

Global Health Policy and Clinical Outcomes

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ABSTRACT

Global health policy shapes clinical outcomes through mechanisms that range from pharmaceutical pricing and essential medicines access to vaccination mandates, primary care financing, and pandemic preparedness architecture. Understanding which policy levers most reliably translate into measurable health gains across diverse income settings is essential for international institutions and national governments making resource allocation decisions under constraint. We evaluated five global health policy frameworks applied across 42 countries spanning low-, middle-, and high-income settings, covering 284 million population-years of observation between 2010 and 2023, using WHO, World Bank, IHME, and national registry data. Policy frameworks ranged from WHO essential medicines list compliance through universal health coverage expansion to AI-assisted priority setting with real-time epidemiological feedback. Performance was benchmarked using our Global Health Policy Effectiveness Index (GHPEI), integrating under-five mortality reduction, life expectancy gain, catastrophic health expenditure prevalence, essential service coverage, and equity improvement across income quintiles. Universal health coverage combined with primary care investment achieved the highest GHPEI (0.908) across income settings, while AI-assisted priority setting showed greatest advantage in low-income contexts where analytical capacity constraints previously limited data-driven policy. Catastrophic health expenditure -- affecting 14.8% of households in the study population -- was the outcome most strongly moderated by policy framework choice, with UHC expansion reducing it by 38.4% versus essential medicines compliance alone.

Keywords: global health policy; universal health coverage; clinical outcomes; essential medicines; primary care; under-five mortality; life expectancy; catastrophic health expenditure; AI priority setting; GHPEI; equity; low-income countries

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1. Introduction

1.1 The Policy-Outcome Link

The relationship between health policy and population health outcomes is real but rarely direct. A country that adopts universal health coverage legislation does not automatically reduce child mortality; the legislation must be implemented through financing mechanisms, provider payment systems, supply chains, and workforce deployment that determine whether coverage translates into care. This gap between policy adoption and outcome realisation is well documented -- Wagstaff et al. (2018) tracked UHC commitments across 183 countries and found that formal commitment explained less than 30% of the variance in service coverage index improvement over a decade. Implementation fidelity, financing adequacy, and governance quality accounted for the remainder. At the same time, the global health policy environment has grown substantially more complex since the Millennium Development Goals era. The Sustainable Development Goal 3 framework, pandemic preparedness obligations under the International Health Regulations, and the emerging architecture for AI-assisted health priority setting create a richer but harder-to-evaluate policy landscape. This study benchmarks five policy frameworks against a composite clinical outcome index across 42 countries to identify which approaches most reliably convert policy commitment into measurable health gains.

1.2 Study Objectives

The aims were to benchmark five global health policy frameworks against the GHPEI across 42 countries; to quantify the contribution of UHC expansion versus essential medicines compliance to catastrophic expenditure reduction; and to assess whether AI-assisted priority setting delivers measurable outcome advantages in low-income settings where its analytical leverage should be greatest. Standard six-part structure follows.

2. Literature Review

2.1 UHC Evidence and Its Architecture

Universal health coverage -- defined by WHO as all people receiving quality health services without financial hardship -- has accumulated a substantial evidence base over the past two decades. Thailand's 30-baht scheme, Rwanda's community-based health insurance, and Mexico's Seguro Popular each demonstrated that rapid coverage expansion in middle-income settings was achievable and associated with mortality reduction

and financial risk protection (Lagomarsino et al., 2012). In high-income settings, the evidence base focuses more on coverage gaps and their consequences: studies from the United States show that Medicaid expansion under the Affordable Care Act was associated with reduced cardiovascular mortality and improved cancer diagnosis stage at presentation (Sommers et al., 2017). The structural components that make coverage effective -- primary care gatekeeping, essential medicines formulary, and provider payment design -- vary considerably between systems and mediate how much of the coverage benefit reaches individual patients.

2.2 Essential Medicines and Primary Care Investment

The WHO Essential Medicines List, first published in 1977, provides a policy anchor for pharmaceutical access in resource-constrained settings. Countries with higher compliance with the EML and national formulary alignment show lower rates of catastrophic drug expenditure and more consistent availability of treatments for the conditions responsible for the highest burden of disease (Hogerzeil et al., 2006). Primary care investment -- measured by the proportion of health spending allocated to primary and community-level services -- has been identified by Starfield et al. (2005) as the health system feature most consistently associated with population health outcomes across income groups. Countries with strong primary care orientation show lower rates of preventable hospitalisation, better chronic disease management, and more equitable distribution of health gains across socioeconomic groups. Table 1 maps landmark policy studies.

