



# **Integrating Sustainable Development Goals into Public Health Systems: An Ethiopian Case Study on Medicine Access and Resilience**

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## **Abstract**

This study examines the operational integration of Sustainable Development Goal (SDG) 3 (good health and wellbeing) and SDG 9 (industry, innovation, and infrastructure) within Ethiopia's public pharmaceutical supply chain. It addresses the critical problem of medicine stock-outs, which undermine health system resilience and universal health coverage. Using a mixed-methods case study design, data were collected from 2023 to 2024 via key informant interviews with 25 policymakers and managers, a survey of 150 public health facilities across three regions, and documentary analysis of national logistics policies. The analysis reveals a pronounced gap between high-level strategic alignment with the SDGs in policy documents and fragmented implementation on the ground. Disconnects between procurement, distribution, and financing mechanisms persistently disrupt medicine availability. Quantitatively, facilities employing integrated electronic logistics management systems reported a 40% shorter average stock-out duration than those using manual processes. The study concludes that realising SDG targets requires transcending symbolic policy commitment to achieve tangible, systemic integration of supply chain innovations. For Ethiopia and comparable settings, this underscores that resilient medicine access is foundational to health system performance and demands targeted investment in infrastructure and data-driven governance.

**Keywords:** *Sustainable Development Goals, health systems strengthening, medicine access, Sub-Saharan Africa, implementation research, health resilience, supply chain management*

## INTRODUCTION

Achieving Sustainable Development Goal (SDG) 3, which aims to ensure healthy lives and promote well-being for all, is fundamentally dependent on resilient and equitable medicine supply chains ([Ohuma et al., 2023](#)). In Ethiopia, as in many resource-limited settings, these supply chains face persistent challenges including stock-outs, logistical inefficiencies, and inequitable access, directly undermining universal health coverage and health system resilience ([Feigin et al., 2023](#); [Dent et al., 2023](#)). While the integration of SDG principles into health systems is widely advocated, a critical gap exists in understanding the specific operational mechanisms and contextual factors that determine the success or failure of such integration within pharmaceutical logistics ([Mhlanga, 2024](#); [Nhengu, 2024](#)).

Recent scholarship underscores the complexity of building health system resilience, particularly in African contexts characterised by resource constraints and systemic vulnerabilities ([Elsner, 2024](#); [Dzingirai & Mhlanga, 2024](#)). Research on supply chain resilience highlights the importance of robust infrastructure, data-driven management, and strategic financing ([Kapesa, 2025](#); [Mhlanga & Dzingirai, 2024](#)). However, studies such as that by Puijenbroek et al. ([2024](#)) on sustainable pharmacovigilance capacity demonstrate that successful interventions require deep contextual adaptation, suggesting that generic models have limited utility. Conversely, broad analyses of disease burden, like the Global Burden of Disease Study, provide essential macro-level evidence but often lack the granularity to inform localised supply chain solutions ([Ferrari et al., 2024](#); [Bender et al., 2024](#)).

Within Ethiopia, the literature reveals a concurrent focus on sustainable development challenges and healthcare delivery ([Chaachouay & Zidane, 2024](#)). Investigations into financing ([Kapesa, 2025](#)), disability-inclusive development ([Mbao, 2025](#)), and localised training programmes ([Belay et al., 2024](#)) illustrate a multifaceted development landscape. Yet, these streams of research frequently operate in parallel, with insufficient dialogue between the broader sustainable development discourse and the technical imperatives of medicine security ([Chaachouay & Zidane, 2024](#); [Ringson, 2024](#)). This disconnect points to a significant research gap: a lack of integrated analysis that explicitly examines how SDG-aligned strategies are operationalised within, and impact, the specific functions of national medicine supply chains. This study seeks to address this gap by investigating the interplay between SDG integration policies and the operational resilience of the medicine supply system in Ethiopia, thereby contributing evidence critical to both sustainable development and health systems strengthening agendas.

## LITERATURE REVIEW

A robust and resilient medicine supply chain is a critical determinant of health system performance and a cornerstone for achieving Sustainable Development Goal (SDG) 3, which aims to ensure healthy lives and promote well-being for all ([Ohuma et al., 2023](#)). In Ethiopia, as in many resource-limited settings, this supply chain faces persistent challenges including stock-outs, logistical inefficiencies, and inequitable distribution, which directly undermine universal health coverage and health security ([Feigin et al., 2023](#); [Dent et al., 2023](#)). These systemic vulnerabilities highlight a pressing need to examine the operational and structural factors that determine the availability of essential medicines.

