Global Research and Technology Development
Funded by UK Government

RCC Research Commissioning Centre

The health impact of investments in vertical programs and broader health system development

Findings from Malawi

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August 2025

KAMUZU UNIVERSITY OF HEALTH SCIENCES

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About the Research Commissioning Centre

This project is funded by Global Research and Technology Development (GRTD), the research portfolio of the UK government's Foreign, Commonwealth and Development Office (FCDO). Part of the research is managed through the Research Commissioning Center (RCC), which is led by 3ie and the University of Birmingham, with several other consortium members.

About the brief

This brief is authored by Dr Tara Mangal from the Department of Infectious Disease Epidemiology, Imperial College London and the Centre for Health Economics, University of York, Prof Timothy Hallet from the Department of Infectious Disease Epidemiology, Imperial College London, and Sakshi Mohan from Centre for Health Economics, University of York, on behalf of the Thanzi la Onse Epidemiological Modelling Team (https://www.tlomodel.org/contributors.html). This brief is based on "System-Wide Investments Enhance HIV, TB and Malaria Control in Malawi and Deliver Greater Health Impact" research report. RCC conducted an internal anonymous review of the research report by a senior expert in health economic evaluation. The report has since been submitted to a peer-reviewed journal and is currently undergoing the journal's formal peer review process. Any errors or omissions are the sole responsibility of the authors.

Summary

Broad Health System investment

- Investments in broader health system development—such as increasing human resources for health or strengthening supply chains—yield substantial health improvements, particularly for high-burden non-HTM conditions.
- These investments offer a strongly positive return on investment, even under conservative assumptions, and justify major financial commitment.

Scale-up of Vertical Programs

- Expanding disease-specific (vertical) programs can achieve additional health gains, particularly for malaria, although the impact is less pronounced for HIV.
- However, the effectiveness of vertical programs may be limited by weaknesses in the broader health system, such as infrastructure and workforce constraints.

Broad Health System investment in combination with Vertical Programs

- A combined approach, integrating broader health system investments and vertical program scale-ups, delivers synergistic benefits that amplify health outcomes.
- The evidence supports a compelling case for investing in both health system-wide strengthening and targeted disease-specific (vertical) interventions.

Background

Investments in vertical programs for HIV, Tuberculosis (TB), and Malaria (HTM) have driven substantial public health improvements in low- and middle-income countries. However, their effectiveness is often limited by challenges within broader health systems, such as insufficient human resources, unreliable supply chains, and inadequate infrastructure. This study evaluates the independent and combined health impacts of national-level HTM program scale-up and investments in broader health system development in Malawi, using the *Thanzi La Onse* (TLO) model. Developed in partnership with Malawi's Ministry of Health (MOH) and aligned with the Health Sector Strategic Plan III (2023–2030), this model provides detailed insights into how investments can improve health outcomes and return on investment (ROI). Full details on the *Thanzi la Onse* model can be found at www.tlomodel.org and Hallett *et al.*(Hallett, Mangal et al. 2024)

Methods

We investigate the impact of three sets of scenarios for investment:

1. **Standalone Investments in Broader Health System Development:** Expansion of human resources for health (HRH), improvements in consumable availability, and packages combining key components of the healthcare system. (Table 1)
2. **Standalone HTM Program Scale-Up:** Expansion of HIV, TB, and malaria interventions (in scale, scope and coverage), implemented within the existing constraints of the healthcare system.
3. **Combined Investments:** Simultaneous scale-up of HTM programs and broader health system resources, facilitating the integrated delivery of services.[1]

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[1] *The HTM program scale-up adjusts key health system parameters:*
***HIV**: Access to preventive treatment for HIV (for female sex workers and adolescent girls), retention on preventive or antiretroviral treatment, uptake of medical male circumcision, HIV testing during pregnancy, childbirth, or for newborns, annual testing rates for adults, and likelihood of viral suppression on treatment.*
***Tuberculosis**: First-line expanded Xpert testing, treatment success rates for drug-sensitive and drug-resistant infections, and preventive therapy for people living with HIV and child contacts of active cases.*
***Malaria**: Increased uptake of testing, treatment success, expanded coverage of indoor residual spraying in high-risk districts and higher coverage of insecticide-treated bednets across all districts.*