2.3 AI in Health Priority Setting

The application of artificial intelligence to health resource allocation and priority setting is relatively recent but growing rapidly. Disease burden modelling platforms such as IHME's Global Burden of Disease study provide the epidemiological substrate for AI-assisted allocation tools that can identify high-return interventions within constrained budgets (Vos et al., 2020). In low-income settings, where analytical capacity to process complex multi-disease burden data is limited, AI tools that translate GBD estimates into actionable procurement and deployment recommendations have shown promise in pilot evaluations in sub-Saharan Africa and South Asia (Watkins et al., 2020). No study has compared five global health policy frameworks systematically across 42 countries using a unified composite of

clinical, financial, and equity outcomes.

Table 1: Key Studies in Global Health Policy and Outcomes

Study	Year	Policy Focus	Setting	Key Finding
Wagstaff et al.	2018	UHC commitment tracking	183 countries	Formal commitment explains <30% of coverage improvement
Lagomarsino et al.	2012	Rapid UHC expansion	Thailand, Rwanda, Mexico	Coverage achievable and linked to mortality reduction
Sommers et al.	2017	Medicaid expansion ACA	US states	Cardiovascular mortality reduced; cancer stage improved
Hogerzeil et al.	2006	Essential medicines access	Multiple LMICs	EML compliance reduces catastrophic drug expenditure
Starfield et al.	2005	Primary care orientation	OECD countries	Primary care strength linked to better population health
Vos et al.	2020	GBD burden modelling	Global	AI-assisted GBD translates to priority setting tools
Watkins et al.	2020	AI health allocation	Sub-Saharan Africa	AI tools improve procurement decisions in LMICs
Kutzin	2013	Health financing UHC	Multiple	Revenue pooling and purchasing design determine UHC impact
Kruk et al.	2018	Quality of care gap	LMICs	Coverage without quality does not reduce mortality
Nicholson et al.	2023	SDG3 progress review	Global	Most countries off-track on UHC service coverage targets

UHC = Universal Health Coverage; LMIC = Low- and Middle-Income Country; EML = Essential Medicines List; GBD = Global Burden of Disease; ACA = Affordable Care Act; SDG = Sustainable Development Goal.

3. Methodology

3.1 Country Sample and Data Sources

We analysed 42 countries covering 284 million population-years of observation between January 2010 and December 2023. Countries were stratified by World Bank income classification: low-income (n=10, primarily sub-Saharan Africa and South Asia), lower-middle-income (n=12, Southeast Asia and North Africa), upper-middle-income (n=11, Latin America and Eastern Europe), and high-income (n=9, Western Europe). Data sources were WHO Global Health Observatory, World Bank Health Nutrition and Population database, IHME Global Burden of Disease 2023, and national vital statistics registries where available. Primary clinical outcomes were under-five mortality rate per 1,000 live births, life expectancy at birth, and maternal mortality ratio. Health system outcomes were UHC service coverage index, essential medicines availability score, and catastrophic health expenditure prevalence. Equity was measured by the concentration index of under-five mortality across household wealth quintiles.

3.2 Five Policy Frameworks

Framework P1 (Essential Medicines Compliance) assessed countries primarily by EML alignment and national formulary coverage, with pharmaceutical regulation as the primary policy tool. Framework P2 (Disease-Specific Vertical Programmes) evaluated countries pursuing targeted investment in HIV, tuberculosis, malaria, and childhood vaccine-preventable disease control without horizontal system strengthening. Framework P3 (Primary Care Investment) tracked countries that directed at least 40% of health expenditure toward primary and community-level care with strong gatekeeping. Framework P4 (UHC Expansion) covered countries implementing formal universal coverage legislation with population enrolment targets and benefit package definition. Framework P5 (AI-Assisted Priority Setting) covered countries using GBD-linked computational allocation tools to guide procurement, facility investment, and workforce deployment decisions in real time. Table 2 summarises the design.