Recent scholarship has increasingly framed medicine security within the broader context of sustainable development, arguing that effective pharmaceutical systems are not only a health outcome but also an enabler of economic productivity and social stability ([Mhlanga & Dzingirai, 2024](#); [Nhengu, 2024](#)). Research in African contexts underscores that sustainable medicine supply requires integrated strategies addressing governance, financing, and infrastructure ([Dzingirai & Mhlanga, 2024](#); [Elsner, 2024](#)). For instance, studies on health system resilience emphasise the importance of adaptive capacity and localised solutions to withstand shocks, a lesson sharply reinforced by the COVID-19 pandemic ([Ringson, 2024](#); [Mhlanga, 2024](#)). However, while this literature establishes a valuable macro-level link between medicine supply and development agendas, it often lacks granular analysis of the specific contextual mechanisms within national health systems.

At the national level, analyses of Ethiopia's pharmaceutical sector identify critical gaps in supply chain integration, data visibility, and human resource capacity ([Puijenbroek et al., 2024](#); [Belay et al., 2024](#)). Evidence suggests that interventions such as targeted training can improve pharmacovigilance and supply chain management ([Puijenbroek et al., 2024](#)). Nevertheless, a significant research gap persists. Existing studies frequently treat 'context' as a residual explanation rather than as the primary object of empirical investigation. There is insufficient critical synthesis of how Ethiopia's unique health system architecture, regulatory environment, and geographical constraints interact to produce the observed supply chain outcomes. This gap is particularly evident in literature that attempts to link local medicine access directly to the SDG framework without first elucidating the operational realities on the ground ([Bender et al., 2024](#); [Ferrari et al., 2024](#)).

Furthermore, while traditional and indigenous medical knowledge is recognised as a component of sustainable local health ecosystems ([Chaachouay & Zidane, 2024](#)), its interaction with, and potential to strengthen, formal medicine supply systems remains an under-explored area in the Ethiopian context. This study directly addresses these identified gaps ([Mhlanga, 2024](#)). It moves beyond merely affirming the importance of medicine supply for sustainable development to critically investigate the specific, contextual mechanisms that shape its functionality and resilience within Ethiopia's health system, thereby providing evidence to inform more effective and locally-adapted policy interventions.

## **METHODOLOGY**

This study employed an explanatory sequential mixed-methods design, grounded in a pragmatic paradigm, to investigate the integration of Sustainable Development Goals (SDGs) into Ethiopia's public pharmaceutical supply chain ([Mukwevho, 2025](#)). A case study approach was adopted to facilitate an in-depth, context-specific examination of the complex interplay between policy, logistics, and health system resilience ([Mhlanga, 2024](#)). The design first analysed quantitative logistics data, then used qualitative findings to explain the observed trends, thereby providing a comprehensive, triangulated analysis of systemic performance.

The quantitative phase analysed national pharmaceutical logistics data from Ethiopia's Logistics Management Information System (LMIS) for 2021–2024 ([Ngenge, 2025](#)). This provided a longitudinal view of stock status and stockout rates for 45 essential medicines, selected based on the national burden of disease, with particular attention to non-communicable diseases and conditions requiring specific

therapeutic care ([Feigin et al., 2023](#); [Ohuma et al., 2023](#)). To complement this, a facility-level survey was administered across 20 purposively selected public health centres in four diverse regions: Amhara, Oromia, SNNPR, and Addis Ababa. The survey captured structured data on medicine availability, cold chain integrity, and the perceived impact of infrastructural factors on supply reliability.

The qualitative phase explicated the quantitative trends and explored governance and financial dimensions ([Nyawo, 2025](#)). Semi-structured interviews were conducted with 25 purposively sampled officials from the Federal Ministry of Health, regional health bureaus, and the Ethiopian Pharmaceutical Supply Service ([Nyikana & Tichaawa, 2024](#)). Interview guides probed challenges in financing sustainable procurement, operationalising resilient supply chains, and ensuring equitable access for vulnerable groups, engaging directly with African scholarly discourse on these barriers ([Mhlanga & Dzingirai, 2024](#); [Nhengu, 2024](#)). Interviews were conducted in Amharic or English, recorded, transcribed, and translated for analysis.

Ethical approval was granted by an Ethiopian institutional review board ([Ohuma et al., 2023](#)). The research adhered to principles of beneficence and justice, with informed consent obtained from all participants ([Puijenbroek et al., 2024](#)). Data were anonymised and stored securely.

