-capita healthcare spending, estimated at approximately \$12,914 per person and nearly double the OECD average, the country continues to face insurance gaps, high treatment costs, administrative complexity, and medical debt. Around 30 million Americans remain uninsured, and 66.5% of U.S. bankruptcies have been linked to medical expenses, showing how market failures can affect even wealthy health systems (Kaiser Family Foundation, 2026; Himmelstein et al., 2019). These contrasts demonstrate that the central issue is not only how much a country spends on healthcare, but also how resources are financed, distributed, governed, and transformed into health outcomes.

In this context, health economics becomes essential because it provides tools for analysing how scarce resources can be allocated to improve population health efficiently, equitably, and sustainably. The combined pressure of disease burden, underfunding, demographic change, pandemic risk, and unequal access to care shows the need for a systematic economic



approach to healthcare policy. Health economics therefore offers a framework for understanding why health systems fail, how they can be compared, and what types of reforms may improve both health outcomes and economic resilience.

1.2. Definition and scope of health economics

Health economics is a branch of economics that studies how scarce resources are allocated within healthcare systems and how these allocation choices influence health outcomes, efficiency, equity, and financial sustainability. Unlike general market analysis, health economics focuses on a sector in which demand is often urgent, information is unevenly distributed, uncertainty is high, and decisions may affect life expectancy, quality of life, productivity, and social welfare. In this sense, health economics is not limited to the study of healthcare costs, but also examines how health systems are financed, how services are delivered, how policies affect access, and how resources can be distributed in a way that maximizes population health. A useful way to define the scope of health economics is through three core questions: how healthcare should be financed, how healthcare delivery can be made more efficient, and how health policies affect equity and access for marginalized groups. These questions connect financing models, cost-benefit reasoning, and distributive justice within one analytical field.

A central concern of health economics is healthcare financing. Different health systems rely on different combinations of public taxation, social insurance, private insurance, employer contributions, and out-of-pocket payments. Single-payer systems such as Canada's Medicare rely mainly on taxation; social insurance systems such as Germany's combine employer and employee contributions; and out-of-pocket-dominant systems, common in many low- and middle-income countries, place a larger financial burden directly on patients. These financing arrangements strongly influence access to care, risk protection, equity, and the probability that medical expenses will become catastrophic for households (WHO, 2023a).

Health economics also studies efficiency in healthcare delivery. Since health resources are limited, every investment in one intervention implies an opportunity cost, because the same resources cannot be used elsewhere. For this reason, economic evaluation tools such as cost-effectiveness analysis and cost-utility analysis are important in policy decision-making. Cost-effectiveness analysis compares the cost of an intervention with its health benefits, while cost-utility analysis often uses quality-adjusted life years to compare interventions across different disease areas. Concrete examples show the policy relevance of this type of analysis. Vaccination programmes have been estimated to generate approximately \$16 in economic benefits for every \$1 spent, while hypertension treatment can prevent around 10.3 million deaths annually at global level (WHO, 2025a; Sabaté, 2003). These tools help decision-makers evaluate whether resources should be allocated to prevention, diagnosis, treatment, workforce expansion, infrastructure, pharmaceuticals, or public-health campaigns (Folland et al., 2021).

Another major area of health economics is the analysis of behaviour in healthcare. Traditional economic models often assume rational decision-making, but healthcare decisions are influenced by psychological, social, institutional, and informational factors. Patients may delay treatment, fail to adhere to long-term medication, or underestimate future risks. Providers may influence demand through diagnostic and treatment recommendations, and this can create supplier-induced demand when professional authority and financial incentives are misaligned. Patient adherence is another example of why behavioural economics matters for healthcare. Only around 50% of patients with chronic diseases follow long-term treatment plans, meaning that health outcomes depend not only on the availability of medical interventions, but also on patient behaviour, incentives, trust, and system design (Sabaté, 2003). Behavioural economics therefore helps explain why healthcare markets do not always operate according to the assumptions of perfect rationality and why policy design must account for biases, incentives, trust, and institutional context (McGuire, 2012).

The field is also closely connected to equity and public policy. Health economics asks not only whether a health system produces benefits, but also who receives those benefits, who pays for them, and whether vulnerable groups can access essential services. This makes the discipline especially relevant for universal health coverage, because universal coverage requires both access to quality services and protection from financial hardship. As a result, health economics provides a framework for comparing health-system models, identifying market failures, evaluating reforms, and designing policies that improve both efficiency and fairness.

For these reasons, health economics is essential to the study of sustainable health systems. It connects economic reasoning with public-health objectives by analysing how financing, incentives, regulation, and institutional design affect the long-term capacity of health systems to respond to disease burden, demographic change, technological innovation, and future



crises. Its scope therefore includes not only the management of current healthcare expenditure, but also the design of resilient systems capable of producing better health outcomes with limited resources.

1.3. Relevance of health economics for sustainable health systems

Health economics is particularly important because it provides a structured way to examine the inefficiencies that appear at the intersection of healthcare, public finance, social welfare, and institutional governance. Health systems must constantly decide how to allocate limited resources among prevention, diagnosis, treatment, infrastructure, workforce development, pharmaceuticals, emergency preparedness, and long-term care. These decisions are not only technical or medical; they are also economic and ethical, because every allocation choice affects both the quantity of health produced and the distribution of that health across social groups.

One of the central contributions of health economics is its focus on efficiency. In healthcare, inefficiency can appear through unnecessary procedures, duplicated diagnostic tests, avoidable hospitalizations, excessive administrative costs, poorly targeted subsidies, or delayed preventive interventions. Since resources are scarce, inefficient spending reduces the capacity of health systems to respond to other needs. Economic evaluation therefore helps decision-makers compare alternative interventions and identify those that generate the greatest health benefit for the resources available. This is especially important in periods of fiscal pressure, demographic ageing, and increasing chronic disease burden, when health expenditure tends to rise faster than the available public budget (Folland et al., 2021).

A second major contribution is the analysis of equity. Health systems are sustainable only if they protect populations not only from disease, but also from financial exclusion and unequal access to care. A system may be technologically advanced and still fail socially if essential services remain inaccessible to low-income groups, rural communities, migrants, or other vulnerable populations. Health economics therefore examines how financing models, insurance design, co-payments, subsidies, and public provision affect access to care and financial protection. This equity dimension is central to universal health coverage, which requires that people receive needed health services without suffering financial hardship (WHO, 2023a).

Health economics is also necessary because healthcare markets are structurally different from ordinary competitive markets. Patients often lack the same information as providers, demand for urgent care is frequently price-inelastic, and the benefits of some interventions extend beyond the individual patient. Vaccination, antimicrobial stewardship, disease surveillance, and pandemic preparedness all generate collective benefits that markets may underprovide without public coordination. For this reason, government intervention, regulation, public financing, and institutional design are essential parts of health-economic analysis. The classic economic problem of uncertainty in medical care shows why healthcare requires special policy attention and why market mechanisms alone are insufficient to guarantee efficient and equitable outcomes (Arrow, 1963).

Finally, health economics supports policy guidance and long-term resilience. It helps governments and international organizations evaluate which reforms are likely to reduce waste, improve access, strengthen preparedness, and increase the sustainability of healthcare financing. In the context of pandemics, antimicrobial resistance, climate-related health risks, and non-communicable diseases, this policy function becomes increasingly important. Health economics therefore contributes not only to the management of present healthcare expenditure, but also to the design of systems capable of adapting to future shocks while preserving efficiency, equity, and population health.

1.4. Aim, research question, and article structure

Based on these considerations, the aim of this article is to review health economics as a framework for understanding and improving the performance, equity, and sustainability of healthcare systems. The article examines how economic principles can be used to interpret healthcare financing, resource allocation, market failures, public intervention, global inequalities, and the growing pressure created by disease burden, demographic change, technological development, and emergency preparedness needs.

The central research question guiding the article is the following: how can health economics contribute to the development of more efficient, equitable, resilient, and sustainable health systems in different global contexts? This question is addressed through a global review of theoretical concepts, comparative health-system models, major bottlenecks, and policy and technological solutions. The article is therefore not limited to describing healthcare systems, but seeks to connect economic analysis with practical directions for reform.



The contribution of the article is threefold. First, it synthesizes key concepts in health economics, including healthcare financing, cost-effectiveness, opportunity cost, market failure, information asymmetry, externalities, and the role of government intervention. Second, it compares health-system patterns across high-income, middle-income, and low-income countries, showing how financing models and institutional arrangements influence access, efficiency, and outcomes. Third, it identifies major global bottlenecks and discusses possible responses, including universal health coverage, stronger global health governance, health-workforce investment, pharmaceutical access reforms, digital health, artificial intelligence, and sustainable health technologies.

The remainder of the article is structured as follows. Section 2 describes the data and methods used for the narrative review and prospective policy analysis. Section 3 presents and discusses the main findings, including theoretical foundations, global healthcare-system patterns, structural bottlenecks, and proposed policy and technological solutions. Section 4 concludes by summarizing the main arguments, highlighting the significance of health economics for sustainable health-system reform, and identifying limitations and future research directions.

2. Data and methods

This article is designed as a narrative global review and prospective policy analysis of health economics. The purpose of the review is not to test a single econometric hypothesis using primary data, but to synthesize theoretical concepts, comparative evidence, global health-system patterns, and policy-oriented solutions relevant to the sustainability of healthcare systems. The review therefore combines conceptual analysis with comparative interpretation and prospective discussion.

2.1. Review design

The narrative review component is used to organize the main foundations of health economics, including healthcare financing, opportunity cost, cost-effectiveness analysis, market failure, information asymmetry, externalities, government intervention, universal health coverage, and health-system efficiency. These concepts provide the theoretical basis for interpreting why healthcare systems differ in performance and why similar levels of expenditure may produce different outcomes across countries.

The comparative component examines differences between high-income, middle-income, and low-income countries, as well as differences between major healthcare financing models. The article considers tax-funded systems, social insurance systems, private-insurance arrangements, and out-of-pocket-dominant models in order to show how financing structures influence access, equity, financial protection, and system efficiency. This comparative perspective is necessary because health economics is strongly shaped by national income, institutional capacity, political priorities, demographic structure, and public-health needs.

The prospective policy-analysis component identifies major bottlenecks and possible reform directions. These include non-communicable diseases, inefficient healthcare spending, limitations of economic modelling in low-income settings, social determinants of health, emergency preparedness, climate-related health risks, pharmaceutical access, workforce shortages, digital health, artificial intelligence, and sustainable health technologies. The article uses these themes to discuss how health economics can contribute to more efficient, equitable, resilient, and sustainable healthcare systems.

Overall, the research design follows a synthesis logic: first, it defines the conceptual foundations of health economics; second, it compares global health-system patterns; third, it identifies major structural bottlenecks; and fourth, it discusses policy and technological solutions. This structure allows the article to connect theory, empirical comparison, and future-oriented policy recommendations within a single health-economic framework.

2.2. Source base and selection logic

The article is based on secondary sources selected for their relevance to global health economics, healthcare financing, health-system performance, disease burden, equity, and sustainability. The source base includes reports from international organizations, policy institutions, public-health agencies, and academic publications. This approach is appropriate for a global review because health economics depends on comparative data and institutional evidence that are often produced by organizations with international monitoring capacity.