The scenarios were projected in the model for the period 2025–2035. The comparator Baseline scenario assumed that healthcare system performance and program coverage remain unchanged, with no further investment in HTM programs or broader health system development. Health outcomes tracked were the Disability-Adjusted Life-Years (DALYs) averted, deaths averted and life expectancy gains. DALYs measure the total burden of disease, combining years of life lost due to premature death and years lived with disability. Costs were estimated using standardised inputs for service delivery, including human resources, medical consumables, and infrastructure. Without information on the additional costs expected to be incurred to implement the vertical and horizontal scale-up scenarios ('above service level costs (ASC)'), we report the return on investment (ROI) of the alternative investment options over an exhaustive range of ASC over which the ROI remains positive. To calculate the ROI, we monetise the incremental health benefits of the alternatives using a value of a statistical life year (VSLY) of US $834 for Malawi.(Malawi National Planning Commission 2020) The VSLY is an economic measure that assigns a monetary value to one additional year of healthy life, reflecting individuals' willingness to pay for life-extending interventions or reduced health risks. All source code is publicly available for download and use.(Hallett, Phillips et al. 2024, Thanzi la Onse Epidemiological Modelling Team 2024)

Pessimistic HRH Scale-up (1% Annual Growth)	Project an increase in HRH below historical trends, applying a constant 1% annual growth rate over 2025-2030.
Historical HRH Scale-up (4.87% Annual Growth)	Project an increase in HRH based on historical growth trends from 2017–2024, maintaining a 4.87% annual growth (the average increase in HRH reported from 2017 to 2024) over 2025-2030.
Optimistic HRH Scale-up (6% Annual Growth)	Project an accelerated increase in HRH above historical trends, applying a constant 6% annual growth rate over 2025-2030.
Primary Healthcare Workforce Scale-up	Increase the number of healthcare workers employed at primary health care facilities using the Accelerated HRH scale-up targets, 6% growth rate annually from 2025-2030. *Five-years' worth of growth is implemented instantaneously in 2025.*
Increase all consumables to 75th percentile	Align the availability of all consumables to the average availability seen at the 75th percentile of top-performing facilities.
Consumables available at HIV levels	Standardise the availability of all consumables by upgrading to match the higher average availability observed for HIV-related consumables, utilising the greater value from the reported estimate and the HIV estimate
Consumables available at Expanded Progam of Immunization (EPI) levels	Standardise the availability of all consumables by upgrading to match the higher average availability observed for EPI-related consumables, utilising the greater value from the reported estimate and the EPI estimate
Realistic HSS Package	A comprehensive HSS package including: • Primary Healthcare Workforce Scale-up • Accelerated HRH Scale-up (6% Annual Growth) • Increase all consumables to 75th percentile *(Health-seeking behaviour assumed increased in response to improved appointment availability)*

Table 1: Scenarios for Standalone Investments in Broader Health System Development

Key Findings

1. Investments in Broader Health System Development:

- Scaling all cadres of human resources at all facility levels by 6% annually could avert up to 14% of DALYs; a similar level of scale-up focussed on primary healthcare workers only could avert 6.2% of DALYs.

- Improving consumable availability to the levels observed in top-performing programs like EPI could avert 9.6% of DALYs.

- Non-HTM areas, such as respiratory infections and diarrhoeal diseases, saw the greatest health benefits, underscoring the wider impacts of investing in system capacity.

- The HSS Expansion Package averted 18.9% of DALYs and prevented over 200,000 deaths.

- The ROI for the HSS Expansion Package was **4.81** (UI: 4.46–5.60), indicating up to $4.81 in benefits for every $1 spent, assuming no above-service-level costs above the incremental cost of training, recruiting and employing the additional health workers. Even under conservative assumptions (138% additional above service-level costs), the ROI remained positive at **1.44**, as long as Malawi is willing to spend US $834 to prevent one year of poor health or early death (one DALY).

- For supply chain improvements alone, ROI estimates ranged from 89 to 213 (depending on scenario and above service-level cost assumptions), illustrating very high value-for-money at moderate implementation costs.