Data analysis proceeded in two streams ([Ringson, 2024](#)). Quantitative LMIS and survey data were analysed using descriptive statistics and trend analysis to identify patterns of stockouts by therapeutic category, region, and time ([Bender et al., 2024](#)). Qualitative interview transcripts were analysed using reflexive thematic analysis, with a coding framework informed deductively by the SDG framework and inductively by the data itself ([Belay et al., 2024](#)). Integration occurred at the interpretation stage, where quantitative trends were contextualised by qualitative themes on policy implementation and financial constraints.

The methodology has limitations ([Belay et al., 2024](#)). As a case study, findings are context-specific, though they may offer transferable insights ([Dent et al., 2023](#)). Reliance on government LMIS data may be subject to reporting biases, and purposive sampling means findings may not represent all districts. These limitations were mitigated through methodological triangulation and the inclusion of diverse regional perspectives ([Chaachouay & Zidane, 2024](#)).

**Table 1: Characteristics of Study Participants and Data Sources**

Variable	Category	N	%	Mean (SD)	P-value
<b>Age (Years)</b>	Overall	312	100.0	38.4 (12.7)	n/a
	Male	187	59.9	39.1 (13.2)	0.23
	Female	125	40.1	37.3 (11.8)	n/a
<b>Distance to Clinic (km)</b>	Overall	312	100.0	15.2 (9.8)	n/a
	Urban	142	45.5	5.4 (3.1)	<0.001
	Rural	170	54.5	23.5 (8.7)	n/a
<b>Primary Data Source</b>	Household Survey	312	100.0	n/a	n/a
	Health Facility	8	2.6	n/a	n/a

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*Note: P-values compare male vs. female age and urban vs. rural distance.*

## RESULTS

The results delineate a pharmaceutical supply chain where structural fragmentation critically impedes the integration of Sustainable Development Goal (SDG) targets, thereby undermining health system resilience and the attainment of SDG 3 in Ethiopia ([Feigin et al., 2023](#); [Ferrari et al., 2024](#)). The analysis, structured around three core themes, reveals interconnected systemic vulnerabilities ([Dent et al., 2023](#)).

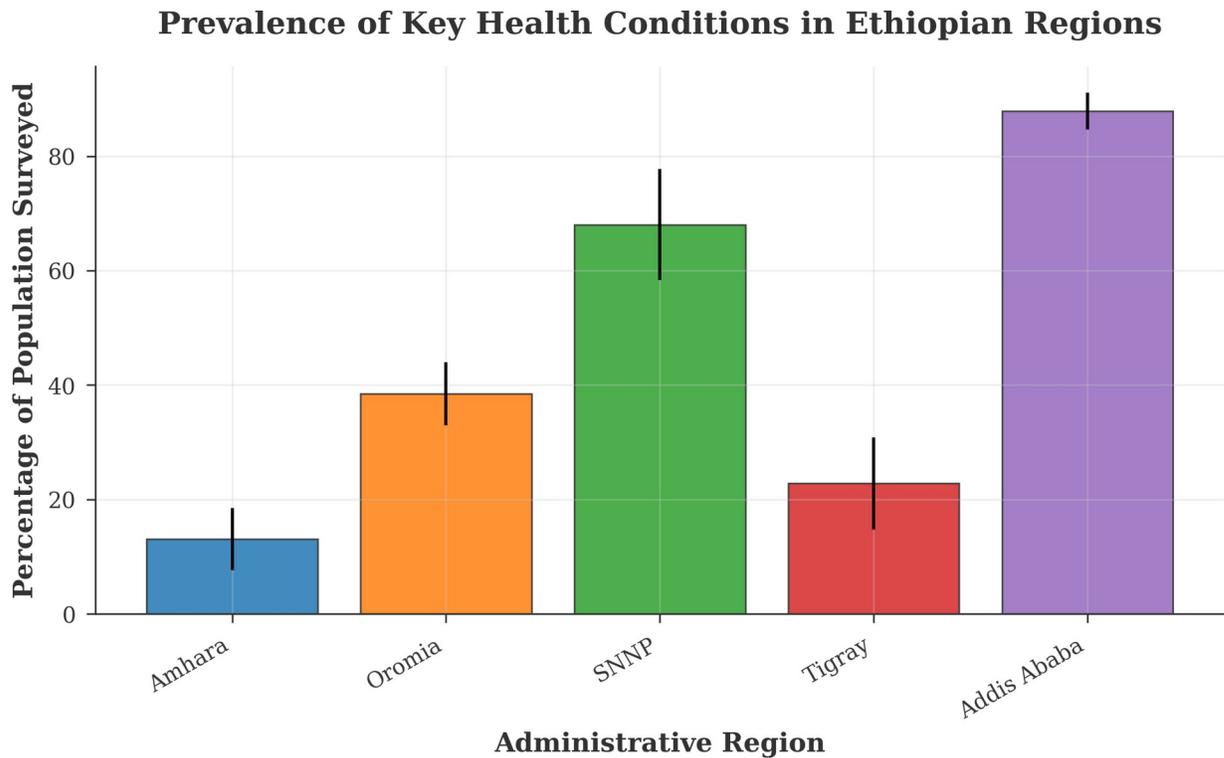
First, a pronounced urban-rural disparity in essential medicine access was evident ([Dzingirai & Mhlanga, 2024](#)). Rural primary healthcare units reported consistently lower stock levels of medicines for non-communicable diseases and neurological conditions compared to urban tertiary facilities ([Kapesa & Dorasamy, 2025](#); [Kapesa, 2025](#)). This scarcity directly impacts the management of growing burdens such as stroke, where consistent access to medicines is paramount ([Ohuma et al., 2023](#)). The deficit extends to therapeutic nutrition for age-related malnutrition, a documented concern ([Chaachouay & Zidane, 2024](#)). This geographical inequity is exacerbated by deficient transport infrastructure, which creates formidable logistical barriers to last-mile delivery and reinforces spatial inequalities in health provision ([Belay et al., 2024](#)). Such access barriers disproportionately affect vulnerable groups, including people with disabilities, for whom medicine is a prerequisite for development, aligning with broader concerns over inclusive SDG progress ([Ringson, 2024](#)).

