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# Who Suffers Most? Determinants of Catastrophic Health Expenditure in Somalia and Implications for Universal Health Coverage

**Dr Abdulrazaq Yusuf Ahmed**

drjalaal@hotmail.com

RIYAADA Institute for Leadership & Governance Mogadishu

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**Original Research**

# Who Suffers Most? Determinants of Catastrophic Health Expenditure in Somalia and Implications for Universal Health Coverage

Corresponding author : Dr Abdulrazaq Yusuf Ahmed

Affiliationa

RIYAADA Institute for Leadership & Governance

Mogadishu, Somalia

ORCID 0000 0002 6985 1087

drjalaal@hotmail.com drjalaal@riyaadaacademy.com

## Abstract

**Background**: In fragile and conflict affected settings, household health shocks can lead to severe economic consequences. Somalia's healthcare system is predominantly private and financed at the point of service. Out of pocket (OOP) payments constitute approximately 45% of total healthcare expenditure, surpassing the global average of about 18.6%. Pooled prepayment is virtually nonexistent. There is a dearth of granular evidence on the individuals who are financially burdened by paying for healthcare. This study quantifies the incidence, intensity, and structural determinants of catastrophic health expenditure (CHE) and impoverishing health expenditure (IHE) and elucidates the implications for Somalia's emerging universal health coverage (UHC) framework.

**Methods**:

A reproducible synthetic household dataset (n = 1,350) was constructed using a multi stage stratified design encompassing the four Somali Health and Demographic Survey (SHDS 2020) residence domains: urban, rural, nomadic, and internally displaced person (IDP) settlements. The distributions of household size, wealth, chronic illness, and expenditure were algorithmically calibrated to the SHDS 2020, the World Health Organization (WHO) Global Health Expenditure Database, and World Bank household survey proxies. CHE was evaluated using budget share thresholds (≥10% and ≥25% of total consumption) and the WHO capacity to pay threshold (≥40% of non food expenditure). IHE was assessed against

a per capita poverty line. Determinants were estimated using a multivariable logistic regression analysis.

**Results**:

One in four households experienced catastrophic spending (CHE10 = 25.0%; CHE40 CTP = 25.6%). Out of pocket payments increased the poverty headcount from 44.4% to 49.0%, impoverishing an additional 4.6% of households. CHE10 rose from 18.5% among urban households to 32.1% among nomadic and 38.5% among internally displaced persons (IDP) households, and from 11.1% in the wealthiest quintile to 35.6% in the poorest. In adjusted models, chronic illness was the strongest determinant (aOR 4.05, 95% CI 3.02 5.44). Facility delivery, IDP residence, nomadic residence, female headship, and household size increased risk; insurance and wealth were protective.

**Conclusions:**

Out of pocket health financing in Somalia functions as a regressive tax that deepens poverty, particularly among displaced, nomadic, chronically ill, female headed, and impoverished households. Progress toward universal health coverage (UHC) requires pooled prepayment, strategic purchasing, targeted exemptions for chronic and maternal care, and demand side subsidies for highly vulnerable groups.

**Keywords:** catastrophic health expenditure; financial protection; out of pocket payments; universal health coverage; fragile states; Somalia; impoverishment; health financing

**Key findings**

- In Somalia, a significant portion of households, specifically 25.0%, encounter catastrophic health expenditures. Internally Displaced Persons (IDPs) face the most severe burden, accounting for 38.5% of the affected households.
- Out of pocket payments contribute to an increase in the poverty headcount by 4.6 percentage points, rising from 44.4% to 49.0%.
- Chronic illnesses are the primary factor driving catastrophe, with an adjusted odds ratio of approximately 4.1.
- Health financing is characterized by regressive effects, as the poorest quintile is approximately three times more vulnerable than the wealthiest.
- Approximately 60% of households affected by health crises resort to asset liquidation or informal debt to cope with their financial burdens.

## 1. Background

Financial protection is a fundamental pillar of universal health coverage (UHC). A health system cannot be considered equitable if individuals are compelled to rely on debt, asset depletion, or poverty to access services. In situations where formal risk pooling is weak, public financing is fragmented, and service delivery is dominated by private or non state providers, the cost of illness directly impacts households at a time when their financial resilience is often weakest. Consequently, out of pocket (OOP) payments are among the most regressive forms of health financing. These payments are borne by the sick rather than the healthy, fail to adequately adjust to household ability to pay, and are often incurred precisely when illness reduces earning capacity, disrupts employment, and increases non medical costs such as transportation, accommodation, and caregiving.

To address this issue, the World Health Organization (WHO) and the World Bank monitor financial protection through two key indicators: catastrophic health expenditure (CHE) and impoverishing health expenditure (IHE). CHE occurs when direct health payments consume a significant portion of household resources, compelling families to cut back on essential expenses such as food, education, shelter, livelihoods, and other necessities. IHE, on the other hand, occurs when health payments push a household below a poverty line or exacerbate the poverty of households already living below that line. Together, these indicators provide a comprehensive view of both the intensity of health related financial stress and its distributional implications. They hold particular significance in fragile and conflict affected settings, where public subsidies are often uneven, health markets are poorly regulated, livelihoods are insecure, and vulnerable groups are systematically under protected.

1. **Problem and Somali Context:**

In Somalia, the issue of financial protection in the context of health coverage is a pressing concern. The country's fragile and conflict affected environment exacerbates the problem, leading to a lack of access to essential health services and a high burden of disease. The World Health Organization (WHO) and the World Bank monitor financial protection through two key indicators: catastrophic health expenditure (CHE) and impoverishing health expenditure (IHE). CHE occurs when direct health payments consume a significant portion of household resources, compelling families to cut back on essential expenses such as food, education, shelter, livelihoods, and other necessities. IHE, on the other hand, occurs when health payments push a household below a poverty line or exacerbate the poverty of households already living below that line. Together, these indicators provide a comprehensive view of both the intensity of health related financial stress and its distributional implications. They hold particular significance in fragile and conflict affected settings, where public subsidies are often uneven, health markets are poorly regulated, livelihoods are insecure, and vulnerable groups are systematically under protected.

In the Somali context, the issue of financial protection is particularly pressing. The country grapples with numerous challenges, including conflict, insecurity, and restricted access to essential services. These factors contribute to a high burden of disease and a lack of financial protection for vulnerable populations. The Somali population is disproportionately affected by out of pocket payments, as they frequently lack access to formal health insurance and rely on private providers. This situation exacerbates existing poverty and creates a cycle of financial stress for households. Addressing this problem necessitates a comprehensive approach that encompasses strengthening public health systems, enhancing access to affordable healthcare, and providing financial protection mechanisms for vulnerable populations.

Somalia exemplifies these challenges with particular urgency. Decades of conflict, state fragmentation, recurrent humanitarian crises, displacement, climate shocks, and underinvestment in public systems have resulted in a health sector where care is often provided by private, charitable, humanitarian, and other non state providers. While

this diverse delivery structure has helped maintain access in the absence of a fully consolidated public system, it has also led to fragmented financing, variable quality, weak price regulation, and high reliance on point of care payments. According to WHO Global Health Expenditure Database estimates, out of pocket payments account for approximately 45% of current health expenditure in Somalia, while formal health insurance remains limited and concentrated among a small, predominantly urban minority. In a context of widespread poverty, livelihood insecurity, displacement, and high dependence on informal coping mechanisms, even modest healthcare costs can become catastrophic.

The repercussions of this financing structure are not uniformly distributed. Households grappling with chronic illnesses may encounter recurring expenditures for medications, diagnostics, consultations, and follow up care. Women necessitating facility based maternity services may encounter user fees, transportation costs, informal payments, and opportunity costs. Internally displaced person (IDP) households may have limited assets, unstable income, and reduced social protection. Nomadic and pastoralist households may face substantial geographic and indirect costs when seeking care from urban centered facilities. Female headed households may experience overlapping economic and caregiving vulnerabilities. Even impoverished households, despite spending less in absolute terms, may sacrifice a larger share of their disposable resources to obtain essential services. These patterns underscore the necessity for financial protection not only as a health financing concern but also as a matter of equity, poverty reduction, and social justice.