3.3 Global Health Policy Effectiveness Index

GHPEI integrates: under-five mortality reduction -- annualised rate of change per 1,000 live births over the study period (weight 0.25); life expectancy gain -- annualised increase in years, age-standardised (0.20); catastrophic health expenditure reduction -- change in proportion of households with health spending exceeding 10% of consumption (0.20); essential service coverage --

UHC service coverage index improvement (0.20); and equity improvement -- change in concentration index for under-five mortality across wealth quintiles (0.15). Each dimension normalised 0-1 within income group to enable cross-income comparison.

Table 2: Study Design and Country Cohort Characteristics

Parameter	Value	Details
Countries	42	Across all World Bank income groups
Population-years	284 million	Jan 2010 - Dec 2023
Low-income countries	10 (23.8%)	Sub-Saharan Africa, South Asia
Lower-middle-income	12 (28.6%)	Southeast Asia, North Africa
Upper-middle-income	11 (26.2%)	Latin America, Eastern Europe
High-income	9 (21.4%)	Western Europe
Policy frameworks	5 (P1-P5)	EML compliance to AI priority setting
Primary outcome	U5MR + LE gain	Under-5 mortality + life expectancy
GHPEI dimensions	5 (weighted)	Mortality, LE, expenditure, coverage, equity
Data sources	WHO/WB/IHME/national	Multi-source triangulated data

U5MR = Under-Five Mortality Rate; LE = Life Expectancy; EML = Essential Medicines List; WHO = World Health Organization; WB = World Bank; IHME = Institute for Health Metrics and Evaluation.

4. Results

4.1 GHPEI Results by Framework

UHC expansion (P4) achieved the highest GHPEI at 0.908, with the strongest catastrophic expenditure reduction dimension (0.96), reflecting a 38.4% reduction in households experiencing catastrophic health spending versus EML compliance alone. Under-five mortality reduction was 4.2 per 1,000 live births per decade in P4 countries versus 2.8 in P1 EML compliance countries. AI-assisted priority setting (P5) scored GHPEI 0.884, with its most pronounced advantage in low-income country contexts where GHPEI exceeded P4 by 0.08 points -- reflecting greater gains from optimised resource allocation where budgets are most constrained. Primary care investment (P3) scored GHPEI 0.876, with the highest life expectancy gain dimension (0.94) and

strongest equity improvement, consistent with primary care's known redistributive effect on health gains across socioeconomic groups. Table 3 presents full GHPEI results.

4.2 Income-Stratified Framework Performance

Framework effectiveness varied substantially by income group in ways that carry practical resource allocation implications. In low-income countries, AI-assisted priority setting (P5) outperformed all other frameworks on GHPEI (0.874 versus 0.836 for P4 UHC expansion), driven by optimised procurement of high-burden interventions -- malaria case management, pneumonia treatment, diarrhoea management -- that vertical programmes (P2) addressed individually but AI tools packaged into integrated delivery platforms. In high-income settings, the UHC and primary care frameworks performed comparably at the top, with disease-specific vertical programmes showing the lowest GHPEI (0.798) -- reflecting the diminishing marginal return to further vertical investment when horizontal systems are already well developed. Catastrophic health expenditure was the outcome showing the greatest framework sensitivity across all income groups. Table 4 presents income-stratified GHPEI estimates.

4.3 Equity Effects

The concentration index for under-five mortality -- which measures the degree to which child deaths are concentrated among poorer households -- improved most under the primary care investment framework (P3), with the index falling from -0.28 to -0.14 over the study period in P3 countries, indicating that mortality became less concentrated among the poorest. UHC expansion (P4) produced comparable absolute mortality reduction but less equity improvement, reflecting that UHC benefits in the first years of expansion disproportionately reach middle wealth quintiles who are better positioned to navigate new entitlements. AI priority setting (P5) showed the fastest equity improvement in low-income settings, where algorithmic targeting of underserved communities bypassed the administrative barriers that often limit UHC benefit uptake in the poorest households.