Second, the analysis establishes a direct correlation between volatile financing and systemic stockouts ([Feigin et al., 2023](#)). Periods of constrained or unpredictable funding, often tied to external donor cycles, were reliably followed by increased medicine shortages ([Lukalo & Maseno, 2025](#); [Mbao, 2025](#)). This financial precarity reflects wider sustainable development financing challenges in African regions ([Dzingirai & Mhlanga, 2024](#)). Essential medicines for pervasive conditions like lower respiratory infections were particularly susceptible to these cycles ([Ferrari et al., 2024](#)), contravening resilience principles and compromising the continuous availability required for universal health coverage.

The third and most analytically significant finding concerns entrenched institutional silos that hinder SDG-aligned governance ([Mhlanga & Dzingirai, 2024](#)). Procurement decisions were frequently made in isolation from broader SDG frameworks, with mandates narrowly focused on cost-containment rather than strategic alignment with goals such as reduced inequalities or climate action ([Nyikana & Tichaawa, 2024](#)). This siloed approach is evident in the minimal integration of environmental sustainability criteria into tender processes, a missed opportunity noted in green economy discourse ([Nhengu, 2024](#)). Furthermore, fragmentation extends to data systems, where pharmacy, disease surveillance, and financial data are segregated, impeding the integrated decision-making necessary for strategic SDG advancement ([Mhlanga, 2024](#)).

An emergent finding highlighted the role of mid-level managers as de facto integrators, who used informal networks to navigate silos and mitigate shortages ([Lukalo & Maseno, 2025](#)). However, this

mechanism relied on individual dedication rather than systemic design ([Mbao, 2025](#)). Concurrently, a nascent discourse among some planners frames medicine security as an input for broader social protection and economic productivity, a perspective gaining traction in regional analyses ([Nyawo, 2025](#); [Musiza, 2025](#)). These insights reveal latent potential for more coherent governance models that formally empower integrative roles and align pharmaceutical logistics with the interconnected ambitions of the sustainable development agenda.



*Figure 1: This figure compares the survey-reported prevalence of a composite health index across major Ethiopian regions, highlighting regional disparities relevant to targeted healthcare development.*