International organizations were used as the main source for global and regional health-system indicators. Reports and databases from the World Health Organization (WHO), the World Bank, the OECD, the United Nations, and the Institute for Health Metrics and Evaluation were used to frame differences in health expenditure, universal health coverage, workforce capacity, disease burden, non-communicable diseases, poverty, and sustainable development (WHO, 2025b; 2023a; World



Bank, 2023a–d; OECD, 2023a–b; IHME, 2023; United Nations, 2023). These sources were prioritized because they provide comparable international indicators and are commonly used in policy-oriented health-economic analysis.

Policy and health-system reports were used to examine specific institutional problems and national cases. For example, sources such as the Kaiser Family Foundation (2026) and the Commonwealth Fund (2024) were used to analyse the United States healthcare system, including insurance coverage, cost pressure, access gaps, and comparative system performance. Similarly, sources connected to the Global Fund (2023), the Global Financing Facility (n.d.), and universal health coverage initiatives were used to discuss health financing, donor-supported programmes, and international policy mechanisms in low- and middle-income countries.

Academic literature was used to support the theoretical and conceptual foundations of health economics. Core economic concepts such as uncertainty in medical care, information asymmetry, physician agency, insurance design, adverse selection, and cost-effectiveness were interpreted through established academic sources in health economics and public-health policy (Arrow, 1963; Folland et al., 2021; McGuire, 2012). These sources are necessary because the article does not only describe health systems, but also explains why healthcare markets differ from ordinary markets and why public intervention is often required.

The selection logic followed three criteria. First, sources were included when they directly supported one of the article's main analytical dimensions: financing, efficiency, equity, disease burden, preparedness, technology, or sustainability. Second, sources were prioritized when they offered internationally comparable data or widely recognized theoretical contributions. Third, case-specific sources were used when they illustrated a broader health-economic mechanism, such as market failure, universal health coverage, workforce shortages, pharmaceutical access barriers, or the role of digital health. This selection logic allows the article to combine global comparability with concrete examples of how health-economic challenges appear in different institutional contexts.

2.3. Analytical framework

The analysis is organized around a multidimensional health-economic framework that connects theoretical concepts, health-system structures, global bottlenecks, and possible reform directions. This framework was designed to make the review coherent across different countries, income groups, financing models, and policy challenges. Instead of treating each country or topic as an isolated case, the article interprets them through recurring analytical dimensions: financing, efficiency, equity, market failure and public intervention, institutional capacity, resilience, technological development, and sustainability.

Healthcare financing ♦ This dimension examines how health systems collect, pool, and spend financial resources through taxation, social insurance, private insurance, employer contributions, donor funding, and out-of-pocket payments. Financing is central to health economics because it influences access to services, financial protection, risk distribution, administrative complexity, and long-term fiscal sustainability. The comparison between tax-funded systems, social insurance models, private-insurance systems, and out-of-pocket-dominant arrangements is therefore used to evaluate how different financing structures affect equity and efficiency (WHO, 2023a).

Efficiency ♦ In this article, efficiency refers to the ability of a healthcare system to transform limited resources into the greatest possible health benefit. This includes the reduction of waste, unnecessary procedures, avoidable hospitalizations, excessive administrative costs, duplicated tests, and poorly targeted expenditure. Efficiency is analysed through concepts such as opportunity cost, cost-effectiveness analysis, cost-utility analysis, and quality-adjusted life years. These concepts are important because every health-system decision involves trade-offs between alternative uses of the same resources (Folland et al., 2021).

Equity ♦ Equity refers to the distribution of healthcare access, financial protection, and health outcomes across income groups, regions, and social categories. The article analyses equity by examining universal health coverage, out-of-pocket expenditure, workforce shortages, rural-urban differences, social determinants of health, and the unequal burden of disease. This dimension is necessary because a healthcare system cannot be considered sustainable if it improves average outcomes while leaving vulnerable populations without access to essential services.

Market failure and public intervention ♦ Healthcare markets differ from ordinary markets because they are shaped by uncertainty, information asymmetry, externalities, supplier-induced demand, monopoly power, and the moral and social importance of health. For this reason, the article analyses the role of government in correcting market failures through regulation, subsidies, public provision, price controls, public-health campaigns, insurance mandates, and emergency preparedness. This dimension is essential for explaining why healthcare cannot rely only on market mechanisms (Arrow, 1963).



Resilience ♦ Resilience refers to the capacity of health systems to respond to shocks such as pandemics, antimicrobial resistance, climate-related disasters, workforce shortages, and sudden increases in demand.

Sustainability ♦ Sustainability refers to the long-term ability of health systems to maintain access, quality, efficiency, and equity without exhausting financial, human, institutional, or environmental resources. This article therefore interprets health economics not only as a tool for cost control, but also as a framework for designing health systems that can adapt to future crises.

Table 1 summarizes the analytical framework used in the review.

Table 1. Analytical framework of the review

Analytical dimension	Main question	Examples of indicators or themes
Healthcare financing	How are healthcare resources collected, pooled, and allocated?	Taxation, social insurance, private insurance, out-of-pocket payments, donor funding
Efficiency	Are resources converted into maximum health benefit?	Cost-effectiveness, opportunity cost, waste, administrative costs, avoidable care
Equity	Who receives care and who bears the financial burden?	Universal health coverage, access gaps, catastrophic spending, social determinants
Market failure and public intervention	Why do healthcare markets fail to produce optimal outcomes?	Information asymmetry, externalities, monopoly power, supplier-induced demand
Institutional capacity	Can the system implement and govern health policies effectively?	Workforce capacity, regulation, procurement, governance, service delivery
Resilience	Can the system respond to shocks and crises?	Pandemic preparedness, emergency response, climate-health risks, supply chains
Technological development	How can innovation improve access, quality, and efficiency?	Telemedicine, AI diagnostics, digital health, disease surveillance, low-cost devices
Sustainability	Can the system maintain performance over time?	Long-term financing, prevention, equity, environmental pressure, system adaptability

This analytical framework guides the structure of the results and discussion section. The theoretical concepts of health economics are first used to explain why healthcare systems face distinctive economic problems. The global comparison then shows how these problems appear differently across income groups and financing models. The bottleneck analysis identifies the main structural barriers to efficient and equitable health systems. Finally, the policy and technological solution analysis discusses how health economics can support more sustainable healthcare reform.

2.4. Comparative and case-study approach

The article uses a comparative and case-study approach to connect general health-economic concepts with concrete institutional examples. The comparison is organized at two levels. The first level compares broad categories of health systems, including tax-funded systems, social insurance systems, private-insurance systems, and out-of-pocket-dominant models. The second level uses selected national and regional cases to illustrate how these models operate in practice and how different health-economic problems appear across income groups and institutional contexts.

The case studies were selected for their illustrative value rather than for statistical representativeness. Each case is used to clarify a broader health-economic mechanism. For example, the United States is used to illustrate how high health expenditure can coexist with market failure, administrative complexity, insurance gaps, and high household financial burden. Germany is used as an example of a social health insurance model with strong cost-control mechanisms, sickness-fund negotiations, and relatively efficient access to specialized care. Singapore is included as an example of a hybrid system that combines compulsory savings, public subsidies, catastrophic insurance, and individual choice.

Several cases are used to analyse universal health coverage and health financing in middle- and low-income settings. Brazil is discussed as an example of a large public healthcare system that expanded access while facing underfunding and waiting-time problems. Ethiopia is used to illustrate the role of community health workers and donor-supported health-system expansion. Thailand and Rwanda are included as examples of universal health coverage strategies adapted to middle- and low-income contexts, while India and Mexico are used to show the implementation difficulties that can appear when universal coverage reforms face rural infrastructure shortages, claim rejection, medicine shortages, or funding gaps.

The case-study approach also supports the analysis of structural bottlenecks and future risks. Pakistan is used in the discussion of climate-related health shocks because flooding and water insecurity, which may lead to infectious-disease outbreaks show how environmental disasters can become health-economic crises. Low-income country examples are used



to illustrate the limits of applying economic models developed in data-rich, high-income environments to contexts where informal care, donor dependency, weak data systems, and workforce shortages strongly shape health outcomes. These cases help demonstrate that health-economic analysis must be adapted to local institutional and socioeconomic conditions.

Overall, the comparative approach allows the article to avoid treating health economics as a purely abstract field. By linking theory with country examples, the review shows how financing arrangements, market failures, public intervention, equity challenges, and sustainability pressures differ across health systems. The case studies therefore function as explanatory examples that make the broader analytical framework more concrete and policy-relevant.

2.5. Methodological limitations

The methodological design of this article has several limitations. First, the article is based on a narrative review and prospective policy analysis rather than on primary data collection or econometric modelling. Therefore, its purpose is not to estimate causal effects or to test a single statistical hypothesis, but to synthesize existing evidence and interpret major health-economic patterns across different systems and contexts.

Second, the use of secondary sources creates limitations related to data comparability. International organizations, academic studies, and policy institutions may use different definitions, measurement methods, reporting years, and country classifications. For example, indicators related to health expenditure, universal health coverage, disease burden, workforce capacity, or out-of-pocket payments may not always be directly comparable across regions. This limitation is especially relevant when comparing high-income, middle-income, and low-income countries, because differences in administrative capacity and data quality can affect the reliability of reported indicators.

Third, the case studies used in the article are illustrative rather than statistically representative. Countries such as the United States, Germany, Singapore, Brazil, Ethiopia, Thailand, Rwanda, India, Mexico, and Pakistan are included because they clarify important health-economic mechanisms, not because they represent all possible healthcare systems. As a result, the conclusions drawn from these examples should be interpreted as analytical insights rather than universal generalizations.

Fourth, the global scope of the article requires a high level of synthesis. Health economics is strongly affected by local institutions, political priorities, demographic structures, epidemiological profiles, cultural expectations, and fiscal capacity. A global review can identify recurring patterns and structural bottlenecks, but it cannot fully capture all national and regional specificities. Policy recommendations must therefore be adapted to local contexts before implementation.

Finally, the article discusses several rapidly evolving areas, including pandemic preparedness, digital health, artificial intelligence, pharmaceutical access, and climate-related health risks. Because these fields change quickly, some data and policy developments may evolve after the sources used in the review. For this reason, the article should be understood as a structured synthesis of current health-economic challenges and reform directions, rather than as a final or exhaustive account of the field.

3. Results and discussion

3.1. Core health-economic mechanisms: scarcity, incentives, and market failure

Health economics begins from the problem of scarcity. Healthcare systems must allocate limited financial, human, technological, and institutional resources among competing needs such as prevention, emergency care, chronic disease management, pharmaceuticals, workforce expansion, digital infrastructure, and long-term care. Because resources used for one intervention cannot simultaneously be used for another, every healthcare decision involves opportunity cost. Opportunity-cost reasoning is also visible in institutional decision thresholds. For example, the United Kingdom's National Institute for Health and Care Excellence commonly uses a threshold of approximately £20,000–30,000 per quality-adjusted life year when assessing whether interventions should be funded (National Institute for Health and Care Excellence, 2022). This is why economic evaluation is central to healthcare policy: it helps decision-makers compare the costs and benefits of alternative interventions and identify which uses of resources generate the greatest health benefit.