2. Standalone HTM Program Scale-Up:

- HTM program scale-up alone averted **4.4%** of DALYs, primarily through reductions in HIV, TB, and malaria.

- Without concurrent HSS investment, overall deaths from non-HTM causes slightly increased, due to constrained system capacity.

- Life expectancy improvements were modest, and total ROI was lower (median ROI: **5.34**) and more sensitive to overhead cost (ASC) assumptions.

3. Combined Investments:

- Joint investments in HTM and broader system resources yielded a four-fold greater health impact compared to HTM scale-up alone (Figure 1 inset, 113.3 million DALYs incurred between 2025-2035 compared with 133.8 million DALYs incurred respectively).

- Joint investments prevented approximately 340,000 deaths between 2025–2035, an additional 234,000 compared with HTM scale-up alone.

- Over 60% of the health gains through joint investments arose from non-HTM conditions, confirming the broader impact of HSS

- Life expectancy increased by 0.7 years for males and 3.3 years for females compared to the Baseline.

- Combined investments in HTM programs and broader system development had the highest ROI: 6.67 (uncertainty interval: 5.81–6.85) and remained superior across a wide range of assumed ASC (Figure 1).

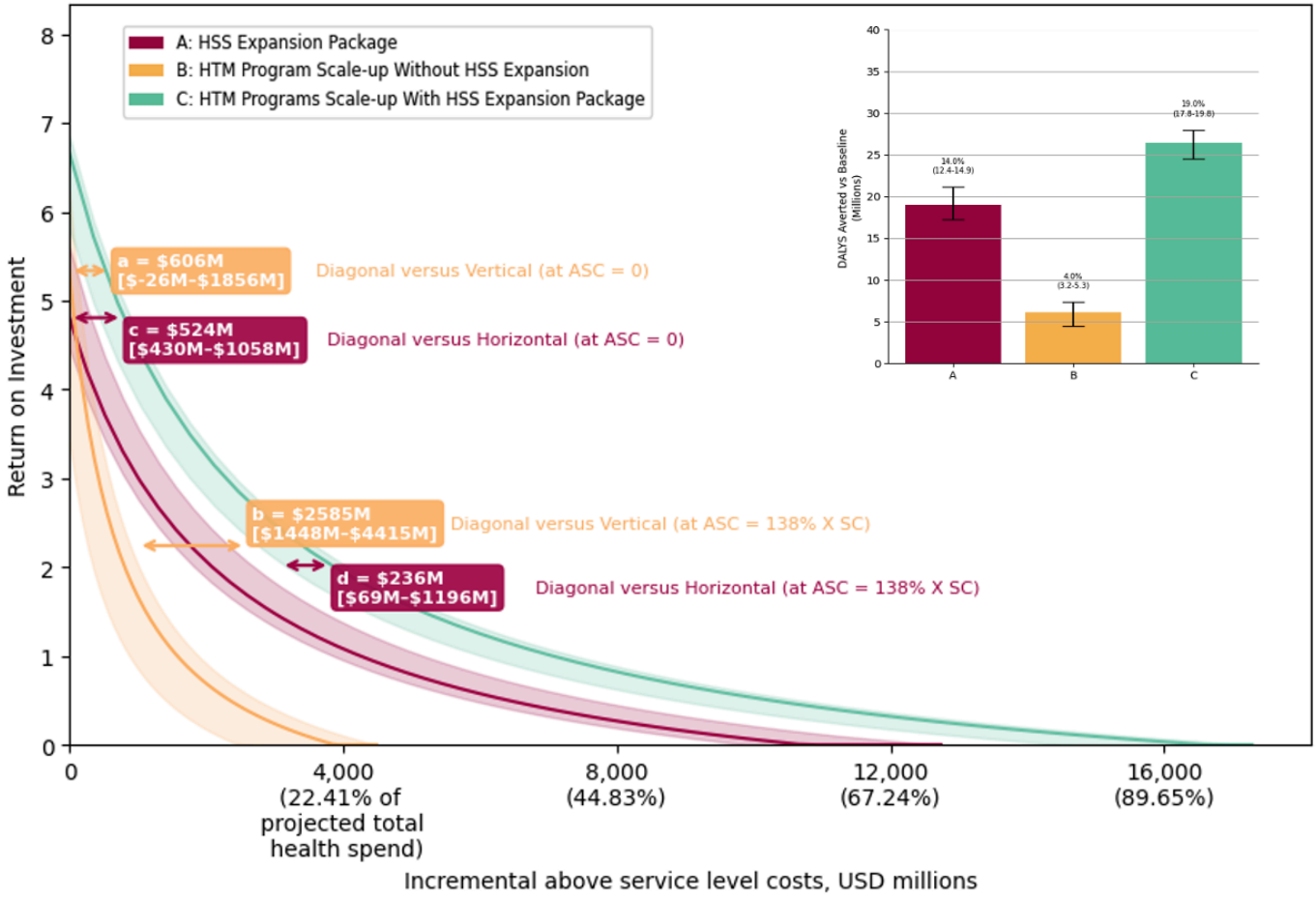

Figure 1. Summary of Key Findings.

Return on investment (ROI) for (A) *HSS Expansion Package*, (B) *HTM Program Scale-up Without HSS Expansion*, and (C) *HTM Program Scale-up With HSS Expansion Package*, across a range of hypothetical incremental above service level costs. Inset: the DALYs averted relative to *Baseline* for the 3 scenarios. Percentage DALYs averted over the 11-year period compared to *Baseline* are annotated above each bar.

Annotations *a* and *b* indicate the maximum additional above service level cost (ASC) the diagonal scenario can incur while still maintaining a higher ROI than the vertical scenario. Annotation *a* assumes no ASC for the vertical scenario; *b* assumes ASC equal to 138% (Opuni *et al*, 2023) of the vertical scenario's service level cost (SC). Similarly, *c* and *d* represent the *breakeven incremental ASC thresholds* for the diagonal versus horizontal scenarios under the same respective assumptions.

Limitations

Fixed Productivity Assumptions
The model assumes that the productivity of healthcare workers (e.g., time per appointment, services delivered per staff) remains constant throughout the projection period. While this reflects current empirical data, it does not account for potential efficiency gains through task-shifting, digitisation, or improved workflow in the future.