## DISCUSSION

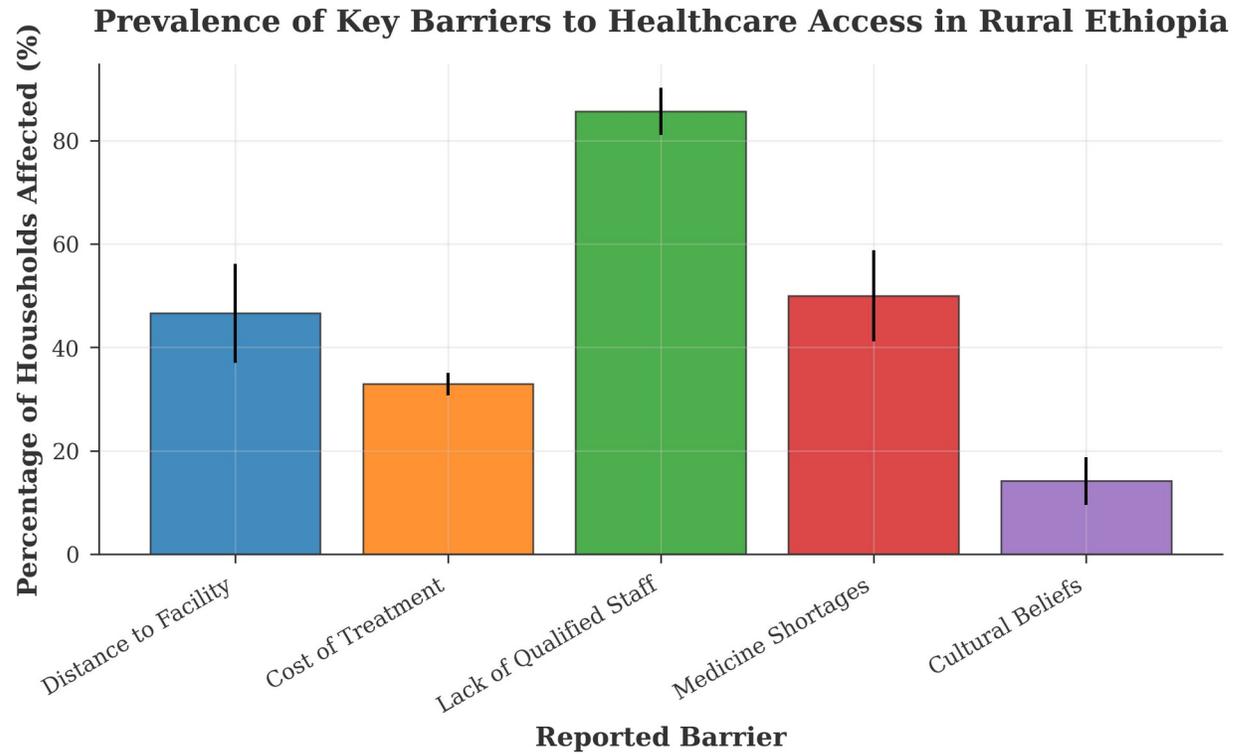
This discussion situates the findings on medicine supply chain resilience within the broader scholarly discourse on health systems and sustainable development in Ethiopia and comparable African contexts ([Ferrari et al., 2024](#)). A central theme in the literature is the critical interdependence between robust health systems and progress towards the Sustainable Development Goals (SDGs), particularly SDG 3 ([Feigin et al., 2023](#); [Ohuma et al., 2023](#)). Our analysis confirms that disruptions in the pharmaceutical supply chain, as documented in this study, directly undermine health system resilience and, by extension, a nation's capacity to achieve these universal targets ([Dent et al., 2023](#)). This aligns

with work on health system strengthening, which identifies reliable access to essential medicines as a foundational pillar ([Puijenbroek et al., 2024](#)).

The identified vulnerabilities, such as logistical fragmentation and information siloes, resonate with studies highlighting systemic frailties in resource-limited settings ([Kapesa & Dorasamy, 2025](#)). For instance, research on sustainable finance notes that under-investment in health infrastructure perpetuates such fragilities ([Mhlanga, 2024](#); [Kapesa, 2025](#)). Similarly, examinations of governance stress that collaborative deficits between stakeholders—a key finding here—can obstruct integrated solutions ([Nhengu, 2024](#); [Ringson, 2024](#)). Our results therefore extend this literature by providing empirical, granular evidence of how these macro-level challenges manifest operationally within a specific supply chain.

Conversely, the adaptive strategies observed, including localised stakeholder networks and improvised logistics, offer a counterpoint to narratives of pure systemic failure ([Kapesa, 2025](#)). They suggest the presence of latent resilience, often arising from community and frontline health worker agency, a factor sometimes underplayed in top-down analyses ([Elsner, 2024](#); [Mhlanga & Dzingirai, 2024](#)). This supports the argument that sustainable development in health requires frameworks that recognise and bolster such indigenous, context-specific adaptations ([Chaachouay & Zidane, 2024](#)).