However, healthcare markets differ substantially from ordinary markets. In many sectors, consumers can compare prices, delay purchases, evaluate quality, and choose between providers with relatively clear information. In healthcare, these conditions are often absent. Patients may need urgent treatment, may not understand the technical quality of care, and may depend on professional advice from physicians. This creates uncertainty and information asymmetry, meaning that providers usually know more than patients about diagnosis, treatment options, risks, and expected outcomes. As a result, healthcare cannot be analysed as a perfectly competitive market (Arrow, 1963).



Demand in healthcare is also distinctive. For life-saving or urgent services, demand is often price-inelastic because patients cannot easily reduce consumption when prices increase. Emergency care, trauma care, cancer treatment, and acute infectious-disease treatment are examples of services where need is determined more by medical urgency than by consumer preference. By contrast, demand for some elective procedures may be more price-sensitive because patients can delay, avoid, or substitute them. This difference matters for policy because high prices or co-payments may reduce necessary care for some services while having limited effect on urgent care. The difference between urgent and elective healthcare demand is summarized in *Table 2*, which illustrates how price elasticity varies across service types.

Table 2. Price elasticity variation across healthcare services (*based on Zeckhauser & Cutler (2000)*)

Service type	Price elasticity	Health-economic implication
Emergency care	-0.1, relatively inelastic	Use remains relatively stable when costs rise because treatment is urgent
Elective procedures	-0.7, more elastic	Demand may decrease significantly when patient costs increase

Another important mechanism is supplier-induced demand. Because physicians and other providers influence diagnosis and treatment decisions, their recommendations can shape patient demand. This is not necessarily negative, because patients need expert guidance. However, when financial incentives reward higher service volume, additional tests, or more expensive interventions, provider recommendations may contribute to overutilization. This can generate inefficient spending, unnecessary procedures, and higher system costs without proportional health gains (McGuire, 2012). This mechanism is supported by empirical evidence. An OECD (2023b) health-system comparison found that a 10% increase in physician density was associated with a 3–7% increase in healthcare utilization, suggesting that provider availability can influence demand as well as respond to it.

Health insurance also creates specific economic problems. Insurance protects individuals from catastrophic medical costs, but it may also create moral hazard when insured patients consume more care because they do not directly pay the full cost of each service. The U.S. insurance market before the Affordable Care Act (ACA) illustrates this problem. Before the ACA, insurers denied coverage to approximately 19% of applicants with pre-existing conditions, showing how risk selection can restrict access for the people most likely to need care. At the same time, adverse selection can occur when people with higher expected healthcare needs are more likely to purchase insurance, increasing the cost of coverage and potentially destabilizing insurance pools. These mechanisms show why health insurance markets often require regulation, risk pooling, mandates, subsidies, or public provision to remain efficient and equitable (Rothschild and Stiglitz, 1976).

Externalities further distinguish healthcare from ordinary markets. Some health interventions produce benefits beyond the individual patient. Vaccination, infectious-disease surveillance, antimicrobial stewardship, sanitation, and pandemic preparedness reduce risks for the wider population. If decisions are left only to individual willingness to pay, these interventions may be underprovided because individuals do not capture the full social benefit. The scale of positive externalities can be substantial. COVID-19 vaccination was estimated to have averted 19.8 million deaths in 2021 through direct protection and herd-immunity effects, demonstrating how individual health interventions can generate population-level benefits (Watson et al., 2022). Conversely, negative externalities such as antibiotic overuse can create broader social costs by accelerating antimicrobial resistance. This justifies public-health regulation and collective financing.

Market failure is also visible in pharmaceutical markets. Patent protection can encourage innovation by rewarding research and development, but it can also create temporary monopoly power, as patents can grant approximately 20-year monopolies on new drugs. For example, Gilead priced the hepatitis C drug sofosbuvir at approximately \$84,000 per treatment course in the United States, while production-cost estimates suggested that direct-acting antivirals could be manufactured at much lower cost. Compulsory licensing and generic competition have been used in low- and middle-income countries to reduce hepatitis C treatment prices by up to 99% (United States Senate Committee on Finance, 2015; Hill et al., 2014; Make Medicines Affordable, n.d.). When monopoly power is strong, prices may rise above production costs and restrict access to essential medicines, especially in low- and middle-income countries. This creates a tension between innovation incentives and equitable access. Health economics helps analyse this trade-off and supports policy instruments such as price regulation, reference pricing, compulsory licensing, pooled procurement, and public-private negotiation.

Government intervention can also correct market failures through regulation, mandates, communication campaigns, and taxation. Germany uses price controls to limit excessive drug prices, while the ACA expanded coverage to approximately 20 million Americans. Public-health campaigns also show measurable effects: anti-smoking policies reduced U.S. smoking



rates from 42% in 1965 to 12% in 2023, and Mexico's soda tax decreased consumption by 7.6% (Kaiser Family Foundation, 2026; Centers for Disease Control and Prevention, 2024; Colchero et al., 2016).

Overall, these mechanisms show why health systems require institutional design rather than simple market reliance. Scarcity, uncertainty, information asymmetry, inelastic demand, supplier-induced demand, moral hazard, adverse selection, externalities, and monopoly power all create conditions in which unregulated markets may fail to produce efficient or equitable outcomes. Health economics is therefore essential for identifying where markets fail, where government intervention is justified, and how healthcare systems can allocate resources in ways that support both population health and long-term sustainability.

3.2. Global patterns in healthcare systems

Health economics differs substantially across countries because healthcare systems are shaped by national income, institutional capacity, demographic structure, political priorities, and historical choices in financing and service delivery. A global perspective therefore shows that healthcare performance cannot be explained only by medical technology or total expenditure. It also depends on how resources are collected, pooled, allocated, regulated, and transformed into accessible services.

The scale of global disparity is visible in per-capita spending. Global health expenditure ranges from approximately \$41 per capita in low-income countries to around \$12,914 per capita in the United States, showing that the financial capacity of health systems differs by several orders of magnitude (WHO, 2023b).

High-income countries generally have the highest levels of healthcare expenditure, broader insurance coverage, more developed infrastructure, and stronger institutional capacity. These systems usually provide extensive access to specialized care, pharmaceuticals, diagnostic technologies, and long-term treatment for chronic diseases. However, they also face rising cost pressures caused by ageing populations, higher expectations for medical innovation, expensive pharmaceuticals, administrative complexity, and the growing burden of non-communicable diseases. In this group, the main health-economic challenge is often not the absence of resources, but the efficient and equitable management of expensive systems (WHO, 2023b). *Table 3* summarizes the main characteristics of high-income health systems, including their expenditure profile, coverage patterns, and dominant cost pressures. High-income systems also face specific cost pressures. Ageing populations increase demand for chronic disease care, while pharmaceutical costs consume approximately 15–20% of health budgets. Japan illustrates both the strengths and pressures of this group: it uses a social insurance system with 10–30% co-payments and achieves the world's highest life expectancy, approximately 84.7 years, while spending around 10.9% of GDP on healthcare (OECD, 2023b; WHO, 2023b).

Table 3. Selected characteristics of high-income health systems (based on WHO (2023b) and OECD (2023b))

Indicator	General pattern in high-income countries	Examples
Health spending	High share of GDP (10.2%) and high per-capita spending	United States (17.3%), Germany (12.6%), Switzerland
Life expectancy	Generally above 80 years (81.3 years)	Japan (84.7), Switzerland (83.4), Sweden
Universal or near-universal coverage	Common (98%), but with different financing arrangements	United Kingdom, Canada, Germany, Japan
Main pressures	Ageing, chronic disease, pharmaceutical costs, administrative complexity	Long-term care, cancer treatment, cardiovascular disease

Middle-income countries form a more heterogeneous group. Upper-middle-income countries such as Brazil, China, South Africa, and Mexico often have expanding public or mixed health systems, but they still face inequalities in access, regional disparities, and pressure from both infectious diseases and chronic conditions. Lower-middle-income countries such as India, Nigeria, the Philippines, and Vietnam generally face more serious constraints in workforce capacity, infrastructure, and public financing. Across this group, health economics is strongly concerned with how to expand universal health coverage while maintaining fiscal sustainability and improving service quality (World Bank, 2023a). The distinction between upper-middle-income and lower-middle-income countries is presented in



Table 4, which highlights differences in financing pressure, workforce availability, and universal health coverage development. Brazil's *Sistema Único de Saúde* illustrates the mixed achievements and constraints of middle-income health systems. Since 1990, Brazil has reduced infant mortality by 56% and provides free antiretroviral therapy for HIV patients. However, the system remains underfunded at approximately 3.8% of GDP. Moreover, around 25% of Brazilians use private insurance because of delays in the public system (World Bank, 2023c).



Table 4. Comparison between upper-middle-income and lower-middle-income health-system conditions (based on World Bank (2023b) and WHO (2023a))

Indicator	Upper-middle-income countries	Lower-middle-income countries
Examples	Brazil, China, South Africa, Mexico	India, Nigeria, Philippines, Vietnam
GNI/capita	\$4,466 – \$13,845	\$1,136 – \$4,465
Health-system profile	Expanding public or mixed systems	More constrained public capacity
Out-of-pocket spending	Lower than in lower-middle-income countries, but still significant: 28%	Often high and financially burdensome: 47%
Physician density	Higher, but unevenly distributed (2.9/1,000 people)	Lower and frequently concentrated in cities (1.2/1,000 people)
Universal health coverage	More developed, but unequal (68%)	Expanding, but limited by infrastructure and financing (54%)

Low-income countries face the most severe structural constraints. These include low public health expenditure, shortages of doctors and nurses, limited hospital and laboratory infrastructure, weak supply chains, donor dependency, and high vulnerability to epidemics, malnutrition, maternal and child mortality. In these systems, even basic services may remain underfunded. The health-economic problem is often how to finance essential care, strengthen primary healthcare, and reduce dependence on direct household payments. Limited fiscal space makes prioritization especially important, because the opportunity cost of every health investment is high. *Table 5* summarizes the main constraints faced by low-income health systems and their health-economic implications. Ethiopia's Health Extension Program illustrates how low-income countries can expand access through community-based capacity building. Since 2003, Ethiopia has trained approximately 40,000 community health workers and increased skilled birth attendance from 10% to 50%. However, the programme remains heavily dependent on external financing, with around 70% of funding coming from donors (World Bank, 2023c; WHO, 2023e).

Table 5. Main health-economic constraints in low-income countries (based on WHO (2023a, 2023b), and World Bank (2023b))

Constraint	Health-economic implication
Low per-capita health spending (\$41/capita)	Insufficient resources for essential services, medicines, infrastructure, and workforce
Shortage of health workers (e.g. doctor availability of 0.3 / 10,000 in Chad, 98% below WHO minimum)	Reduced access to care, especially in rural areas
High maternal and child mortality (462 / 100,000 births, 35 times higher than HICs)	Persistent burden of preventable deaths and weak primary care capacity
Donor dependency	Risk of external priority-setting and unstable financing
High out-of-pocket payments	Increased risk of catastrophic expenditure and poverty

The contrast between income groups shows that health-system sustainability has different meanings in different contexts. In high-income countries, sustainability often means controlling expenditure growth, reducing waste, improving value for money, and managing the costs of ageing and chronic disease. In middle-income countries, sustainability often means expanding coverage while preventing excessive fiscal pressure and reducing inequalities between regions and social groups. In low-income countries, sustainability requires building basic institutional capacity, increasing domestic financing, reducing donor dependency, and protecting households from catastrophic out-of-pocket payments.