The Federal Government of Somalia has demonstrated a strategic commitment to advancing Universal Health Coverage (UHC) through emerging national reforms. These reforms encompass the establishment of the National Social Health Insurance Authority (NSHIA), the implementation of the Essential Package of Health Services (EPHS), and the World Bank supported Damal Caafimaad program. These initiatives serve as crucial institutional platforms for transitioning from fragmented, point of service financing to pooled prepayment, strategic purchasing, targeted subsidies, and

more equitable access to essential services. However, the effective design of these reforms necessitates evidence on who is most vulnerable to financial hardship, which household characteristics contribute to catastrophic expenditure, and where targeted financial protection mechanisms would yield the greatest equity gains.

Despite the significance of this evidence, Somalia's household level financial protection data remain limited. The Somali Health and Demographic Survey 2020 provided foundational information on population health, service coverage, fertility, maternal and child health, and barriers to care. However, it was not specifically designed to measure the household level financial shock associated with healthcare seeking or to estimate catastrophic health expenditure (CHE) and informal health expenditure (IHE) using standard financial protection methods. Consequently, policymakers are aware that Somalia's healthcare system heavily relies on out of pocket (OOP) payments, but they lack sufficiently disaggregated evidence on the incidence, intensity, and determinants of financial hardship across Somalia's distinct residence categories: urban, rural, nomadic, and internally displaced person (IDP) households.

This study addresses the planning gap by developing a transparent, reproducible, and secondary data calibrated analytic framework to estimate catastrophic and impoverishing health expenditure in Somalia. The study is explicitly framed as a methodological pilot using synthetic household microdata anchored to the best available demographic, health financing, and poverty related secondary data. Its contribution is twofold. First, it provides plausibility calibrated estimates of the distribution of financial hardship across key household groups. Second, it offers a reproducible analytic pipeline that Somali institutions and partners can update as primary household expenditure data become available. The central question guiding the study is deliberately distributional: who suffers most from out of pocket health financing in Somalia, and what does this imply for Universal Health Coverage (UHC) reform?

The measurement of financial protection has evolved through two complementary methodological traditions. The first is the budget share approach, which defines a household as experiencing catastrophic health expenditure when out of pocket (OOP) payments exceed a fixed share of total household consumption or expenditure. Commonly used thresholds include 10% and 25% of total consumption. This approach has several advantages. It is transparent, easy to communicate to policymakers, and widely used in international monitoring. It also allows for comparison across countries and over time. However, because it uses total household consumption as the denominator, it may understate hardship among very poor households whose spending is dominated by subsistence needs.

The second tradition is the capacity to pay approach. This method compares out of pocket health payments to non subsistence resources, typically defined as total household expenditure after deducting food or other basic consumption. The underlying logic is that households with limited income have less discretionary spending after meeting essential needs, so even a small health payment can be a significant financial shock, even if it does not exceed a fixed percentage of total expenditure. The conventional WHO threshold for cost effectiveness is that out of pocket payments should be equal to or exceed 40% of household capacity to pay. This approach is more sensitive to the vulnerability of poorer households, especially in settings where food expenditure consumes a large portion of household resources.

These two approaches are best understood as complementary rather than competing. The budget share approach provides a straightforward and internationally comparable measure of financial burden, while the capacity to pay approach better captures the hardship faced by households with limited discretionary spending. In fragile and low income settings, reporting both measures is particularly useful because the poorest households may spend little in absolute terms but suffer substantial welfare losses when paying for care. A household may appear to spend only a moderate share of total consumption on health, yet still be forced to reduce food intake, sell productive assets, borrow informally, or delay care. Therefore, a comprehensive assessment of financial

protection should report multiple thresholds and interpret them in relation to poverty, household composition, and vulnerability.

Health expenditure that depletes resources offers an additional and policy relevant dimension. While health expenditure (CHE) assesses whether health spending consumes an excessive share of resources, health insurance expenditure (IHE) evaluates whether such spending pushes households below the poverty line. This distinction is crucial because a household can incur catastrophic spending without crossing a poverty threshold, and a household can be impoverished by health spending even if the health payment appears modest. In contexts where poverty is prevalent, IHE may underestimate the full welfare impact because many households are already impoverished before incurring healthcare costs. Nevertheless, it remains a potent indicator for demonstrating the poverty effects of out of pocket (OOP) financing and the broader social protection value of health financing reform.

### 2.2 Determinants and Consequences in Low Income and Fragile Settings

Empirical studies conducted across low and middle income countries consistently identify a set of household level determinants of catastrophic health expenditure. Chronic illnesses and non communicable diseases are repeatedly associated with higher risk because they necessitate continuous medication, monitoring, diagnostic testing, and repeat consultations. Unlike acute episodes, chronic conditions generate recurring expenditure over extended periods. In the absence of pooled financing or subsidized medicine supply, these repeated payments can create cumulative financial toxicity, gradually eroding household assets and diminishing the ability to meet other essential needs.

Socioeconomic status is another significant factor. Poor households are more susceptible not only due to limited resources but also because they lack buffers against shocks. They are less likely to have savings, formal insurance, stable employment, or access to affordable credit. Even when their absolute health expenditure is lower than

that of wealthier households, their relative burden is often higher. Large households may also face increased risk because they have more members exposed to illness and higher total consumption needs. Female headed households may be particularly vulnerable where gendered labor market constraints, caregiving responsibilities, and reduced asset ownership limit their financial resilience.

Geographical location and residence status also play a crucial role. Rural and remote households often encounter indirect costs that are not reflected in facility fee schedules, such as transportation, accommodation, food during travel, and lost income. Nomadic and pastoralist populations may face additional challenges because health services are frequently designed around fixed facilities and settled populations. Internally Displaced Persons (IDP) households face a distinct set of vulnerabilities, including disrupted livelihoods, insecure shelter, limited assets, weak documentation, exclusion from formal employment, and dependence on humanitarian or informal support. These factors can make even low cost services financially inaccessible.

The repercussions of out of pocket (OOP) payments extend beyond the immediate health episode. Households may resort to selling livestock, tools, land, jewelry, or other productive assets to cover medical expenses. They may also borrow from relatives, shopkeepers, moneylenders, or informal networks. In extreme cases, households may withdraw children from school, reduce food consumption, delay rent payments, or postpone other essential spending. Some households even avoid or delay care altogether due to the fear of unaffordable costs, leading to preventable morbidity, complications, disability, or even death. This cycle of OOP payments can transform a short term illness into a long term poverty trap, highlighting the inseparable link between economic and clinical consequences. Financial barriers hinder timely care, while delayed care often exacerbates health severity and increases the eventual cost.

Fragile and conflict affected settings exacerbate these risks. Health systems in such contexts frequently encounter weak public financing, dependence on external assistance, fragmented purchasing processes, shortages of essential medicines, uneven

distribution of healthcare providers, and inadequate regulation of private sector pricing. Households face not only direct medical expenses but also indirect costs associated with insecurity, displacement, restricted road access, and geographical distance. While humanitarian programs may provide partial coverage, they often operate on a project based, geographically restricted, or time bound basis, lacking the stability of a national risk pool. Consequently, households are compelled to heavily rely on informal coping strategies, which may offer temporary relief but rarely provide sustainable protection.

## 2.3 The Somali evidence gap

Somalia's available literature predominantly focuses on system level descriptions of high private provision, substantial donor financing, limited public pooling, and high out of pocket (OOP) expenditure. While the SHDS 2020 and related national data sources provide crucial information on service coverage, maternal and child health, health seeking behavior, and barriers to care, the country lacks a robust, nationally representative body of household level financial protection evidence utilizing standard cost effectiveness (CHE) and impact effectiveness (IHE) methodologies.