Exclusion of Health System Governance and Infrastructure
The scenarios model expansions in staffing and consumables but do not explicitly quantify the health impact of other system components such as improving facility infrastructure, governance, and supervision quality. These may also interact with vertical programme performance.

No Explicit Modelling of Implementation Bottlenecks
We do not model delays or inefficiencies that could arise during real-world implementation, such as recruitment lags, lags in supply chain improvements, or funding interruptions/fluctuations/delays. All scale-ups are assumed to be effective and immediate unless otherwise stated.

Country-Specific Context
The model is calibrated to Malawi and its health system structure. While the findings are likely transferable to similar settings, caution should be used when extrapolating to countries with substantially different health system configurations or disease burdens.

Recommendations

To realise the benefits identified in this analysis, we recommend the following actions across short-, mid-, and long-term timeframes. These are organised by stakeholder group.

A. Policy and Planning Authorities (e.g. Ministry of Health, Ministry of Finance)
Short-term: Include health system strengthening in annual budgets and sector strategies. Use ROI evidence to advocate for increased funding.
Mid-term: Align HSSP III implementation with high-impact packages (e.g. HRH and supply chains). Develop national investment benchmarks.
Long-term: Embed joint HSS and vertical programme planning into budgeting and financing systems.

B. Programme Implementers (e.g. DHOs, donor programmes, implementing partners)
Short-term: Identify local system bottlenecks limiting programme delivery. Adopt a cross-programmatic perspective rather than a narrow focus on the impacts of specific disease / public health programmes.
Mid-term: Pilot HSS in selected districts. Track outcomes and bottlenecks.
Long-term: Scale proven HSS models. Integrate system investment tracking into programme monitoring.

C. Researchers and Modelling Community
Short-term: Refine assumptions on productivity and service uptake. Strengthen links between inputs and outcomes.
Mid-term: Expand models to include infrastructure and governance. Compare scenarios across countries.
Long-term: Support in-country modelling capacity. Evaluate real-world outcomes of investment strategies.

We thank the FCDO through 3iE for funding this work. Core funding for the underlying model is from Wellcome (223120/Z/21/Z).

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