These differences show why health economics must be adapted to context. A policy that is appropriate in a high-income country may not be feasible in a low-income setting, and a financing model that works in one institutional environment may fail in another. Comparative health economics is therefore essential because it identifies both general principles and context-specific constraints. The global pattern is clear: more spending can improve health-system capacity, but spending alone is not sufficient. Efficiency, equity, governance, workforce planning, and financial protection determine whether healthcare resources become sustainable improvements in population health.

3.3. Healthcare financing models and universal health coverage

Healthcare financing is one of the most important determinants of health-system performance, because it influences who pays for care, who receives access, how financial risk is distributed, and how efficiently resources are used. Although national systems vary significantly, three broad financing models are especially relevant for comparative health economics: tax-funded systems, social health insurance systems, and private-insurance or out-of-pocket-dominant systems. These models are summarized in *Table 6*, which shows their basic financing logic, strengths, and limitations.



Table 6. Main healthcare financing models (based on Folland et al. (2021) and WHO (2023a))

Financing model	Core mechanism	Main strengths	Main limitations
Tax-funded (e.g. United Kingdom)	Healthcare is financed mainly through general taxation and often provided or strongly coordinated by the state	Universal access, strong risk pooling, lower financial barriers at point of care	Waiting times, rationing, pressure on public budgets
Social health insurance (e.g. Germany)	Healthcare is financed through mandatory contributions from employers, employees, and sometimes the state	Broad coverage, pluralistic providers, relatively stable financing	Administrative complexity, contribution burden, dependence on employment structure
Private-insurance or out-of-pocket-dominance (e.g. United States)	Healthcare is financed through private insurance, employer plans, individual payments, or direct household spending	Greater consumer choice in some contexts, stronger private-sector role	Inequity, high administrative costs, financial hardship, coverage gaps

Table 7 compares three representative national financing arrangements and shows how spending, life expectancy, and infant mortality differ across the United Kingdom, Germany, and the United States.

Table 7. Comparison of three national healthcare financing systems in 2022 (based on OECD (2023b), WHO (2023b), and Commonwealth Fund (2024))

Metric	UK (National Health Service)	Germany	United States
% GDP spent on healthcare	11.1%	12.6%	17.3%
Life expectancy	81.3 years	80.6 years	77.5 years
Infant mortality	3.9 deaths / 1,000	3 deaths /1,000	5.61 deaths / 1,000

Tax-funded systems, often associated with the Beveridge Model, finance healthcare mainly through general taxation and usually provide services free or nearly free at the point of use. This model can support universal access and strong financial protection because the cost of care is pooled across the population. Countries such as the United Kingdom and Sweden illustrate how tax-funded systems can promote equity and cost control through public provision or strong public coordination. However, these systems may also face waiting times, rationing, and political pressure when public budgets are constrained. The Beveridge Model is further illustrated in Table 8 through the examples of the United Kingdom, Sweden, and Cuba. This model also shows the trade-off between equity, cost control, and waiting times. In the United Kingdom, maternal mortality is approximately 7 deaths per 100,000 live births, compared with 23.8 in the United States, while administrative costs are around 5% compared with 31% in the United States. However, rationing remains a weakness: approximately 650,000 UK patients wait more than 18 weeks for surgery, and new cancer drugs may be adopted more slowly (OECD, 2023b; Commonwealth Fund, 2024).

Table 8. Beveridge Model Healthcare systems comparisons by country in 2022 (based on OECD (2023b), WHO (2023b), and World Bank (2023b))

Country	%GDP on health	Life expectancy	Key features
UK	11.1%	81.3 years	Centralized NHS, free at point of use
Sweden	10.5%	83 years	Decentralized county management
Cuba	11.8%	77.6 years	Physician-heavy primary care

Social health insurance systems, often associated with the Bismarck Model, are financed through mandatory contributions from employers and employees, usually combined with public regulation and non-profit or semi-public insurance funds. Germany, France, and Japan illustrate this model. Social insurance can combine broad coverage with pluralistic service delivery, while sickness funds or insurers negotiate with providers and help regulate prices. However, this model can also generate administrative complexity and may require subsidies for unemployed, informal, or low-income populations in order to maintain universal coverage. Table 9 presents selected Bismarck-type systems and compares their financing mechanisms, coverage rates, and out-of-pocket (OOP) shares. Germany also illustrates the operational advantages of regulated social insurance. Sickness funds negotiate prices with providers, and reference pricing helps keep drug costs low. Germany has approximately 35 MRI scanners per million people, compared with 40 in the United States and 8 in the United Kingdom, while cardiac surgery waiting time is generally under two weeks (OECD, 2023b).



Table 9. Comparison between multiple countries with Bismarck Healthcare Model (based on OECD (2023b), WHO (2023a–b) and Folland et al. (2021))

Country	Financing mechanism	Coverage rate	OOP share
Germany	14.6% payroll tax	99%	10%
France	13% payroll + income tax	99%	7%
Japan	Employer/employee premiums	98%	12%

Private-insurance and out-of-pocket-dominant systems rely more heavily on market mechanisms, employer-based insurance, voluntary private coverage, or direct payments by patients. These systems may offer more consumer choice for some groups, but they also create major equity and financial-protection problems when coverage is incomplete or when treatment costs are high. Out-of-pocket payments are especially problematic in low- and middle-income countries, because they expose households to catastrophic health expenditure and may cause people to delay or avoid needed care. *Table 10* compares selected private-insurance or market-oriented systems, showing differences in uninsured rates, administrative costs, and drug prices. Singapore's Medisave Model shows how private responsibility can be combined with public safeguards. The system uses mandatory health savings accounts equal to approximately 8–10.5% of wages, supported by catastrophic insurance through MediShield Life. The system achieves very low infant mortality, approximately 1.8 deaths per 1,000 live births, while health spending remains around 4.5% of GDP.

Table 10 Comparison between selected private-insurance and market-oriented healthcare systems in 2022 (based on Commonwealth Fund (2024), Kaiser Family Foundation (2026), OECD (2023b), and WHO (2023b))

Metric	United States	Switzerland	Singapore
% uninsured	8.4%	0.3%	0%
Administrative costs	31%	2-3%	15-20%
Drug prices	3.5 times OECD average	1.2 times	0.8 times

Universal health coverage represents a central objective in health economics because it aims to ensure that all people can access quality essential health services without financial hardship. The United Nations Sustainable Development Goal 3.8 explicitly targets universal health coverage, including financial risk protection and access to essential healthcare services and medicines (United Nations, 2023). In practice, universal coverage does not require all countries to adopt the same financing model. Instead, it requires each system to create effective risk pooling, reduce direct financial barriers, expand service availability, and protect vulnerable groups from catastrophic expenditure. *Figure 2* summarizes regional progress toward universal health coverage and

Table 11 highlights the main barriers affecting each region.

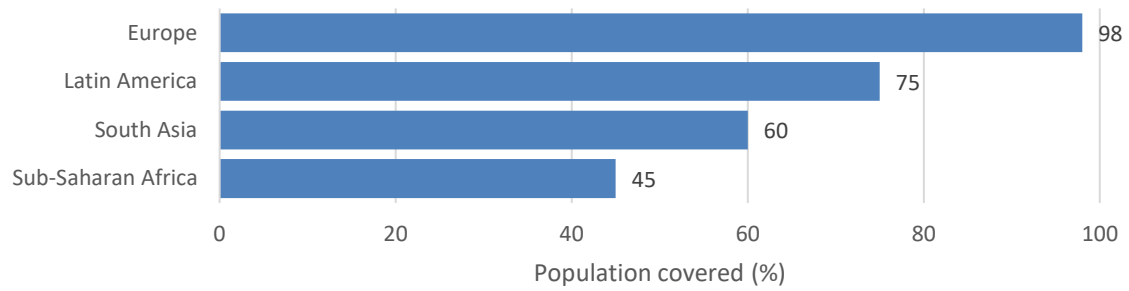


Figure 2. Universal health coverage progress across selected regions
(based on United Nations (2023), WHO (2023b), and World Bank (2023c))



Table 11. UN SDG 3.8 progress across selected regions (based on United Nations (2023), WHO (2023a), and World Bank (2023c))

Region	Key barriers
Europe	Ageing population strains system
Latin America	Informal employment (40% of workers)
South Asia	Underfunded public facilities
Sub-Saharan Africa	Doctor shortages (0.2/1,000people)

Table 12 presents selected universal health coverage cases and shows how different countries have pursued coverage expansion through different institutional pathways.

Table 12. Selected universal health coverage cases (based on WHO (2023b), World Bank (2023c), and United Nations (2023))

Case	Main mechanism	Main achievements	Main challenges
Thailand	Tax-funded universal coverage scheme with low co-payments	Expanded access to outpatient, inpatient, and emergency care; reduced catastrophic spending	Long-term fiscal pressure and demand management
Rwanda	Community-based health insurance supported by subsidies and community health workers	High enrolment, improved primary care access, stronger maternal and child health outcomes	Dependence on subsidies and administrative capacity
India	Large publicly financed hospitalization coverage for low-income households	Expanded financial protection for poor households	Rural hospital shortages, claim rejection, uneven implementation
Mexico	Transition from <i>Seguro Popular</i> to a more centralized public model	Formal objective of free care for uninsured populations	Funding gaps, medicine shortages, implementation disruption

Thailand's universal coverage strategy shows how a middle-income country can expand access through a tax-funded system adapted to national fiscal capacity. The 30-Baht Scheme was launched in 2002 after the 1997 financial crisis and was financed mainly through general taxation, approximately 67%, with a nominal co-payment of 30 Baht, around \$1, per visit. The scheme helped achieve child vaccination rates of approximately 98% and reduced catastrophic health spending from 6% to 2% of households (World Bank, 2023c; WHO, 2023a).

Rwanda illustrates a different pathway, using community-based insurance, premium subsidies, performance incentives, and community health workers to expand coverage in a lower-income setting. In the *Mutuelle de Santé* system, the poorest pay approximately \$0.5 per year compared with the standard \$5 per year. The model is supported by around 45,000 community health workers, who helped enrol approximately 90% of the population. Since 2005, malaria deaths have fallen by around 85%, and skilled birth attendance increased to approximately 90%, compared with 30% in 2000 (World Bank, 2023c; WHO, 2023b).

India and Mexico show that universal coverage reforms may face serious implementation challenges. India's *Ayushman Bharat*, launched in 2018, provides free hospitalization coverage of up to approximately \$6,000 per family per year for 500 million low-income Indians, targeting the poorest 40% of the population. However, claim rejection rates of 15–20% and the concentration of approximately 70% of facilities in cities limit its reach. Mexico replaced *Seguro Popular*, which operated from 2003 to 2019, with INSABI in 2020, aiming to provide free public care for 68 million uninsured Mexicans. However, implementation was affected by funding gaps, a 30% budget cut, and cancer drug shortages that created waits of up to six months (World Bank, 2023c; WHO, 2023a).

From a health-economic perspective, the main lesson is that financing design determines the relationship between efficiency, equity, and sustainability. Tax-funded systems may perform strongly in equity and risk pooling but depend heavily on fiscal capacity. Social insurance systems can provide stable funding and negotiated cost control but require institutional sophistication. Private-insurance and out-of-pocket systems may expand choice for some groups but often weaken equity and financial protection. Universal health coverage therefore depends less on the label of the financing model and more on whether the system can pool risk, finance essential services, control costs, and protect households from financial hardship over time.