This evidence gap has significant implications for policy. Without disaggregated estimates, financial protection reforms risk being designed based on average households that do not accurately represent those most vulnerable to hardship. National averages can obscure the specific vulnerabilities of internally displaced persons (IDPs) settlements, nomadic populations, female headed households, chronically ill households, and the poorest quintiles. Similarly, macro level out of pocket (OOP) shares indicate that Somalia's health financing is structurally dependent on household payments, but they fail to reveal which groups cross catastrophic thresholds, the intensity of the burden, or which determinants remain significant after adjusting for wealth and residence.

Somalia's residence structure exacerbates this gap. Urban, rural, nomadic, and IDP households differ not only in income but also in mobility, access pathways, asset structures, exposure to displacement, reliance on humanitarian assistance, and ability to use fixed health facilities. A financial protection analysis that fails to distinguish these groups may underestimate the hardship experienced by mobile and displaced populations. For instance, nomadic households may incur substantial indirect costs even when direct facility fees are modest, while IDP households may have limited capacity to pay even when absolute payments are small.

This study addresses the gap in Somalia's financial protection measurement by providing a methodological bridge. It does not claim to replace a dedicated national household expenditure survey but rather offers a transparent synthetic microdata framework calibrated to available secondary data. This approach enables the study to estimate plausible distributional patterns, test policy relevant associations, and identify priority groups for future primary data collection. Consequently, it contributes to Somalia's Universal Health Coverage (UHC) policy dialogue by linking financial protection measurement directly to the design of pooled financing, benefit packages, fee exemptions, strategic purchasing, and targeted subsidies.

## 3. Conceptual Framework

This study adapts established financial protection frameworks to the structural realities of Somalia's fragile, displacement affected, and highly informal economy. In a well pooled health system, the financial risk of illness is distributed across the population through taxation, social health insurance, private insurance, or other prepayment mechanisms. Households do not bear the full cost of care at the point of service; instead, resources are pooled in advance and used to purchase services according to need. However, in Somalia, formal pooling remains limited, public financing is fragmented, and households frequently pay directly when seeking care. This creates a direct pathway from illness to financial distress.

**The conceptual framework proceeds through four interconnected stages.**

The initial stage encompasses the structural context. Somalia's health financing environment is characterized by limited pooled prepayment, a high reliance on out of pocket payments, fragmented public and donor financing, a substantial private and non state delivery sector, weak price regulation, and uneven geographic distribution of services. These structural conditions influence the prices households encounter, the services available to them, and the extent to which they are safeguarded from financial risk. They also determine whether care is accessed through public facilities, private clinics, pharmacies, humanitarian providers, traditional healers, or informal channels.

The second stage pertains to household vulnerability. Households enter a health shock with varying levels of resilience. Key vulnerability characteristics include residence status, wealth, household size, sex of household head, chronic illness, maternity needs, displacement status, and insurance coverage. In Somalia, vulnerability is also influenced by livelihood type and asset structure. Urban households may have closer physical access to facilities but still face high private sector costs. Rural households may encounter distance and transportation barriers. Nomadic households may depend on livestock and mobility, rendering facility based care challenging and expensive. IDP households may have limited assets, weak income security, and diminished capacity to absorb even small payments.

The third stage involves the health shock and payment decision. When illness, injury, childbirth, or chronic disease occurs, households confront a set of constrained choices. They may seek care and pay out of pocket; delay care until the condition worsens; substitute formal care with more affordable informal care; mobilize remittances; borrow from relatives or merchants; sell livestock or other assets; or forgo treatment entirely. These decisions are influenced not only by clinical need but also by anticipated cost, distance, perceived quality, social networks, gender dynamics, and the availability of cash at the time of illness.

The fourth stage pertains to the economic consequences. If out of pocket payments constitute a substantial portion of household resources, the household may face catastrophic health expenditure. Conversely, if health payments push the household below the poverty line, it experiences impoverishing health expenditure. Even when households avoid formal catastrophe thresholds, they may still incur welfare losses due to reduced food consumption, school withdrawal, debt accumulation, or the sale of productive assets. For pastoralist households, selling livestock to cover care expenses may jeopardize future income. For internally displaced persons (IDPs), borrowing or curtailing consumption may exacerbate existing deprivation. For households with chronic illnesses, repeated payments may perpetuate a cycle of cumulative impoverishment.

The framework also acknowledges the role of informal buffers. In Somalia, households may depend on diaspora remittances, kinship networks, shop credit, clan based support, community fundraising, or livestock liquidation. These mechanisms can mitigate immediate barriers to care, but they are unevenly distributed and may not provide reliable protection. Remittances may be accessible to some households while being unavailable to others. Kinship support may be strained during widespread shocks. Credit can postpone rather than prevent financial hardship. Asset sales may finance treatment but undermine long term livelihood security. Informal mechanisms, therefore, function as coping strategies rather than genuine risk pooling.

Based on this framework, the study identifies five policy relevant expectations. Firstly, the study anticipates that the cost of health care (CHE) will exhibit a residence gradient, with lower costs among urban households and higher costs among internally displaced persons (IDPs) and nomadic households. Secondly, chronic illness is expected to be a significant driver of catastrophe due to the recurring expenditure for medications, monitoring, and consultations. Thirdly, facility based delivery is anticipated to impose a measurable financial burden in the absence of effective maternal fee exemptions or demand side subsidies. Fourthly, out of pocket (OOP) financing is expected to be regressive, with poorer households bearing a higher

relative burden compared to wealthier households. Lastly, even limited insurance or prepaid coverage is expected to provide a protective effect, although current coverage levels may be insufficient to precisely estimate this effect.

This conceptual framework serves as a guiding principle for the empirical analysis by linking structural financing conditions, household vulnerability, health care seeking behaviors, coping mechanisms, and financial protection outcomes (Fig. 1). It also establishes a direct connection between evidence and policy. If financial hardship is concentrated among identifiable groups, then Somalia's universal health coverage (UHC) reforms should not solely rely on the broad expansion of services. Instead, they should encompass targeted financial protection instruments, such as subsidized enrollment for poor and displaced households, exemptions for chronic and maternal care, mobile and outreach services for nomadic populations, strategic procurement from accredited providers, and explicit limitations on OOP payments for essential services.

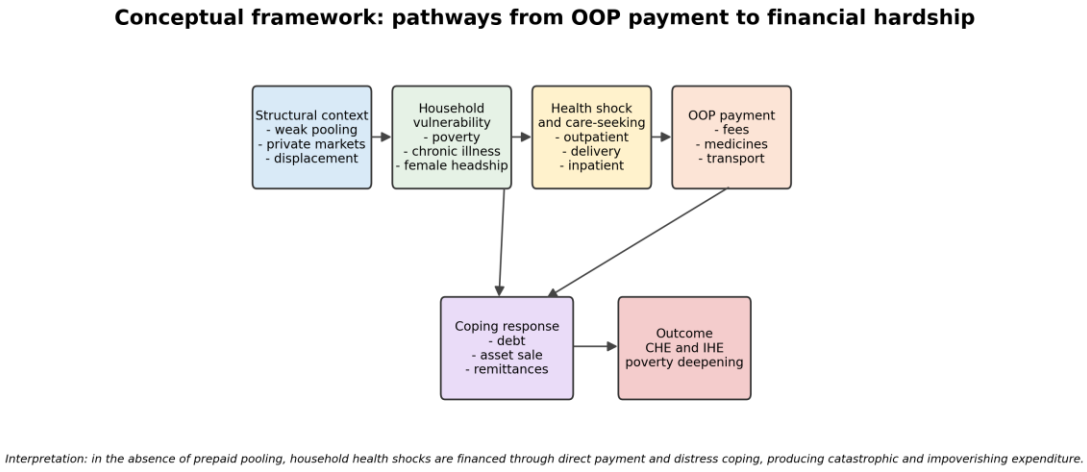



*Figure 1. Conceptual framework linking structural context, household vulnerability, health shocks, out of pocket payment, coping responses, and catastrophic or impoverishing health expenditure.*

## 4. Working hypotheses

On the basis of the conceptual framework, the study advances five policy relevant expectations. First, catastrophic health expenditure (CHE) is expected to follow a residence related gradient, with the lowest incidence among urban households and the

highest incidence among internally displaced person (IDP) and nomadic households. This expectation reflects differences in income security, service proximity, transport costs, asset ownership, and exposure to displacement related vulnerability. Second, the presence of chronic illness in the household is expected to be the strongest household level driver of catastrophic spending because chronic conditions require repeated expenditure on medicines, diagnostics, consultations, monitoring, and follow up care. Third, facility based maternity care is expected to impose a measurable financial burden in the absence of effective fee exemptions, vouchers, or maternal care subsidies. Fourth, out of pocket (OOP) financing is expected to be regressive, with poorer households facing a higher relative burden even when their absolute health expenditure is lower than that of wealthier households. Fifth, even limited forms of insurance, prepayment, or pooled coverage are expected to provide measurable protection by reducing direct payment at the point of service, although low coverage levels may limit the precision of estimated effects.