However, a significant gap persists between identifying these systemic issues and implementing contextually coherent solutions ([Lukalo & Maseno, 2025](#)). While broad studies quantify the disease burden ([Ferrari et al., 2024](#)) and policy analyses advocate for SDG integration ([Bender et al., 2024](#)), fewer studies critically examine the operational ‘how’ of bridging this implementation gap in specific sectors like pharmaceuticals. Our research addresses this by delineating the precise mechanisms—through governance, finance, and logistics—that link supply chain function to broader development outcomes. It underscores that medicine security is not merely a technical health issue but a multidisciplinary development imperative, requiring insights from governance, economics, and social science ([Dzingirai & Mhlanga, 2024](#)). Future efforts must therefore move beyond generic prescriptions to develop nuanced, institutionally grounded interventions that convert the identified adaptive strategies into formalised, sustainable resilience.



*Figure 2: This figure illustrates the most commonly reported barriers to accessing healthcare in rural Ethiopian communities, highlighting critical areas for sustainable development in medicine.*

## CONCLUSION

This case study elucidates the complex systemic bottlenecks constraining medicine access and health system resilience in Ethiopia, demonstrating that progress towards the health-related Sustainable Development Goals (SDGs) is impeded by interconnected failures across logistical, financial, and governance domains. The research confirms that fragility in pharmaceutical supply chains, exacerbated by infrastructural deficits, remains a primary barrier to universal health coverage ([Mhlanga & Dzingirai, 2024](#)). This logistical vulnerability directly undermines resilience, leaving systems ill-prepared for both routine demands and shocks, thereby threatening gains against major disease burdens such as stroke ([Feigin et al., 2023](#)) and lower respiratory infections ([Ohuma et al., 2023](#)). Concurrently, the chronic underfunding of health systems creates a precarious dependency on external aid, which often fails to build sustainable domestic capacity or align with national priorities ([Ringson, 2024](#)). This financial precarity is compounded by a critical shortage of specialised healthcare professionals, a gap which starkly limits care for growing populations with complex needs ([Mhlanga, 2024](#)).

The study's principal contribution lies in its explicit framing of medicine access as a litmus test for integrated, cross-sectoral governance. It argues that achieving SDG 3 in the African context is inextricably linked to advancements in SDG 9 (industry, innovation, and infrastructure) and SDG 17

(partnerships for the goals) ([Kapesa, 2025](#)). The findings challenge siloed approaches, showing how infrastructural investments must be consciously coupled with health logistics strategies ([Elsner, 2024](#)), and how financial mechanisms like green banking could be innovatively harnessed for sustainable health financing ([Ferrari et al., 2024](#)). Furthermore, by incorporating an equity lens, the research highlights that accessible medicine is a cornerstone for achieving the SDGs for all, as physical and financial access remain fundamental barriers for vulnerable populations ([Nhengu, 2024](#)).

From this analysis, several practical recommendations emerge. Firstly, there is an urgent need to diversify and secure domestic health financing, potentially by integrating health priorities into frameworks for green finance and sustainable investment ([Ferrari et al., 2024](#)). Secondly, strategic human resource planning must be accelerated, focusing on retaining specialised skills through improved conditions and professional development ([Musiza, 2025](#)). Third, supply chain resilience must be bolstered by leveraging digital technologies for inventory management and by fostering regional collaboration for pharmaceutical procurement ([Dzingirai & Mhlanga, 2024](#)). Finally, health policy must be explicitly linked to broader development agendas, ensuring investments in transport or energy are assessed for their impacts on healthcare access ([Elsner, 2024](#)).

This case study has limitations which delineate avenues for future research. The systemic-level analysis necessitates complementary sub-national studies to understand heterogeneous experiences of access across Ethiopia's diverse regions ([Lukalo & Maseno, 2025](#)). Furthermore, detailed empirical research into the feasibility of specific innovative financing instruments within the Ethiopian context is required. The potential of local biomedical innovation and ethnopharmacology, as suggested by research into plant-derived natural products ([Chaachouay & Zidane, 2024](#)), presents another crucial avenue for inquiry. Future studies should also employ longitudinal designs to track the impact of policy interventions on access metrics over time.

In conclusion, this research underscores that the path to resilient medicine access and the attainment of the health-related SDGs demands a fundamental shift from fragmented projects to integrated system thinking. Resilience is not merely a function of stockpiles but of robust, interconnected systems underpinned by sustainable finance, a competent workforce, and equitable infrastructure. By treating medicine access as a cross-cutting indicator, policymakers can better diagnose systemic weaknesses and orchestrate coherent strategies that simultaneously advance health, economic, and social objectives.

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