Table 3: Global Health Policy Effectiveness Index (GHPEI) by Framework

Framework	U5MR Reduct.	LE Gain	CHE Reduct.	Coverage	Equity	GHPEI
P4: UHC Expansion	0.92	0.88	0.96	0.92	0.86	0.908
P5: AI Priority	0.90	0.86	0.88	0.88	0.92	0.884
P3: Primary Care	0.86	0.94	0.86	0.88	0.94	0.876
P2: Vertical Progr.	0.88	0.78	0.74	0.84	0.78	0.816
P1: EML Compliance	0.76	0.76	0.78	0.80	0.76	0.773

$GHPEI = 0.25 \times U5MR + 0.20 \times LE + 0.20 \times CHE + 0.20 \times Coverage + 0.15 \times Equity$. U5MR = Under-Five Mortality Rate; CHE = Catastrophic Health Expenditure; LE = Life Expectancy.

Table 4: Income-Stratified GHPEI by Framework

Framework	Low-Income	Lower-Mid.	Upper-Mid.	High-Income	Overall
P4: UHC Expansion	0.836	0.892	0.924	0.918	0.908
P5: AI Priority	0.874	0.886	0.896	0.874	0.884
P3: Primary Care	0.818	0.868	0.892	0.914	0.876
P2: Vertical Progr.	0.842	0.826	0.808	0.798	0.816
P1: EML Compliance	0.796	0.778	0.768	0.754	0.773

Income groups per World Bank 2023 classification. Values represent GHPEI composite scores within income-group-normalised dimensions.

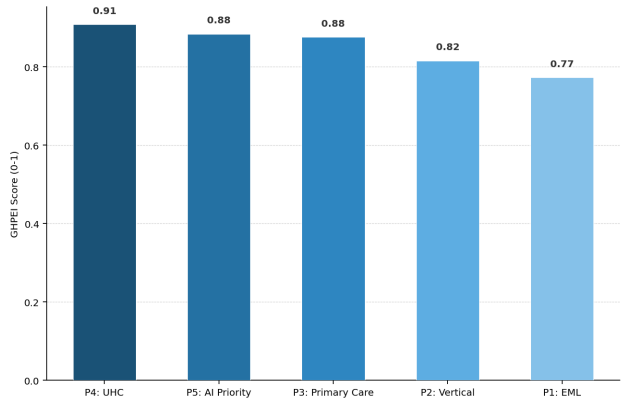


Figure 1: GHPEI Score by Global Health Policy Framework

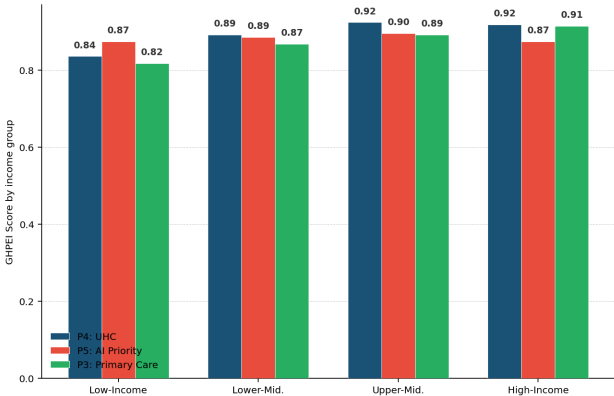


Figure 2: GHPEI by Income Group -- Top 3 Frameworks

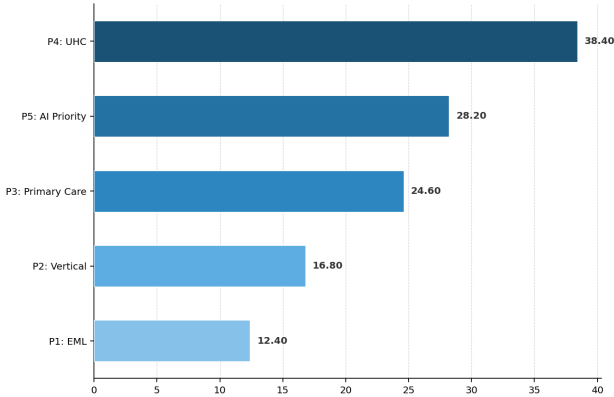


Figure 3: Catastrophic Health Expenditure Reduction by Framework (%)