## 4. Materials and methods

### 4.1 Study design and rationale

This study is designed as a methodological pilot using a reproducible, secondary data calibrated simulation. In the absence of a dedicated national household health financing survey for Somalia, a synthetic household microdataset was generated to approximate the joint distribution of demographic, socioeconomic, health need, and expenditure variables relevant to financial protection analysis. The simulation was calibrated to the best available Somali and international secondary data sources and analysed using standard WHO/World Bank approaches for measuring catastrophic and impoverishing health expenditure.

The rationale for this design is both empirical and methodological. Empirically, Somalia requires timely, disaggregated evidence to guide the design of emerging universal health coverage (UHC) reforms, including social health insurance, strategic

purchasing, targeted exemptions, and demand side subsidies. However, the absence of observed national household expenditure microdata limits the ability to estimate who is most exposed to financial hardship from seeking care. Methodologically, a transparent synthetic dataset allows the study to generate plausibility calibrated estimates while explicitly avoiding unsupported claims of primary data collection. The purpose is not to replace a nationally representative survey, but to provide an interim analytic instrument that can be updated, recalibrated, or re estimated once observed household level data become available.

The objectives of the methodological pilot are therefore twofold. First, it estimates the incidence, intensity, and distribution of CHE and impoverishing health expenditure (IHE) across key Somali household groups. Second, it demonstrates a reproducible analytic pipeline that Somali institutions, researchers, and partners can apply to future primary household surveys or administrative datasets. All estimates should be interpreted as model based projections derived from calibrated synthetic microdata, not as direct observations from fielded household interviews.

### 4.2 Sampling architecture emulated by the simulation

The simulation emulates a multi stage stratified cluster sampling design similar to the architecture used in national household surveys such as the Somali Health and Demographic Survey 2020. The sampling frame is stratified by Somalia's four major residence domains: urban households, rural agro pastoralist households, nomadic pastoralist households, and households living in IDP settlements. This four domain structure is essential because residence in Somalia captures more than geography; it also reflects differences in livelihood systems, mobility, access to fixed health facilities, exposure to displacement, asset structures, and capacity to absorb financial shocks.

Within each stratum, primary sampling units are conceptually selected with probability proportional to size. Households are then systematically sampled within

selected clusters. The household head or the principal household financial decision maker is treated as the unit of observation because the study focuses on household level health payments, consumption, coping capacity, and financial hardship. The final analytic sample consists of 1,350 synthetic households distributed across the four residence domains.

Recall periods were selected to mirror common practice in household health expenditure measurement. A 30 day recall window is used for routine outpatient expenditure, including consultations, medicines, diagnostics, transport, and minor procedures. A 12 month recall window is used for less frequent but higher cost events, including hospitalisation, facility based delivery, surgical care, and chronic condition expenditure. This distinction is important because short recall windows reduce memory error for routine spending, while longer recall windows are necessary to capture rare but financially significant health events.

### 4.3 Secondary data anchors and calibration

The synthetic dataset was calibrated using three categories of secondary data anchors. First, the Somali Health and Demographic Survey 2020 informed the demographic and residence related structure of the dataset, including residence shares, household size, sex of household head, and selected household vulnerability indicators. These variables are important because household composition and residence domain strongly influence both health care access and capacity to pay.

Second, health financing anchors were drawn from the WHO Global Health Expenditure Database and World Bank Somalia relevant estimates. These sources informed the calibration of the overall reliance on OOP payments, the limited level of prepaid or insurance based coverage, and the expected magnitude of catastrophic expenditure in a highly OOP dependent health system. The calibration was designed to ensure that the simulated expenditure patterns were consistent with known macro level features of Somalia’s health financing environment.

Third, household budget and poverty related proxies were used to shape total consumption, food expenditure, non food expenditure, and capacity to pay. Because direct national household health expenditure microdata are limited, these proxies were used to generate plausible distributions of household resources across wealth groups and residence domains. Wealth quintiles were constructed using a latent asset index approach, preserving the expected correlation between residence and poverty. For example, IDP households were more likely to be concentrated in the poorest quintiles, while insured households were constrained to a small and predominantly urban minority, consistent with the limited reach of formal coverage in Somalia.

Calibration was conducted to preserve internal consistency across variables. Residence domain influenced household size, poverty status, chronic illness probability, insurance coverage, and health service access. Health need influenced OOP expenditure through chronic illness and facility based maternity care. Household resources influenced both capacity to pay and the likelihood that health spending would cross catastrophic or impoverishing thresholds. This approach allowed the synthetic dataset to reproduce plausible relationships among vulnerability, expenditure, and financial hardship.

### 4.4 Measurement of catastrophic and impoverishing health expenditure

The study applies standard financial protection indicators to the synthetic household dataset. For household (i), let ($Y_i$) denote total monthly household consumption expenditure, ($F_i$) denote food expenditure, and ($OOP_i$) denote out of pocket health payments net of any reimbursement. OOP payments include direct payments for consultations, medicines, diagnostics, inpatient care, delivery care, supplies, transport related to care seeking, and other health related payments borne by the household.

Budget share catastrophic health expenditure is defined as the ratio of OOP payments to total household consumption. A household is classified as experiencing CHE when:

548
549 [
550 \frac{OOP_i}{Y_i} \geq \alpha
551 ]
552
553 where (\alpha) is evaluated at two commonly used thresholds: 10% and 25% of total
554 household consumption. The 10% threshold captures a broader measure of financial
555 stress, while the 25% threshold identifies more severe expenditure burden.
556
557 The capacity to pay measure defines household capacity to pay as total consumption
558 net of food expenditure:
559
560 [
561 CTP_i = Y_i F_i
562 ]
563
564 A household is classified as experiencing CHE under the WHO capacity to pay
565 approach when:
566
567 [
568 \frac{OOP_i}{CTP_i} \geq 0.40
569 ]
570
571 This measure is particularly important in low income settings because food
572 expenditure represents a large share of household consumption and is largely non
573 discretionary. The capacity to pay approach therefore captures hardship among poor
574 households whose total expenditure may be low but whose discretionary resources are
575 extremely limited.
576
577 Impoverishing health expenditure is assessed by comparing household welfare before
578 and after OOP payments. A household is classified as impoverished by health

spending if it is above the relevant poverty line before paying for care but falls below that poverty line after OOP payments are deducted. Formally, with (PL_i) denoting the household specific poverty line adjusted for household size, IHE occurs when:

[
Y_i \geq PL_i \quad \text{and} \quad Y_i  OOP_i < PL_i
]

The study reports the poverty headcount before OOP payments, the poverty headcount after OOP payments, and the additional percentage of households pushed into poverty by health expenditure.

### 4.5 Econometric specification

The determinants of catastrophic health expenditure were estimated using a multivariable binary logistic regression model. The primary dependent variable is CHE at the 10% budget share threshold, selected because it is widely used in international financial protection monitoring and provides a policy relevant measure of household exposure to excessive OOP spending.