3.4. Outstanding system cases: United States, Germany, and Singapore

The comparison between the United States, Germany, and Singapore illustrates how different institutional designs can produce very different health-economic outcomes. These cases are useful because they do not simply represent three countries, but three broader approaches to healthcare financing and governance: a highly market-oriented and



administratively complex system, a regulated social insurance model, and a hybrid system combining individual responsibility with strong public safeguards. *Table 13* summarizes the main health-economic lessons that can be drawn from these three cases.

Table 13. Comparative health-economic lessons from the United States, Germany, and Singapore (*based on Commonwealth Fund (2024), Folland et al. (2021), and WHO (2023b)*)

Country	System type	Main health-economic strength	Main health-economic weakness	General lesson
United States	Market-oriented, private-insurance-heavy system	High technological capacity and medical innovation	High costs, administrative complexity, insurance gaps, unequal access	High spending does not guarantee efficiency or equity
Germany	Social health insurance model	Broad coverage, negotiated prices, strong institutional regulation	Complex multi-payer administration and contribution burden	Regulated pluralism can combine access and cost control
Singapore	Hybrid savings, insurance, and subsidy model	Cost discipline, public safeguards, individual savings, targeted subsidies	Dependence on careful state regulation and household savings capacity	Hybrid models can balance choice and fiscal sustainability if strongly governed

The United States represents a major health-economic paradox: it spends more on healthcare than most comparable high-income countries, yet it does not consistently achieve better population-level outcomes. Its system combines employer-based insurance, private insurers, public programmes, high administrative complexity, and substantial household financial exposure. This creates a situation in which technological capacity and specialized care coexist with insurance gaps, high prices, administrative waste, and medical debt. From a health-economic perspective, the U.S. case shows that high expenditure alone is insufficient if financing is fragmented and if market failures are not corrected through effective regulation and risk pooling (Commonwealth Fund, 2024; Kaiser Family Foundation, 2026).

The magnitude of U.S. administrative waste is particularly important. Administrative waste is estimated at approximately \$812 billion per year, with billing complexity accounting for around 30% of hospital costs. The system also includes approximately 1,200 private insurers using different forms and claims procedures. Drug pricing adds another source of inefficiency: insulin costs around ten times the OECD average, and Medicare was prohibited from negotiating drug prices until 2023 (Commonwealth Fund, 2024; Kaiser Family Foundation, 2026; OECD, 2023b).

One of the central problems in the U.S. model is administrative complexity. The presence of many insurers, different reimbursement rules, complex billing procedures, and frequent claim disputes increases transaction costs for hospitals, providers, patients, and insurers. These administrative costs do not directly produce health benefits, which means that part of healthcare expenditure is absorbed by system management rather than prevention, treatment, workforce expansion, or service quality. The U.S. case therefore illustrates how inefficient institutional design can reduce value for money even in a technologically advanced health system.

Germany provides a contrasting example. Its social health insurance model relies on mandatory coverage, sickness funds, negotiated prices, and strong regulation. Rather than leaving healthcare allocation entirely to individual purchasing power, Germany uses collective financing and institutional negotiation to balance access, pluralism, and cost control. Sickness funds negotiate with providers, and reference pricing helps limit excessive pharmaceutical expenditure by setting reimbursement levels for therapeutically comparable products. Germany's system relies on approximately 110 non-profit sickness funds and collective bargaining with providers. This institutional structure helps maintain relatively short access times, with specialist waiting times generally under four weeks. Germany also has longer average hospital stays, around 7.3 days compared with 5.5 in the United States, but with lower readmission rates (OECD, 2023b; Commonwealth Fund, 2024). This structure shows how regulated competition and collective bargaining can reduce some forms of market failure while preserving patient choice and provider diversity. The performance contrast between the United States and Germany is summarized in *Table 14*.

Table 14. Healthcare services performance indicator comparison between U.S. and Germany in 2022 (*based on Commonwealth Fund (2024), OECD (2023b), and WHO (2023b)*)

Metric	U.S.	Germany	Difference
Life expectancy	77.5 years	80.6 years	-3.1 years
Preventable deaths	280/100k	249/100k	+12%



The German case is especially relevant for sustainable health economics because it demonstrates that universal or near-universal coverage can coexist with relatively efficient access to specialized care. Its strength lies not only in the amount of money spent, but in the institutional mechanisms through which resources are pooled, negotiated, and allocated. However, the system also requires strong administrative capacity and careful regulation. Social insurance models can become complex, especially when multiple funds, contribution rules, provider associations, and reimbursement mechanisms interact. Germany therefore illustrates both the advantages and the governance requirements of regulated pluralism.

Singapore represents a different model, combining compulsory medical savings, public subsidies, catastrophic insurance, and regulated patient choice. Its system is often described as hybrid because it does not rely exclusively on taxation, social insurance, or private insurance. Instead, it uses several layers of financing: individual savings for routine or predictable costs, insurance for major health risks, and state subsidies to protect affordability. This design creates incentives for cost awareness while maintaining public mechanisms that reduce the risk of catastrophic financial exposure. Singapore's hybrid model is built around *Medisave* accounts, which require mandatory income contributions of approximately 8–10.5% and cover hospitalization and chronic care. Government safeguards include price controls on around 10,000 medical services and subsidies of up to 80% for low-income patients. The system combines strong outcomes and cost discipline, including infant mortality of approximately 1.7 deaths per 1,000 live births and MRI costs of around \$300 compared with approximately \$1,200 in the United States (WHO, 2023b; OECD, 2023b).

From a health-economic perspective, Singapore shows that cost control can be pursued through a combination of individual responsibility and public regulation. However, this model also depends on specific institutional and socioeconomic conditions. Mandatory savings require sufficient household income, and cost discipline requires strong public oversight of prices, subsidies, hospital organization, and insurance design. For this reason, Singapore should not be treated as a model that can be copied mechanically in all countries. Its relevance lies in showing how hybrid financing can work when supported by high administrative capacity, careful regulation, and targeted public protection.

Together, these three cases show that no health financing model is automatically efficient, equitable, or sustainable. The U.S. demonstrates that market-driven healthcare can produce high innovation but also severe cost and access problems. Germany shows that social insurance can combine broad coverage with negotiated cost control, but requires complex governance. Singapore shows that hybrid models can maintain cost discipline, but only when individual financing is balanced by public safeguards. The broader lesson is that health-system performance depends less on ideological labels and more on the concrete design of financing, regulation, incentives, risk pooling, and institutional accountability.

3.5. Major bottlenecks in global health economics

The global comparison of health systems shows that healthcare sustainability is limited not only by financing models, but also by deeper structural bottlenecks. These bottlenecks include the growing burden of non-communicable diseases (NCDs), inefficient use of healthcare resources, weak data and modelling capacity in low-income countries, persistent inequities, emergency preparedness gaps, and climate-related health risks. *Table 15* summarizes these major bottlenecks and their health-economic implications.

Table 15 Major bottlenecks in global health economics (*Author's own synthesis.*)

Bottleneck	Main health-economic implication
Non-communicable diseases	Long-term expenditure pressure, productivity losses, and demand for chronic care
Inefficient healthcare systems	Waste, unnecessary procedures, administrative costs, and weak value for money
Weak modelling capacity in low-income countries	Poor policy targeting due to limited data and context-specific uncertainty
Health inequities and social determinants	Unequal access, preventable mortality, and reduced social welfare
Emergency preparedness gaps	High vulnerability to pandemics, supply-chain shocks, and system overload
Climate-related health risks	Rising disease burden, infrastructure stress, displacement, and productivity losses

Non-communicable diseases represent one of the most important long-term pressures on healthcare systems, accounting for approximately 74% of global deaths (WHO, 2025a). Cardiovascular diseases, diabetes, cancers, and chronic respiratory illnesses require continuous prevention, screening, medication, monitoring, and long-term treatment. This creates sustained



expenditure pressure for governments, insurers, households, and employers. The economic burden is not limited to direct medical costs; it also includes productivity losses, disability, premature mortality, and informal care. The main drivers of this burden include unhealthy diets, which are linked to around 11 million deaths per year, physical inactivity, with approximately 27% of adults insufficiently active, and tobacco use, which causes around 8 million deaths per year (IHME, 2023). These drivers show that NCDs are not only clinical problems, but also behavioural, environmental, and economic challenges. As shown in *Table 16*, the main non-communicable diseases combine large mortality burdens with major economic costs, making them central to health-economic planning.

Table 16. Selected non-communicable diseases and health-economic burden in 2022 (based on WHO (2025a) and IHME (2023))

Disease group	Yearly deaths (millions)	Main health-economic relevance
Cardiovascular diseases	19.8	High mortality, long-term treatment needs, prevention potential, and productivity losses, estimated cost of \$863 billion
Diabetes	11.0	Chronic medication, screening needs, complications, and high household cost burden, estimated cost of \$966 billion
Cancer	9.7	Expensive diagnostics, treatment innovation, long-term care, and equity concerns, estimated cost of \$1.2 trillion
Chronic respiratory diseases	4.0	Long-term management, environmental links, and pressure on primary and hospital care

South Asia illustrates the inequality of NCD management. India has approximately 77 million people with diabetes, but around 50% remain undiagnosed. For poor patients, insulin can cost around four times monthly wages, creating a major access barrier even when treatment exists (IDF Diabetes Atlas, 2023). *Table 17* shows the unequal burden of non-communicable disease management between high-income and low-income regions.

Table 17. Comparison between NCD Management in High and Low Income regions in 2022 (based on WHO (2025a) and IHME (2023))

Region	NCD Mortality Rate (/100,000 people)	Access to treatment
High-income	340–390	85%
Low-income	480–510	35%

A second bottleneck is inefficient healthcare spending. Inefficiency occurs when resources are used without producing proportional health benefits. This can include unnecessary diagnostic tests, avoidable hospital admissions, excessive administrative costs, fragmented care, low-value interventions, weak prevention, or poor coordination between providers. The problem is especially visible in systems where financial incentives reward service volume rather than health outcomes. In such cases, expenditure may increase while population health indicators improve only marginally. Health economics is therefore essential because it offers tools such as cost-effectiveness analysis, cost-utility analysis, and value-based evaluation to identify where resources are being wasted and where they could generate greater health benefits. Inefficiency has also major economic consequences. Waste accounts for approximately 20–40% of health spending, while unnecessary treatments cost around \$1 trillion per year globally. Administrative complexity also absorbs resources that could otherwise be used for care, as shown by the contrast between the United States, where bureaucracy accounts for approximately 31% of healthcare spending, and the United Kingdom, where administrative costs are closer to 5%. The United States illustrates the cost of fragmented care. Its healthcare system costs approximately \$3.6 trillion annually, yet it remains ranked last among high-income countries in efficiency (Commonwealth Fund, 2024). A major reason is that fee-for-service incentives reward service volume, which can encourage overutilization rather than prevention, coordination, or value-based care.