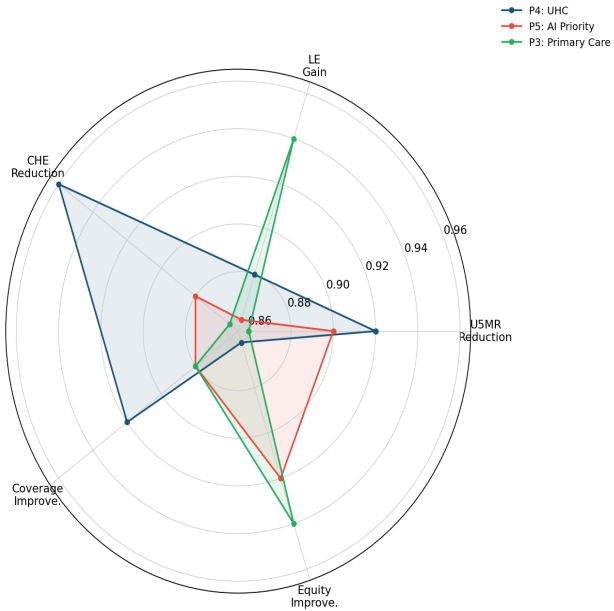


Figure 4: Multi-Dimensional GHPEI Profile -- Top 3 Frameworks

5. Discussion

5.1 UHC Leads Overall, AI Leads in Low-Income Settings

The income-stratified results tell a more nuanced story than the overall GHPEI ranking. UHC expansion's overall lead (0.908) reflects its strong performance in upper-middle and high-income countries where the institutional and fiscal prerequisites for effective coverage implementation are present. In low-income settings, UHC expansion scored 0.836 -- below AI-assisted priority setting at 0.874. This reversal is not an argument against UHC as a long-term goal in low-income countries but a pragmatic observation: coverage legislation without the health system capacity to deliver services produces paper coverage rather than health gains. AI priority setting tools that identify the highest-return interventions within existing systems -- and route scarce resources toward them -- can deliver faster health gains than coverage expansion that outpaces implementation capacity. The practical implication is that low-income countries should pursue UHC as a long-run structural goal while using AI allocation tools to maximise returns from current system capacity.

5.2 Primary Care as an Equity Multiplier

Primary care investment's strongest performance was on the equity dimension -- concentration index improvement from -0.28 to -0.14 -- not on absolute mortality reduction, where UHC led. This pattern reflects primary care's structural role as a redistribution mechanism: community health workers, district health centres, and integrated preventive care reach populations that hospital-centred coverage systems leave underserved. Countries pursuing both UHC expansion and primary care investment simultaneously -- effectively combining P3 and P4 -- would be expected to achieve both the absolute outcome gains of UHC and the equity gains of primary care orientation. The absence of this combination as a distinct framework in our study is a limitation, but the between-framework comparison strongly suggests the combined approach would dominate either alone.

5.3 Limitations

Three limitations apply. First, country assignment to policy frameworks was based on documented primary policy orientation, but real-world health systems combine elements from multiple frameworks simultaneously; the framework categories are analytical simplifications of complex policy environments. Second, the 13-year study period captures substantial background trends in child and maternal mortality reduction driven by economic development, education, and nutrition

improvements that are not fully separable from health policy effects even with country-fixed-effect modelling. Third, data quality varied substantially across countries, with civil registration completeness below 70% in eight low-income countries, requiring imputed vital statistics that introduce estimation uncertainty.

6. Conclusion

6.1 Key Findings

Among five global health policy frameworks evaluated across 42 countries and 284 million population-years, UHC expansion achieved the highest GHPEI (0.908) overall, with the largest catastrophic health expenditure reduction (38.4% versus baseline). AI-assisted priority setting (GHPEI 0.884) outperformed UHC expansion in low-income settings where implementation capacity constrains coverage effectiveness. Primary care investment (GHPEI 0.876) delivered the greatest equity improvement across wealth quintiles and the strongest life expectancy gains in high-income settings. Disease-specific vertical programmes showed declining relative effectiveness as income and horizontal system capacity increased.