The model is specified as:

[
logit[P(CHE_i = 1)] = \beta_0 + \beta_1 Residence_i + \beta_2 Wealth_i + \beta_3 Chronic_i + \beta_4 FacilityDelivery_i + \beta_5 Insured_i + \beta_6 FemaleHead_i + \beta_7 HHSize_i + \varepsilon_i
]

where (Residence_i) represents residence domain, (Wealth_i) represents household wealth quintile, (Chronic_i) indicates the presence of at least one household member with a chronic illness, (FacilityDelivery_i) indicates whether the household

experienced a facility based birth in the previous year, (Insured_i) indicates any form of health insurance or prepaid coverage, (FemaleHead_i) indicates female household headship, and (HHSize_i) represents household size.

Urban residence, the poorest wealth quintile, absence of chronic illness, no facility based delivery, no insurance, and male headed household status are used as reference categories. Adjusted odds ratios (aORs), 95% confidence intervals, and p values are reported. The model is intended to identify associations between household characteristics and catastrophic expenditure within the synthetic dataset. Because the analysis is based on simulated cross sectional data, coefficients should be interpreted as adjusted associations rather than causal effects.

### 4.6 Reproducibility and ethics

The full data generating process is deterministic given the random seed 20260626. Household generation, variable construction, financial protection indicator calculation, and regression estimation were implemented using reproducible Python scripts. The use of a fixed seed ensures that the same synthetic microdataset and analytic results can be regenerated exactly. This reproducibility is central to the purpose of the study: the analytic pipeline is designed to be transparent, auditable, and adaptable to future observed household data.

Because the analysis uses fully synthetic, algorithmically generated records and does not include identifiable human subject data, formal ethics committee review was not required for this methodological pilot. No individual, household, or community level primary data were collected. Nevertheless, any future implementation using observed household data would require approval from a recognised Somali institutional review board, informed consent from participants, data protection safeguards, and careful attention to the ethical inclusion of displaced, nomadic, and other vulnerable populations.

# 5. Results

## 5.1 Sample profile

The calibrated analytic sample comprised 1,350 households distributed across Somalia's four residence domains: urban, rural agro  pastoralist, nomadic pastoralist, and internally displaced person (IDP) settlements. Urban households constituted the largest share of the sample, representing 595 households (44.1%). Rural agro  pastoralist households accounted for 338 households (25.0%), while nomadic pastoralist households and IDP households represented 212 (15.7%) and 205 (15.2%) households, respectively. Together, nomadic and IDP households accounted for 30.9% of the analytic sample, ensuring that the model captured two population groups that are particularly relevant to equity  oriented health financing in Somalia.

The sample reflected the demographic structure and vulnerability profile expected in a fragile and displacement  affected setting. Household size was high, with 70.7% of households containing five to eight members and a further 13.1% containing more than eight members. Female  headed households accounted for 38.7% of the sample, indicating a sizeable subgroup potentially exposed to overlapping socioeconomic and caregiving vulnerabilities. Chronic illness was present in 293 households (21.7%), while 265 households (19.6%) reported a facility  based delivery in the previous year. Any form of health insurance or prepaid coverage was extremely limited, reaching only 44 households (3.3%). This very low level of coverage provides an important contextual basis for interpreting the financial protection results: most households in the model were exposed to direct payment at the point of care (Table 1).

**Table 1. Socio  demographic profile of the analytic sample (N = 1,350).**

| Characteristic | Category | n (%) |
|---|---|---|
| Residence domain | Urban | 595 (44.1) |

| Characteristic | Category | n (%) |
|---|---|---|
| | Rural (agro  pastoralist) | 338 (25.0) |
| | Nomadic (pastoralist) | 212 (15.7) |
| | IDP settlement | 205 (15.2) |
| Wealth quintile | Q1 (poorest) | 270 (20.0) |
| | Q2 | 270 (20.0) |
| | Q3 | 270 (20.0) |
| | Q4 | 270 (20.0) |
| | Q5 (richest) | 270 (20.0) |
| Household size | 1  4 members | 219 (16.2) |
| | 5  8 members | 954 (70.7) |
| | >8 members | 177 (13.1) |
| Chronic illness in household | Present | 293 (21.7) |
| Female  headed household | Yes | 522 (38.7) |
| Facility delivery in previous year | Yes | 265 (19.6) |
| Health insurance or prepaid coverage | Any coverage | 44 (3.3) |

Marked differences in vulnerability were observed across residence strata (Table 2). IDP households were the most socioeconomically vulnerable group: 62.0% were in the poorest wealth quintile, 55.1% were female  headed, and 29.8% had at least one household member with a chronic illness. Nomadic households were also highly vulnerable, with larger average household size (7.0 members), high concentration in the poorest quintile (34.0%), and almost no insurance coverage (0.5%). Rural households had similarly large household size and no modelled insurance coverage. Urban households had comparatively lower poverty

concentration, but they remained exposed to direct payment through Somalia's largely private and non state service delivery environment. These stratum specific differences suggest that residence status captures not only geography, but also livelihood structure, asset security, displacement exposure, and ability to absorb health related financial shocks.

**Table 2. Vulnerability indicators by residence stratum. Figures are within stratum percentages unless otherwise indicated.**

| Residence stratum | Female headed (%) | Mean household size | In Q1 poorest quintile (%) | Chronic illness (%) | Insured (%) |
|---|---|---|---|---|---|
| Urban | 39.7 | 6.1 | 2.4 | 23.4 | 7.2 |
| Rural | 32.8 | 7.0 | 16.9 | 15.1 | 0.0 |
| Nomadic | 29.7 | 7.0 | 34.0 | 19.8 | 0.5 |
| IDP settlement | 55.1 | 5.7 | 62.0 | 29.8 | 0.0 |

## 5.2 Incidence and intensity of catastrophic and impoverishing health expenditure

The results indicate a substantial burden of financial hardship associated with out of pocket health payments. At national level, one in four households experienced catastrophic health expenditure at the 10% budget share threshold (CHE10 = 25.0%). Using the more stringent 25% budget share threshold, 7.8% of households experienced severe catastrophic expenditure. Under the WHO capacity to pay definition, which measures health spending against non food expenditure, 25.6% of households crossed the 40% threshold (Table 3). The similarity between CHE10 and CHE40 CTP at national level suggests that health payments were not only large relative to total consumption, but also highly burdensome relative to discretionary household resources.

The mean out of pocket burden was 8.5% of total household consumption. However, this average conceals substantial variation across residence, wealth, clinical need, and insurance status. The burden was consistently higher among IDP, nomadic, poorer, chronically ill, and uninsured households. Out of pocket payments were also impoverishing. The poverty headcount increased from 44.4% before health spending to 49.0% after health spending, meaning that health care payments pushed an additional 4.6% of households below the poverty line. This finding demonstrates that OOP expenditure functions not only as a barrier to service access, but also as a driver of household impoverishment.

A clear residence gradient was observed (Fig. 2). CHE10 increased from 18.5% among urban households to 23.7% among rural households, 32.1% among nomadic households, and 38.5% among IDP households. The capacity to pay measure showed an even sharper gradient, rising from 16.3% among urban households to 45.9% among IDP households. This pattern indicates that IDP households were particularly vulnerable because they had very limited non food resources after meeting subsistence needs. Nomadic households also faced elevated risk, consistent with the combined burden of direct medical costs, transport costs, mobility constraints, and reduced access to nearby fixed facilities.