The measurement of disease burden is central to this efficiency challenge. Disability-adjusted life years (DALYs) and quality-adjusted life years are used to compare the impact of diseases and interventions across different conditions. Disability-adjusted life years estimate the burden created by premature mortality and years lived with disability, while quality-adjusted life years combine length and quality of life into a single measure, where 1 represents perfect health and 0 represents death (Folland et al., 2021). These indicators help policymakers compare interventions that affect different diseases and populations. However, they also require reliable data and careful ethical interpretation, because health cannot be reduced only to numerical efficiency. Figure 3 presents selected leading causes of DALYs globally: ischemic heart



disease, Low back pain, and stroke. Ischaemic heart disease primarily affected populations in Europe and South Asia, low back pain affected populations globally, and stroke imposed a particularly high burden in East Asia and Africa (IHME, 2023).

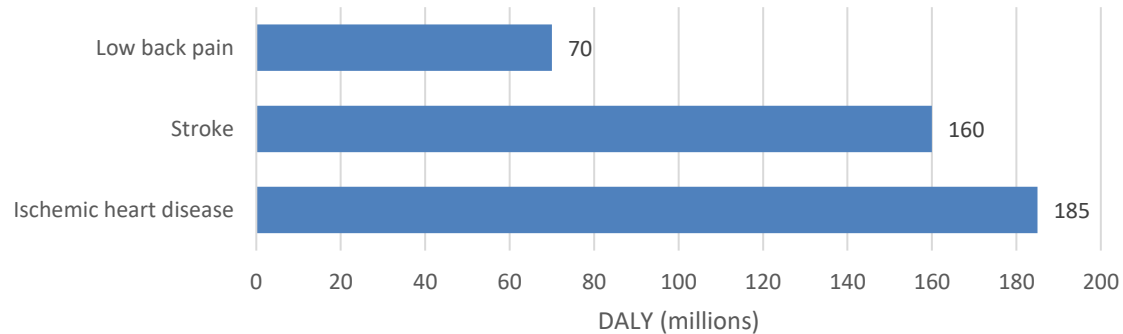


Figure 3. Leading global causes of disability-adjusted life years in 2022 (*based on IHME (2023)*)

A third bottleneck concerns the limitations of economic models in low-income countries. Many health-economic models are developed in high-income, data-rich environments where information on costs, service use, adherence, disease prevalence, and outcomes is more available. In low-income settings, data may be incomplete, informal care may play a larger role, and donor funding may distort national priorities. For example, a model developed under the assumption of stable medication access, high treatment adherence, and complete cost data may produce misleading conclusions in a context where supply chains are fragile, households pay directly for care, and health records are incomplete. This means that health-economic modelling must be localized rather than transferred mechanically from one context to another. The contrast between high-income and low-income modelling conditions can be summarized as presented in *Table 18*. HIV treatment models illustrate this limitation. Western models often assume around 95% treatment adherence, while real-world adherence rates in low-income countries may be closer to 60–70%. Donor dependency can further distort priorities: in Malawi, approximately 80% of HIV funding comes externally, which can lead to underinvestment in other chronic conditions such as hypertension (UNAIDS, 2023). This supports the need for localized modelling, such as Rwanda’s community-health-worker-driven analytics.

Table 18. Economic model use in high-income and low-income countries

Model type	High-income country application	Low-income country feasibility issue
Cost-effectiveness analysis	Approximately 85% accuracy	Often lacks local cost data
Markov simulations	Widely used	Often cannot capture informal care

Source: Author’s own synthesis.

Health inequity is another major bottleneck. Differences in income, education, geography, gender, ethnicity, and social status strongly influence access to care and health outcomes. A health system may appear efficient in aggregate terms while still failing vulnerable groups. From a health-economic perspective, this is a serious problem because preventable illness and premature mortality reduce social welfare, productivity, and human development. Equity is therefore not only a moral objective, but also an economic concern. Social determinants create large differences in life expectancy and health outcomes.

Life expectancy can vary by up to 20 years across income groups; for example, Haiti has a life expectancy of approximately 64 years, while Canada reaches around 82 years. Education also affects outcomes, as women with no schooling experience approximately 60% higher child mortality. The global distribution of surgical care is similarly unequal: the poorest 80% of people receive less than 20% of surgical care (Meara et al., 2015).

Structural inequalities also appear within high-income countries. In the United States, Black mothers are approximately three times more likely to die in childbirth, while in the United Kingdom South Asian populations face around 40% higher diabetes risk. These examples show that health inequity is not limited to low-income countries; it also appears inside wealthy systems through race, ethnicity, income, and access differences (Meara et al., 2015). Policies that improve access to



preventive care, maternal health, chronic disease management, vaccination, and primary care for disadvantaged groups can generate both health and economic benefits.

Emergency preparedness represents a further structural weakness. The COVID-19 pandemic showed that insufficient preparedness can transform health shocks into economic crises. Weak surveillance, limited laboratory capacity, shortages of protective equipment, underfunded public-health institutions, and insufficient rapid-response capacity can increase mortality, disrupt economic activity, and overload hospitals. Preparedness spending may appear costly before a crisis, but health economics shows that underinvestment in prevention and readiness can generate much higher costs during emergencies. This is especially important for infectious diseases, antimicrobial resistance, and future pandemic risks. *Figure 4* summarizes selected global preparedness gaps in disease surveillance and rapid response capacity.

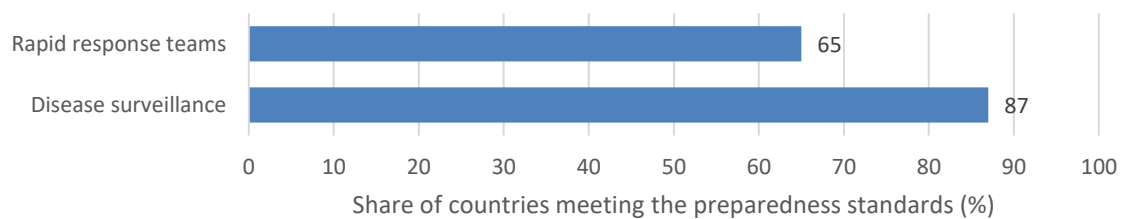


Figure 4. Share of countries meeting selected preparedness standards in 2022 (based on GPMB (2023))

Climate change is increasingly becoming a health-economic bottleneck. It is expected to cause approximately 250,000 additional deaths per year between 2030 and 2050, mainly through malnutrition, malaria, diarrhoea, and heat stress, while generating an estimated economic loss of \$2–4 billion per year (WHO, 2023c). The health impacts are already visible. The 2022 European heatwave caused more than 62,000 deaths, while asthma cases have increased by approximately 15% in high-risk zones affected by worsening air quality. Air pollution linked to wildfires and fossil-fuel combustion generates estimated health damages of around \$8.1 trillion per year. Infectious-disease risks are also shifting: dengue fever cases have increased by approximately 85% since 2000, and warmer climates are expanding malaria risk into new African highland regions. Climate-related food insecurity also creates direct health-system pressure. The Horn of Africa famine in 2022–2023 left approximately 48 million people food-insecure, increasing the risk of malnutrition and related disease. The 2022 Pakistan floods illustrate how climate shocks become health crises: they caused around 1,700 deaths, left 10 million people without clean water, and contributed to cholera outbreaks (WHO, 2023c).

Heatwaves, air pollution, floods, droughts, food insecurity, vector-borne diseases, and displacement all affect population health and healthcare demand. These risks are unequally distributed, with low-income countries, urban poor communities, outdoor workers, elderly populations, and indigenous communities often facing the greatest vulnerability. Climate-related health shocks also damage infrastructure, interrupt service delivery, increase emergency expenditure, and reduce labour productivity. Health economics must therefore include environmental risk and climate resilience in the evaluation of sustainable health systems. The economic impacts of climate-related health risks are summarized in *Table 19*. Climate-health risks are distributed unequally across populations. Mozambique, which is frequently affected by cyclones, spends around five times more on disaster recovery than on prevention. Indigenous communities also face health-system disruption, as Amazon tribes experience malaria surges linked to deforestation and land loss. Urban poor communities face additional heat exposure because slum areas can be 5–10 °C hotter than surrounding suburbs (WHO, 2023c).

Table 19. Economic impact of climate change (based on WHO (2023c), UNDP (2024), and World Bank (2023d))

Impact	Cost/Effect	Example
Disaster healthcare	\$200B/year by 2030	Pakistan floods 2022: \$16B damage
Lost productivity	2% global GDP loss by 2031	Heat reduces labor capacity by 20% in tropics
Health system strain	Hospitals overwhelmed post-disaster	Puerto Rico (Hurricane Maria): 40% clinics closed

Together, these bottlenecks show that sustainable healthcare reform cannot focus only on expanding budgets. Higher expenditure is important, but it is insufficient if health systems remain inefficient, inequitable, poorly prepared, weakly



governed, or vulnerable to climate and disease shocks. The main health-economic challenge is therefore to allocate resources in ways that reduce disease burden, protect vulnerable groups, improve preparedness, strengthen data systems, and produce long-term value for population health.

3.6. Policy and technological reform directions

The bottlenecks identified above show that health-system sustainability requires more than increased expenditure. It also requires better governance, stronger financing mechanisms, improved workforce capacity, fairer pharmaceutical access, responsible technological development, and greater resilience to future crises. Health economics contributes to these reform directions by clarifying how resources can be allocated efficiently, how incentives can be designed, and how public institutions can correct market failures while protecting equity.

A first reform direction is the strengthening of global health governance. Pandemics, antimicrobial resistance, climate-related health risks, and supply-chain disruptions cannot be managed only at national levels. They require international coordination, shared surveillance, common preparedness standards, and mechanisms for equitable access to vaccines, diagnostics, medicines, and emergency supplies. The WHO's work on the Pandemic Agreement (WHO, 2025b) and the revision of the International Health Regulations reflects this need for stronger international rules on outbreak detection, reporting, preparedness, and response (WHO, 2025b). The International Health Regulations already require countries to detect outbreaks early, report public-health emergencies to the WHO within 24 hours, and respond with science-based measures. As of 2023, 194 countries were involved in negotiations on stronger legally binding commitments, although national sovereignty concerns and funding gaps remain major obstacles. From a health-economic perspective, preparedness financing should be interpreted as an investment rather than a cost, because underinvestment before crises can generate much higher health and economic losses during emergencies.

The broader international framework is Sustainable Development Goal 3 (SDG 3), adopted in 2015 as part of the 2030 Agenda for Sustainable Development (United Nations, 2015). SDG 3 includes 13 targets and 28 indicators, including reducing global maternal mortality to below 70 deaths per 100,000 live births, ending preventable newborn deaths by reducing neonatal mortality to 12 or fewer deaths per 1,000 live births, reducing under-five mortality to 25 or fewer deaths per 1,000, and reducing premature deaths from non-communicable diseases by one third through prevention and treatment (United Nations, 2023).

Progress toward SDG 3 remains mixed. Child mortality has fallen by approximately 50% since 2000, HIV treatment access has risen to around 75% of infected individuals, and vaccination coverage has improved despite disruption during COVID-19. However, the SDG agenda faces major obstacles, including an estimated \$5.9 trillion funding shortfall by 2030, climate-related health risks, and fragile health systems in conflict zones such as Yemen and South Sudan (United Nations, 2023; UNAIDS, 2023).

Table 20 presents examples health initiatives led by intergovernmental organizations (IGOs), their achievements, and remaining challenges.