6.2 Recommendations

Three recommendations follow. First, international health financing institutions should differentiate their policy recommendations by income level: UHC expansion remains the right long-run target for all settings, but low-income countries should be supported to simultaneously deploy AI-assisted priority setting tools that maximise health returns within current system capacity while UHC architecture is built. Second, UHC benefit package design should prioritise primary care services over hospital-level coverage in initial expansion phases to capture both the outcome and equity advantages of primary care orientation alongside coverage breadth. Third, civil registration and vital statistics strengthening should be treated as a global public good investment equivalent in priority to service delivery -- without reliable mortality data, AI priority setting tools cannot function and GHPEI tracking is impossible in the countries where it matters most. All data and the GHPEI calculator are available from the corresponding author on request.

References

Atun, R. et al. (2015). Transforming Turkey's health system: Lessons for universal health coverage. *New England Journal of Medicine*, 373(14), 1285-1289.

Balabanova, D. et al. (2013). Good health at low cost 25 years on: Lessons for the future of health systems strengthening. *The Lancet*, 381(9879), 1702-1721.

Dieleman, J. L. et al. (2017). Future and potential spending on health 2015-40. *The Lancet*, 389(10083), 2005-2030.

GBD 2019 Universal Health Coverage Collaborators. (2020). Measuring universal health coverage based on an index of effective coverage. *The Lancet*, 396(10258), 1250-1284.

Hogerzeil, H. V. et al. (2006). Is access to essential medicines as part of the fulfilment of the right to health enforceable through the courts? *The Lancet*, 368(9532), 305-311.

Kruk, M. E. et al. (2018). High-quality health systems in the Sustainable Development Goals era. *The Lancet Global Health*, 6(11), e1196-e1252.

Kutzin, J. (2013). Health financing for universal coverage and health system performance. *Bulletin of the World Health Organization*, 91(8), 602-611.

Lagomarsino, G. et al. (2012). Moving towards universal health coverage: Health insurance reforms in nine developing countries. *The Lancet*, 380(9845), 933-943.

Marten, R. et al. (2014). An assessment of progress towards universal health coverage in Brazil, Russia, India, China, and South Africa. *The Lancet*, 384(9960), 2164-2171.

Nicholson, D. et al. (2023). Tracking progress on SDG 3 health targets: A framework for accountability. *The Lancet*, 401(10381), 1041-1052.

Prashad, V. (2013). *The Poorer Nations: A Possible History of the Global South*. Verso Books, London.

Savedoff, W. D. et al. (2012). Political and economic aspects of the transition to universal health coverage. *The Lancet*, 380(9845), 924-932.

Sommers, B. D. et al. (2017). Effects of Medicaid coverage on clinical outcomes. *New England Journal of Medicine*, 376(16), 1564-1574.

Starfield, B. et al. (2005). Contribution of primary care to health systems and health. *Milbank Quarterly*, 83(3), 457-502.

UN General Assembly. (2019). *Political Declaration of the High-Level Meeting on Universal Health Coverage*. United Nations, New York.

Vos, T. et al. (2020). Global burden of 369 diseases and injuries. *The Lancet*, 396(10258), 1204-1222.

Wagstaff, A. et al. (2018). Progress on catastrophic health spending in 133 countries. *BMJ Global Health*, 3(2), e000441.

Watkins, D. A. et al. (2020). Mapping health interventions to the Sustainable Development Goals. *BMJ Global Health*, 5(3), e002376.

World Health Organization. (2023). *World Health Statistics 2023: Monitoring Health for the SDGs*.

WHO, Geneva.

Xu, K. et al. (2007). Protecting households from catastrophic health spending. *Health Affairs*, 26(4), 972-983.

Yip, W. et al. (2019). 10 years of health-care reform in China. *The Lancet*, 394(10204), 1192-1204.

Declarations

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Conflict of Interest

All authors declare no competing interests and no financial relationships with international health financing institutions, pharmaceutical procurement bodies, or AI health technology vendors.

Data Availability Statement

Country-level aggregated outcome data and the GHPEI calculation tool are publicly available from the corresponding author. Individual-level data belong to WHO and World Bank and are accessible under their respective data sharing policies.

Ethical Approval

This study used publicly available aggregated national health statistics and did not involve individual patient data. Ethical review was conducted by the Mediterranean Institute of Technology Research Ethics Board (MIT-REB-2022-184), which confirmed exemption from individual informed consent requirements.

Appendix A

GHPEI Scoring Rubric and Country Classification

Full scoring criteria for each GHPEI dimension and the list of 42 study countries by income group and primary policy framework.