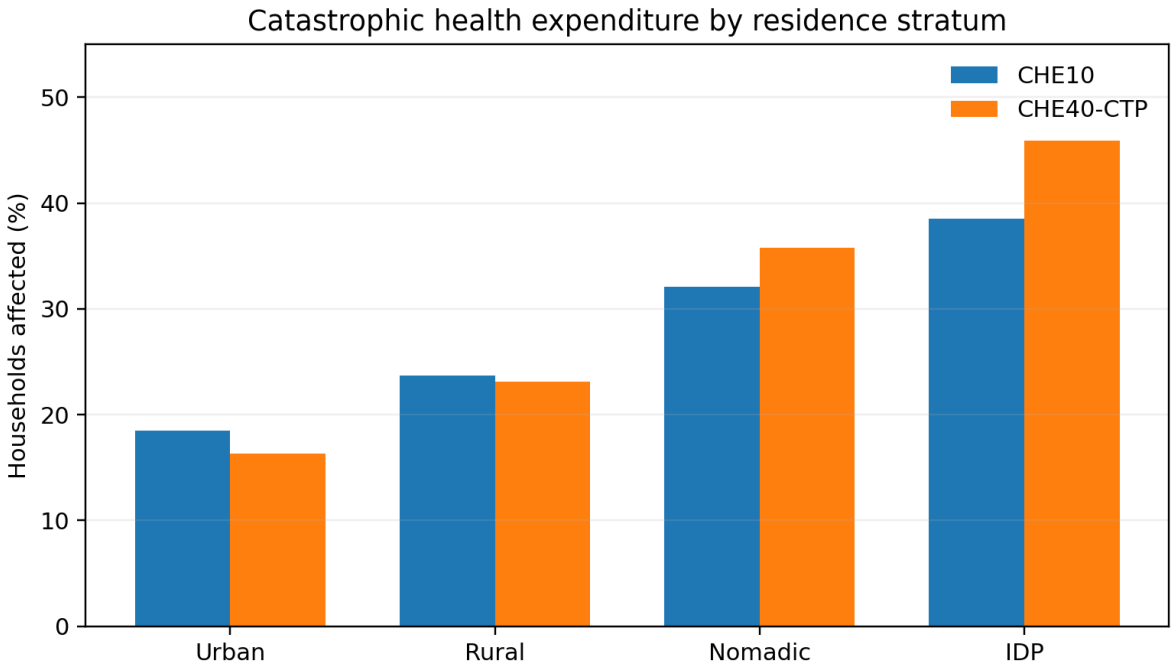



**Figure 2. Catastrophic health expenditure by residence stratum.**

The figure shows a consistent urban to rural to nomadic to IDP gradient across both

budget share and capacity to pay definitions, indicating that residence status is a major axis of financial vulnerability.

**Table 3. Incidence of catastrophic health expenditure and mean out of pocket burden, by subgroup.**

| Subgroup | CHE10 (%) | CHE25 (%) | CHE40 CTP (%) | Mean OOP/Y (%) |
|---|---|---|---|---|
| **National** | **25.0** | **7.8** | **25.6** | **8.5** |
| Urban | 18.5 | 3.7 | 16.3 | 6.1 |
| Rural | 23.7 | 8.0 | 23.1 | 8.9 |
| Nomadic | 32.1 | 14.2 | 35.8 | 11.2 |
| IDP settlement | 38.5 | 12.7 | 45.9 | 11.8 |
| Q1 (poorest) | 35.6 | 15.9 | 43.7 | 11.9 |
| Q2 | 29.6 | 9.3 | 34.1 | 9.8 |
| Q3 | 26.7 | 5.2 | 24.4 | 8.2 |
| Q4 | 21.9 | 5.9 | 16.7 | 7.2 |
| Q5 (richest) | 11.1 | 2.6 | 8.9 | 5.1 |
| Chronic illness present | 47.4 | 17.1 | 45.1 | 14.1 |
| Chronic illness absent | 18.7 | 5.2 | 20.2 | 6.9 |
| Insured | 6.8 | 0.0 | 2.3 | 2.3 |
| Uninsured | 25.6 | 8.0 | 26.3 | 8.7 |

## 5.3 Regressivity of out of pocket financing

The distribution of catastrophic expenditure across wealth quintiles confirms the regressive nature of out of pocket health financing in the modelled Somali setting (Fig. 3). CHE10 declined steadily from 35.6% among households in the poorest quintile to 11.1% among households in the richest quintile. The capacity to pay measure showed an even larger wealth gradient, falling from 43.7% in the poorest quintile to 8.9% in the richest. This indicates that poorer households were not only more likely to experience catastrophic spending, but also more likely to have very limited discretionary resources after meeting food and other subsistence needs.

The mean OOP burden followed the same pattern. Health payments consumed 11.9% of total household consumption among the poorest quintile compared with 5.1% among the richest quintile. This demonstrates that the same health financing mechanism can have very different welfare consequences depending on household resources. Wealthier households may absorb health payments through savings, regular income, or social networks, while poorer households may be forced to reduce essential consumption, borrow informally, sell productive assets, or delay care. In this sense, OOP financing functions as a regressive tax on illness: it imposes the greatest relative burden on those least able to pay.

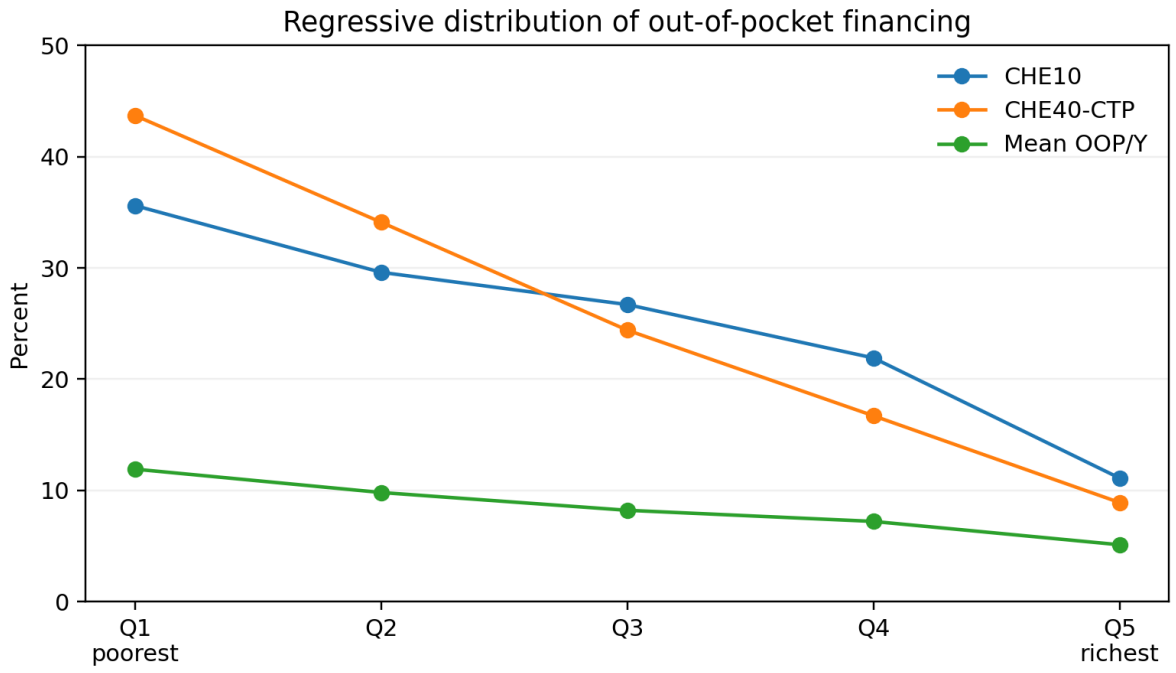


**Figure 3. Regressivity of out of pocket financing.**

The figure illustrates that both catastrophic expenditure and mean OOP burden decline as household wealth rises, confirming that the financial burden of care is concentrated among poorer households.

## 5.4 Adjusted determinants of catastrophic health expenditure

The multivariable logistic regression identified several independent predictors of catastrophic health expenditure at the 10% budget share threshold (Table 4). The strongest determinant was the presence of chronic illness in the household. Households with at least one chronically ill member had more than four times the odds of experiencing CHE compared with households without chronic illness (aOR 4.05, 95% CI 3.02 5.44, $p < 0.001$). This finding is consistent with the recurrent nature of chronic care costs, including repeated consultations, medicines, diagnostics, monitoring, and transport. It also highlights the importance of including chronic disease management within financial protection reforms and essential benefit packages.