Table 20 Effectiveness of IGO-Led Health Initiatives (based on Gavi (2024), Global Polio Eradication Initiative (n.d.), WHO (2023d), and The Global Fund (2023))

Initiative	Key achievement	Remaining challenges
Gavi, the vaccine Alliance	Vaccinated 1 billion children	Equitable distribution issues
Global Polio Eradication	99% reduction in polio cases	Last-mile delivery in conflict zones
WHO's Tobacco Control	62 countries adopted strict policies	Industry lobbying undermines progress

The Global Fund provides a major example of large-scale intergovernmental health financing. Since 2002, it has disbursed approximately \$55 billion, supported 24.5 million people on antiretroviral therapy, and contributed to a 68% reduction in AIDS-related deaths since the peak (The Global Fund, 2023).

A key mechanism proposed under the Pandemic Agreement (WHO, 2025b) is Pathogen Access and Benefit-Sharing. Under this mechanism, countries would share virus samples or genomic data within 24–72 hours of detection, while manufacturers would allocate approximately 20% of vaccines, tests, or related products to low- and middle-income countries at non-profit prices. This mechanism aims to correct the unequal access patterns seen during COVID-19, although pharmaceutical companies such as Moderna and Pfizer have opposed mandatory technology-transfer requirements (WHO, 2025b). The agreement also includes equity mechanisms such as WHO-coordinated stockpiles of personal protective



equipment, antivirals, and vaccines for low- and middle-income countries, as well as possible temporary patent waivers during emergencies. Accountability mechanisms may include independent monitoring of preparedness metrics such as laboratory capacity and surge staffing, with possible penalties for non-compliance. However, major challenges remain, including sovereignty concerns from powerful states and the unresolved question of who should finance the proposed \$10 billion per year preparedness fund (WHO, 2025b).

A second reform direction concerns equitable health financing. Low- and middle-income countries often face limited fiscal space, high out-of-pocket payments, donor dependency, and competing public priorities. Expanding fiscal space for health can involve domestic resource mobilization, better tax collection, targeted sin taxes, debt relief mechanisms, and international financing instruments. Specific fiscal mechanisms show how domestic revenue can support health policy. The Philippines raised approximately \$1.2 billion per year from sugar taxation, while Mozambique redirected approximately \$200 million from debt repayment to healthcare through debt-for-health swaps (WEMOS, 2024). Performance-based financing initiatives, such as the World Bank's Global Financing Facility (GFF), show how external and domestic resources can be linked to maternal, newborn, child, and adolescent health priorities while strengthening data systems and primary healthcare capacity. The GFF was launched in 2015 by the World Bank in partnership with the United Nations and other multilateral organizations. Its model is based on country-led investment cases that prioritize high-impact interventions such as antenatal care, immunization, supply chains, and workforce development. It combines domestic resources, usually 60–70% of funding, with international aid, usually 30–40%, from sources such as the World Bank, bilateral donors including Canada and Norway, and private-sector actors such as the Gates Foundation. Funds are released after countries achieve agreed targets; for example, Ethiopia received additional GFF funds after increasing contraceptive access by 25%. Across supported regions, the GFF has been associated with a 27% reduction in maternal mortality (GFF, n.d.).

A third reform direction is investment in the health workforce. Shortages of doctors, nurses, midwives, community health workers, and public-health professionals limit access to care and reduce system resilience. Workforce expansion is especially important in low-income and rural settings, where physical infrastructure may exist but remain ineffective because there are too few trained professionals to deliver services. Task-shifting can improve access by training community health workers to provide preventive care, health education, basic treatment, maternal health support, and chronic disease follow-up. This approach is particularly relevant when specialist capacity is limited and when early intervention can prevent expensive hospital care. Rwanda illustrates the potential of task-shifting, as approximately 45,000 community health workers contributed to a 60% reduction in malaria deaths. Brain-drain mitigation also requires active policy design, such as ethical recruitment under the WHO Global Code of Practice and bonded scholarships for medical students, as used in Zimbabwe (Sewankambo, 2016).

A fourth priority is improving pharmaceutical access. Medicines are central to health outcomes, but pricing, patents, procurement inefficiencies, and supply-chain weaknesses can restrict access, especially in low- and middle-income countries. Health economics helps identify the trade-off between rewarding innovation and ensuring affordability. Policy instruments such as pooled procurement, price negotiation, generic competition, reference pricing, and compulsory licensing can reduce costs while maintaining access to essential medicines. For example, Malaysia used compulsory licensing for hepatitis C drugs, reducing treatment costs by approximately 99%. Pooled procurement can also reduce access barriers: the African Union's Africa Medical Supplies Platform saved approximately \$1 billion on drug purchases (Make Medicines Affordable, n.d.).

Technological development represents another major reform pathway. Telemedicine, mobile health, digital surveillance, artificial intelligence, low-cost diagnostics, and climate-resilient infrastructure can improve access, quality, and efficiency, particularly in underserved areas. Digital consultations can reduce geographic barriers; AI-supported diagnostics can help address specialist shortages; mobile health platforms can support maternal care, adherence, and prevention; and digital disease surveillance can improve early outbreak detection. However, technology should not be treated as a universal solution. Its benefits depend on infrastructure, regulation, data quality, affordability, digital literacy, and integration with existing health systems.

Table 21 summarizes the main policy and technological reform directions discussed in this section and links them to their expected health-economic effects.



Table 21. Policy and technological reform directions in health economics (based on *Global Financing Facility (n.d.)*, *Make Medicines Affordable (n.d.)*, *Hwang et al. (2024)*, *UNDP (2024)*, and *WHO (2025a)*.)

Reform direction	Main mechanism	Expected health-economic effect
Global health governance	International rules, surveillance, preparedness agreements, emergency coordination	Lower crisis costs, faster response, stronger collective resilience
Equitable health financing	Domestic resource mobilization, targeted taxes, debt relief, pooled funds, performance-based financing	Reduced out-of-pocket burden, stronger financial protection, expanded service access
Health workforce investment	Training, task-shifting, retention strategies, community health workers	Improved primary care access, lower preventable mortality, reduced hospital pressure
Pharmaceutical access reform	Price negotiation, generic competition, pooled procurement, compulsory licensing	Lower medicine costs, improved treatment access, reduced monopoly pressure
Digital health and AI	Telemedicine, AI diagnostics, mHealth, digital surveillance	Expanded access, faster diagnosis, improved efficiency, better monitoring
Sustainable health technologies	Low-cost devices, solar-powered clinics, resilient infrastructure	Improved service delivery in low-resource settings, lower environmental vulnerability

Artificial intelligence and digital health deserve particular attention because they can reshape healthcare delivery and resource allocation. AI-supported screening, radiology tools, and diagnostic algorithms may reduce the time and cost required to identify certain diseases, especially where specialists are scarce. Telemedicine can connect rural patients with urban providers, while mobile health platforms can support health education, appointment reminders, maternal health follow-up, and chronic disease management. Evidence on AI-supported diagnostics suggests potential efficiency gains, but these tools must be validated and monitored, and made transparent to avoid bias, unsafe recommendations, or unequal access (Hwang et al., 2024; Fu et al., 2025). *Table 22* summarizes selected health technologies and their reported applications and cost-effectiveness.

Digital health already shows large-scale implementation. India's *eSanjeevani* platform handled approximately 100 million consultations between 2020 and 2023, demonstrating the ability of telemedicine to expand access at scale (Sood et al., 2025). AI-powered tuberculosis screening in Kenya improved detection rates by approximately 40%, showing how diagnostic algorithms can support care in specialist-constrained settings (Hwang et al., 2024).

Table 22. Effectiveness of selected international health initiatives (based on *Hwang et al. (2024)*, *Fu et al. (2025)*, *Qure.ai (n.d.)*, *South African National Department of Health (n.d.)*, and *UNDP (2024)*)

Technology	Application	Cost-effectiveness
AI Radiology (Qure.ai)	90% accuracy in detecting lung diseases	\$0.5/scan in India
Blockchain for Supply Chains	Reduced counterfeit drugs by 70% in Ghana	\$2M implementation cost
mHealth (MomConnect)	4 million South African mothers receiving SMS care tips	\$0.1/user/month

Digital surveillance and personalized medicine also show health-economic potential. The WHO's Epidemic Intelligence from Open Sources system detected approximately 85% of outbreaks early, while genomic sequencing for precision oncology reduced cancer treatment costs by around 25% (Fu et al., 2025).

Sustainable health technologies are also increasingly important. Low-cost diagnostic devices, portable imaging tools, solar-powered clinics, and climate-resilient infrastructure can improve service delivery in regions where electricity, transport, and hospital infrastructure are limited. For example, the Butterfly iQ foldable ultrasound costs approximately \$2,000 compared with around \$100,000 for traditional machines, while paper-based malaria diagnostic tests can cost approximately \$0.10 per unit (UNDP, 2024).

Climate-resilient infrastructure can also improve health-system continuity. Nigeria's Solar for Health Initiative electrified approximately 500 clinics, while the UK NHS Net-Zero Plan reduced emissions by approximately 30% since 2020 (UNDP, 2024; NHS England, 2022). These examples show that sustainable health technologies can support both service delivery and environmental objectives. These technologies are relevant not only for environmental sustainability, but also for equity and resilience. A clinic that can maintain electricity during climate-related disruptions, for example, is better able to preserve vaccine storage, emergency care, maternal services, and disease surveillance. This connects health economics with



sustainable development because infrastructure choices influence both current access and future system vulnerability (UNDP, 2024).

Technology integration also requires regulation and public-private governance. The WHO's 2021 AI ethics guidelines emphasize transparency, accountability, and bias mitigation, while the EU AI Act of 2024 imposes strict validation requirements for high-risk medical AI (WHO, 2021; European Parliament and Council of the European Union, 2024). Public-private partnerships can also support implementation, such as Google Health and the Kenyan Ministry of Health's AI diabetic retinopathy screening project for 5 million patients, and Pfizer and BioNTech's mRNA hubs in Africa, which aim to reduce dependence on vaccine imports (Asonitou et al., 2024).

Overall, the reform agenda suggested by health economics is multidimensional. Stronger governance improves preparedness; equitable financing protects households; workforce investment expands real service capacity; pharmaceutical reform improves affordability; and responsible technology can increase access and efficiency. The central challenge is to combine these reforms rather than treat them separately. A sustainable health system requires financing, institutions, human resources, medicines, digital tools, and infrastructure to work together toward the same goal: producing better health outcomes with limited resources while protecting equity and resilience.

3.7. Synthesis: health economics and sustainable system transformation

The findings discussed in the previous sections show that health economics is not simply a technical field concerned with healthcare expenditure. It is a framework for understanding how health systems can transform limited resources into population health, financial protection, institutional resilience, and long-term sustainability. The central issue is not only whether countries spend more or less on healthcare, but whether spending is organized through financing mechanisms, incentives, governance structures, and delivery models that produce equitable and efficient outcomes.

A first synthesis point is that sustainability requires efficiency. Health systems cannot remain sustainable if large shares of expenditure are absorbed by administrative complexity, avoidable hospitalizations, low-value interventions, unnecessary procedures, or poorly coordinated care. Economic evaluation tools such as cost-effectiveness analysis, cost-utility analysis, and opportunity-cost reasoning help identify which interventions generate the greatest health benefit for available resources. This does not mean that policy should focus only on cost reduction. Rather, it means that health systems should redirect resources away from waste and toward interventions with stronger population-health value, including prevention, primary care, workforce development, and early diagnosis (Folland et al., 2021).