Residence status remained independently associated with catastrophic expenditure after adjustment for wealth and other household characteristics. IDP households had significantly higher odds of CHE compared with urban households (aOR 1.90, 95% CI 1.18 3.04, $p = 0.008$), while nomadic households also faced elevated odds (aOR 1.66, 95% CI 1.07 2.58, $p = 0.023$). These findings suggest that displacement and mobility are not merely proxies for poverty. They represent independent axes of vulnerability linked to livelihood disruption, distance from services, limited assets, indirect care seeking costs, and weak access to formal financial protection.

Facility based delivery in the previous year was also strongly associated with catastrophic expenditure (aOR 1.98, 95% CI 1.42 2.78, $p < 0.001$). This indicates a measurable maternity related financial penalty in the absence of effective fee exemptions or demand side subsidies. In policy terms, the finding is important because households that seek skilled birth attendance should not be financially penalised for using recommended maternal health services. Without financial protection for delivery care, OOP payments may discourage facility use and undermine efforts to improve maternal and newborn outcomes.

Female headed households had higher odds of catastrophic expenditure than male headed households (aOR 1.44, 95% CI 1.10 1.90, p = 0.009), suggesting that gendered household vulnerability may shape financial exposure to health care costs. Household size was also independently associated with higher risk: each additional household member increased the odds of CHE by 11% (aOR 1.11, 95% CI 1.03 1.20, p = 0.004). Larger households may face more frequent illness episodes, greater dependency burdens, and higher total expenditure needs.

Wealth and insurance were protective. Households in the richest quintile had substantially lower odds of catastrophic expenditure compared with those in the poorest quintile (aOR 0.31, 95% CI 0.17 0.54, p < 0.001). Any form of insurance or prepaid coverage was associated with lower odds of CHE (aOR 0.34, 95% CI 0.10 1.17), although this association did not reach conventional statistical significance (p = 0.086). The wide confidence interval likely reflects the very small number of insured households in the sample. Nevertheless, the direction and magnitude of the point estimate are consistent with the expected protective role of pooled financing (Fig. 4).

**Table 4. Multivariable logistic regression for catastrophic health expenditure at the 10% budget share threshold.**

Reference categories: urban residence, poorest wealth quintile, no chronic illness, no facility delivery, uninsured, and male headed household.

| Predictor | aOR | 95% CI | p value |
|---|---|---|---|
| Rural residence | 1.23 | 0.84 1.80 | 0.289 |
| Nomadic residence | 1.66 | 1.07 2.58 | 0.023 |
| IDP settlement | 1.90 | 1.18 3.04 | 0.008 |
| Q2 | 0.92 | 0.61 1.37 | 0.668 |
| Q3 | 0.82 | 0.53 1.27 | 0.373 |
| Q4 | 0.66 | 0.41 1.06 | 0.086 |

| Predictor | aOR | 95% CI | p value |
|---|---|---|---|
| Q5 (richest) | 0.31 | 0.17 0.54 | <0.001 |
| Chronic illness in household | 4.05 | 3.02 5.44 | <0.001 |
| Facility delivery in previous year | 1.98 | 1.42 2.78 | <0.001 |
| Health insurance or prepaid coverage | 0.34 | 0.10 1.17 | 0.086 |
| Female headed household | 1.44 | 1.10 1.90 | 0.009 |
| Household size, per additional member | 1.11 | 1.03 1.20 | 0.004 |

Model diagnostics: n = 1,350; McFadden pseudo $R^2 = 0.124$; likelihood ratio $\chi^2(12) = 187.6$, $p < 0.001$; classification accuracy = 76.5%.

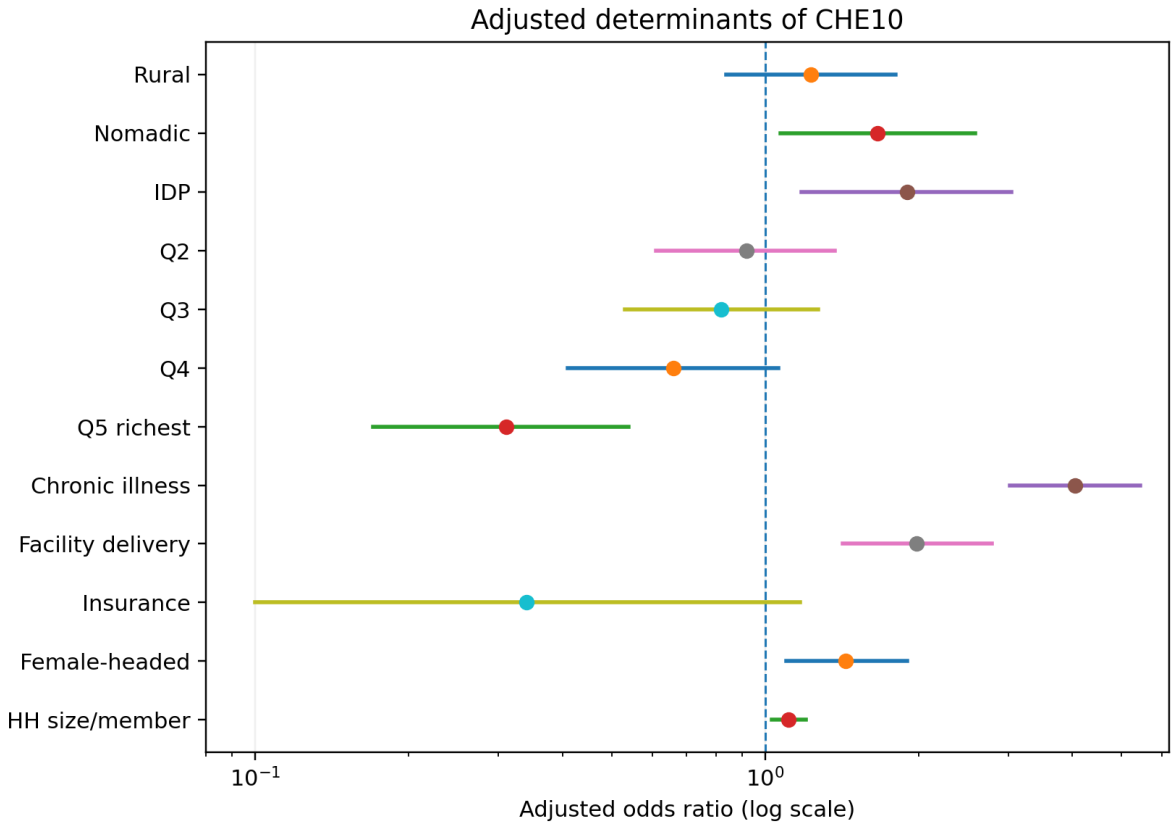


**Figure 4. Adjusted odds ratios for catastrophic health expenditure.**
The figure presents adjusted odds ratios and 95% confidence intervals. Points to the right of OR = 1 indicate elevated risk, while points to the left indicate protective associations.

## 5.5 Impoverishment and distress financing

In addition to catastrophic expenditure, OOP health payments generated measurable impoverishment. The modelled poverty headcount increased from 44.4% before health payments to 49.0% after health payments (Fig. 5). This 4.6 percentage point increase represents households that were above the poverty line before seeking care but fell below it after paying for health services. The finding demonstrates that health payments are not merely a short term household expenditure item; they can directly shift households into poverty.

The economic consequences were compounded by the coping mechanisms used to finance care. Among households experiencing catastrophic expenditure, approximately 60% relied on distress financing rather than savings or insurance. Reported coping mechanisms included selling livestock or productive assets, borrowing informally, and taking on debt from relatives, merchants, or community networks. These strategies may enable immediate access to care, but they can undermine long term household resilience. For pastoralist households, livestock sales may weaken the productive asset base on which future income depends. For IDP households, informal borrowing may deepen pre existing deprivation and dependency. For households affected by chronic illness, repeated distress financing may create a cycle of cumulative impoverishment.

The combined findings on catastrophe, impoverishment, and distress financing indicate that OOP payments in Somalia operate through multiple pathways of hardship. They reduce current consumption, push some households below the poverty line, and force others to deplete assets or accumulate debt. These results strengthen the case for financial protection reforms that move beyond facility expansion alone and directly address the household cost of seeking care.