A second synthesis point is that sustainability requires equity. A system that improves average outcomes while excluding vulnerable populations cannot be considered socially or economically sustainable. Inequitable access to healthcare increases preventable illness, disability, premature mortality, and household financial hardship. Universal health coverage therefore becomes a key sustainability objective because it connects access to services with protection from catastrophic expenditure. Health economics contributes to this goal by analysing how financing models, insurance design, subsidies, public provision, and risk pooling affect the distribution of both benefits and costs (WHO, 2023a).

A third synthesis point is that sustainability requires correction of market failures. Healthcare markets are affected by uncertainty, information asymmetry, externalities, supplier-induced demand, moral hazard, adverse selection, and monopoly power. These mechanisms explain why unregulated healthcare markets may produce high costs, unequal access, underinvestment in prevention, and inefficient allocation of resources. Public intervention is therefore not external to health economics; it is one of its central concerns. Regulation, public financing, collective bargaining, price negotiation, vaccination programmes, pandemic preparedness, and pharmaceutical access policies are all examples of how institutions can correct market failures and protect social welfare (Arrow, 1963).

A fourth synthesis point is that sustainability requires resilience. The COVID-19 pandemic, antimicrobial resistance, climate-related disasters, workforce shortages, and supply-chain disruptions show that health systems must be prepared for shocks. A system may appear efficient in normal conditions but fail during emergencies if it lacks surveillance capacity, emergency reserves, flexible financing, trained personnel, and coordinated governance. Health economics therefore needs to treat preparedness as a long-term investment. Spending on surveillance, primary care, workforce capacity, and climate-resilient infrastructure may reduce future losses by preventing crises from becoming larger health and economic disasters.

A fifth synthesis point is that technological innovation must be integrated responsibly. Digital health, telemedicine, artificial intelligence, mobile health platforms, low-cost diagnostics, and climate-resilient technologies can improve access and efficiency, especially in underserved regions. However, technology alone does not solve structural problems. Without regulation, validation, data protection, affordability, infrastructure, and workforce integration, digital tools may reproduce



inequalities or create new risks. Health economics can support responsible innovation by asking whether technologies are cost-effective, equitable, scalable, safe, and aligned with public-health priorities.

Table 23 summarizes the main ways in which health economics contributes to sustainable health-system transformation.

Table 23. Contributions of health economics to sustainable health-system transformation (*Author's own synthesis*)

Sustainability objective	Health-economic contribution	Expected system effect
Efficiency	Identifies waste, opportunity costs, and high-value interventions	Better use of limited resources
Equity	Assesses access, financial protection, and distributional effects	Reduced inequality and catastrophic expenditure
Market correction	Analyses information asymmetry, externalities, monopoly power, and insurance failures	Stronger regulation and fairer allocation
Resilience	Evaluates preparedness, workforce capacity, and crisis-response investment	Greater ability to absorb shocks
Responsible innovation	Assesses cost-effectiveness, safety, scalability, and access to technology	Better integration of digital and sustainable health technologies
Long-term sustainability	Connects financing, governance, prevention, and institutional capacity	Health systems able to maintain performance over time

Overall, sustainable health-system transformation requires the integration of these dimensions. Efficiency without equity can reduce costs while excluding vulnerable groups. Equity without efficiency can expand access but create unsustainable fiscal pressure. Technology without governance can increase complexity or inequality. Preparedness without stable financing can remain only a formal objective. Health economics is valuable because it connects these dimensions into a single analytical framework. It helps policymakers evaluate not only how much should be spent, but how resources should be organized, for whom, through which institutions, and with what long-term consequences.

The broader implication is that health economics should be placed at the centre of health-system reform. In the coming decades, countries will face increasing pressure from ageing populations, chronic diseases, antimicrobial resistance, climate change, technological disruption, and fiscal constraints. Responding to these challenges requires more than isolated reforms. It requires integrated policy design that aligns financing, incentives, workforce capacity, pharmaceutical access, digital innovation, and public-health preparedness. Health economics provides the conceptual and practical tools needed to guide this transformation toward systems that are more efficient, equitable, resilient, and sustainable.

4. Conclusion

This article reviewed health economics as a framework for understanding and improving the efficiency, equity, resilience, and sustainability of healthcare systems. The analysis showed that health systems face a growing convergence of pressures, including non-communicable diseases, rising expenditure, unequal access to care, workforce shortages, inefficient resource allocation, pandemic risk, climate-related health threats, and technological disruption. These challenges affect countries differently, but they all require economic reasoning because healthcare resources are limited and policy choices involve trade-offs.

4.1. Summary of main findings

The review first showed that healthcare markets differ from ordinary markets because they are shaped by uncertainty, information asymmetry, externalities, supplier-induced demand, moral hazard, adverse selection, and monopoly power. These mechanisms explain why unregulated healthcare markets may generate high costs, unequal access, underinvestment in prevention, and inefficient allocation of resources. Health economics is therefore essential for identifying where market failures occur and where public intervention, regulation, risk pooling, or collective financing may be justified.

The comparative analysis also showed that health-system performance depends not only on the amount of money spent, but on how resources are financed, pooled, governed, and distributed. High-income countries generally face problems of cost control, ageing, administrative complexity, and chronic disease management. Middle-income countries often face the challenge of expanding universal health coverage while maintaining fiscal sustainability. Low-income countries face more fundamental constraints related to workforce shortages, donor dependency, weak infrastructure, out-of-pocket payments, and limited data capacity.

The article further identified major bottlenecks that limit sustainable healthcare reform: non-communicable diseases, inefficient spending, weak modelling capacity in low-income settings, social inequities, emergency preparedness gaps, and



climate-related health risks. Finally, the review discussed reform directions including stronger global health governance, equitable financing, health workforce investment, pharmaceutical access reform, digital health, artificial intelligence, and sustainable health technologies. Overall, the main finding is that health economics should be understood not only as a tool for controlling costs, but as a policy framework for designing healthcare systems that are more efficient, fair, adaptive, and sustainable.

4.2. Significance and original contribution

The significance of this article lies in its integration of health economics with the broader objective of sustainable health-system transformation. Health economics is often associated with cost control, expenditure analysis, or technical evaluation of interventions. However, the review shows that its relevance is wider: it provides a framework for connecting financing, efficiency, equity, market failure, public intervention, institutional resilience, and technological change. This broader perspective is important because contemporary health systems are not challenged by a single problem, but by the interaction of multiple pressures that affect both population health and economic stability.

The article's original contribution is its synthesis of theoretical concepts, global health-system comparisons, structural bottlenecks, and reform directions within one integrated framework. By linking concepts such as opportunity cost, information asymmetry, externalities, insurance failure, and cost-effectiveness with practical issues such as universal health coverage, workforce shortages, pharmaceutical access, digital health, and climate-related risks, the article shows how health economics can support policy design across different national contexts.

Another contribution is the emphasis on sustainability as a multidimensional objective. A sustainable health system is not only one that spends less, but one that uses resources efficiently, protects vulnerable populations, corrects market failures, prepares for shocks, and adapts to technological and environmental change. This approach helps move the discussion beyond the simple contrast between public and private healthcare models. Instead, it highlights the importance of institutional design, governance capacity, risk pooling, regulation, and long-term investment.

The article therefore contributes to the field by presenting health economics as a practical policy framework for improving healthcare systems under conditions of scarcity and uncertainty. Its main value is to show that efficiency, equity, and resilience should not be treated as separate goals, but as interconnected dimensions of sustainable healthcare reform.

4.3. Limitations of the review

This article has several limitations. First, it is based on a narrative global review and prospective policy analysis rather than on primary data collection, statistical modelling, or econometric testing. As a result, the article does not estimate causal relationships between specific policies and health outcomes. Its purpose is instead to synthesize existing evidence, compare major health-system patterns, and identify relevant policy directions.

Second, the review relies on secondary sources, including international reports, policy documents, and academic literature. Although these sources are useful for global comparison, they may differ in methodology, reporting year, definitions, and measurement approach. Indicators such as health expenditure, universal health coverage, disease burden, workforce capacity, and out-of-pocket payments may therefore not always be perfectly comparable across countries or regions.

Third, the country examples used in the article are illustrative rather than exhaustive. Cases such as the United States, Germany, Singapore, Brazil, Ethiopia, Thailand, Rwanda, India, Mexico, and Pakistan were selected because they help explain broader health-economic mechanisms. They should not be interpreted as a complete classification of all healthcare systems or as statistically representative of their income groups.

Fourth, the global scope of the article limits the level of detail that can be provided for each national context. Healthcare systems are shaped by local institutions, political choices, demographic structures, cultural expectations, epidemiological profiles, and fiscal capacity. For this reason, the policy directions discussed in the article should be adapted to each country before implementation.

Finally, several topics discussed in the article, including artificial intelligence, digital health, pandemic preparedness, pharmaceutical access, and climate-related health risks, are rapidly evolving. Future policy changes, technological developments, or new health crises may alter the relevance or urgency of some findings. Therefore, the article should be understood as a structured synthesis of current health-economic challenges and reform directions, not as a final or exhaustive account of the field.

4.4. Future research and final remarks



Future research should develop more detailed country-specific and region-specific analyses of the health-economic challenges identified in this article. While global reviews are useful for identifying broad patterns, national health systems require locally adapted evidence. Further studies could examine how different financing models affect access, efficiency, and financial protection in specific institutional contexts. Quantitative research could also estimate the impact of universal health coverage reforms, workforce investments, pharmaceutical pricing policies, or digital health interventions on health outcomes and public expenditure.

Another important research direction concerns health economics in low- and middle-income countries. More localized data are needed on costs, service utilization, treatment adherence, informal care, workforce distribution, and household financial burden. Strengthening local data systems would improve the reliability of economic evaluations and reduce the risk of applying models developed in high-income countries to contexts where assumptions may not hold. Future studies should therefore focus on developing context-sensitive methods for evaluating healthcare interventions in data-limited settings.

Digital health and artificial intelligence also require further health-economic evaluation. Future research should assess not only whether these technologies are technically accurate, but also whether they are cost-effective, equitable, scalable, safe, and integrated into real healthcare workflows. Particular attention should be given to bias, data protection, regulatory standards, infrastructure requirements, and the risk that digital technologies could widen inequalities if they are accessible only to better-resourced populations.

Climate-related health risks represent another growing area for future research. Health economics should increasingly examine the costs of heatwaves, floods, air pollution, food insecurity, infectious-disease spread, and climate-related displacement. More research is also needed on the economic value of climate-resilient health infrastructure, preventive public-health measures, and sustainable medical technologies.

In conclusion, health economics offers an essential framework for healthcare reform in a period of scarcity, uncertainty, and global pressure. Its value lies in connecting efficiency with equity, financing with access, innovation with regulation, and present expenditure with future resilience. Sustainable healthcare systems will require not only more resources, but better allocation, stronger institutions, fairer financing, and long-term investment in prevention, preparedness, workforce capacity, and responsible technological development. Health economics can guide this transformation by helping policymakers design systems that produce better health outcomes while remaining financially, socially, and institutionally sustainable.

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