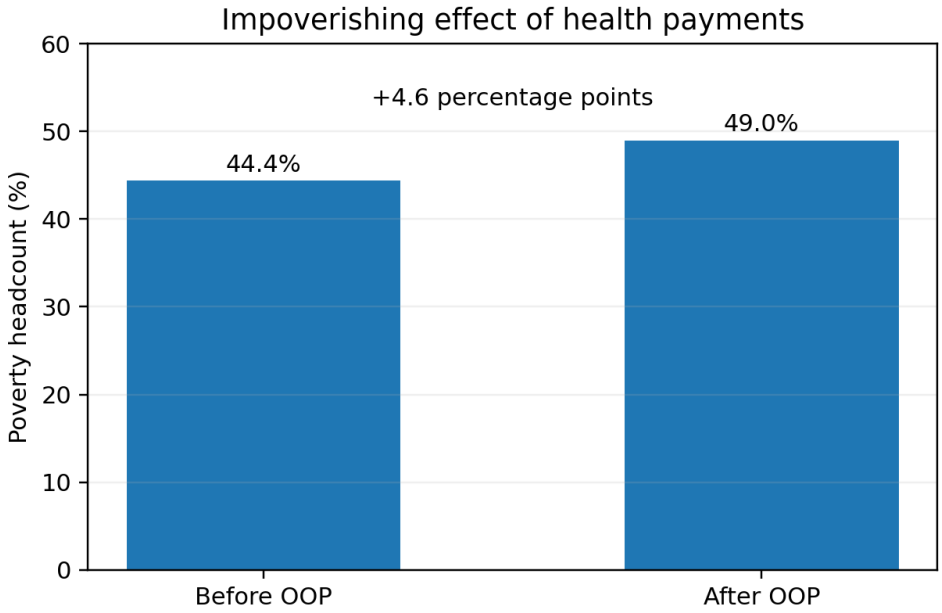



**Figure 5. Poverty headcount before and after out of pocket health payments.**
The figure shows the increase in poverty after health payments. The increment between pre payment and post payment poverty represents households impoverished by paying for care.

## 6. Discussion

This study presents novel evidence on the distribution and determinants of catastrophic health expenditure (CHE) in Somalia. It reveals that financial hardship is both prevalent and deeply inequitable. The observed incidence approximately one in four households experiencing catastrophic expenditure aligns with global analyses showing elevated CHE in settings with weak risk pooling and high out of pocket (OOP) reliance [4,6]. However, beyond confirming high incidence, the present findings contribute by uncovering the structural, social, and spatial inequalities that contribute to financial vulnerability in a fragile, displacement affected context.

Situating Somalia within the global financial protection landscape:

Globally, progress toward financial protection has been uneven, with many low income and fragile settings experiencing stagnation or reversal in CHE reduction [5].

Studies covering over 130 countries show that CHE remains concentrated in countries with high OOP shares and limited prepayment mechanisms [4]. Somalia closely fits this profile: OOP financing accounts for approximately 45% of total health expenditure, significantly exceeding thresholds typically associated with financial protection failure.

Comparative evidence from Sub Saharan Africa indicates that CHE incidence often ranges between 10% and 25%, depending on thresholds and methods [6]. The estimates reported in this study fall at the upper end of that distribution, highlighting Somalia's position among the most financially vulnerable health systems globally. This pattern is not solely a result of poverty but also reflects institutional deficits in risk pooling, regulatory fragmentation, and heavy reliance on market based service delivery.

Equity oriented interpretation: applying health equity frameworks:

To interpret these findings, it is beneficial to consider them within established health equity frameworks, particularly the World Health Organization Commission on Social Determinants of Health (CSDH).

Wagstaff and van Doorslaer's financial protection framework, encompassing vertical and horizontal equity principles in health financing, vertical inequity, vertical equity, horizontal inequity, and displacement and mobility as structural determinants of inequity.

Wagstaff and van Doorslaer's financial protection framework establishes a system to ensure that households contribute to health financing based on their ability to pay. This principle aims to prevent a disproportionate burden on vulnerable populations, such as those in poverty.

Vertical inequity refers to the unequal distribution of health financing resources among different socioeconomic groups. In this study, the steep wealth gradient between the poorest and richest quintiles was observed, with CHE in the poorest quintile being over three times higher than in the richest. This indicates a significant violation of the vertical equity principle, as households with lower incomes are being asked to contribute a disproportionate share of their income to health financing.

Horizontal inequity, on the other hand, refers to the unequal treatment of individuals with similar health needs. This study found that individuals in the most vulnerable groups, such as internally displaced persons (IDPs) and nomadic populations, face a significantly higher risk of CHE. Even after controlling for wealth, these groups still experience greater financial hardship compared to others. This suggests that there are systemic inequities in access to health services, pricing, and protection for individuals with similar health needs.

Displacement and mobility can be structural determinants of inequity. This study identifies displacement status as an independent factor that contributes to financial hardship. Globally, displaced populations are recognized as facing multiple intersecting vulnerabilities, including poverty, social exclusion, and limited access to services. However, financial protection analyses rarely quantify the impact of displacement on households at the individual level.
The elevated chronic health expenditure (CHE) among internally displaced persons (IDPs) aligns with emerging literature on health inequities in conflict and humanitarian settings. This literature emphasizes the role of structural exclusion and fragmented service delivery in exacerbating health disparities. Similarly, nomadic populations represent a uniquely underserved group often overlooked in conventional health financing analyses. Their greater reliance on livestock assets as a form of wealth increases their vulnerability to distress financing through asset liquidation, further compounding their long  term economic vulnerability.

From an equity perspective, these findings underscore the need to move beyond income based targeting toward context sensitive targeting. This approach recognizes displacement, mobility, and marginalization as core axes of inequity that require attention in health policy.

### 6.4 The Chronic Illness Poverty Trap

The strong association between chronic illness and catastrophic expenditure is consistent with global evidence demonstrating the financial burden of non communicable diseases (NCDs) in low resource settings. Unlike acute illnesses, chronic conditions necessitate sustained expenditure on medication, monitoring, and follow up care, making them particularly challenging in systems without prepayment mechanisms.

This dynamic can be interpreted through the lens of the “medical poverty trap.” Illness leads to financial depletion, which in turn restricts future access to care. In Somalia, the absence of insurance and subsidized chronic care creates conditions where households must finance ongoing treatment out of pocket, often resulting in cumulative financial stress. This reinforces cycles of poverty and illness, disproportionately affecting lower income groups.

### 6.5 Maternal Health and the Unintended Consequences of User Fees

Maternal health stands as a paramount concern, and the unintended repercussions of user fees in this domain can have substantial implications. While user fees are intended to generate revenue for healthcare services, they can inadvertently contribute to maternal health disparities and exacerbate existing inequalities. These fees can disproportionately impact low income households, rendering it challenging for them to access essential maternal health services.

Furthermore, user fees can lead to inadequate provision of maternal health services, as providers may prioritize services that generate revenue over those that are essential for maternal and child health. This can result in a decline in maternal health outcomes and an increase in maternal and child mortality rates.

To address these issues, it is imperative to consider the broader context of maternal health and the impact of user fees. Policymakers should endeavor to design user fee systems that are equitable and accessible to all, ensuring that maternal health services are available to all women and children irrespective of their socioeconomic status.

The discovery that facility based delivery significantly increases the likelihood of childbirth complications (CHE) presents a critical policy dilemma. While global health strategies prioritize increasing institutional delivery to reduce maternal mortality, user fees can discourage utilization or cause financial hardship for those who do seek care.

Evidence from various low and middle income countries demonstrates that eliminating user fees for maternal services simultaneously improves utilization and financial protection. However, in Somalia, the persistence of out of pocket payments for maternity services creates a dual risk: reduced service utilization among the poor and financial catastrophe for those who comply with recommended care.

This highlights a broader challenge in health financing: aligning clinical priorities with financial protection mechanisms to avoid unintended inequities.

The protective effect of insurance observed in this study, even with limited coverage, underscores the pivotal role of risk pooling in promoting equity. Global evidence consistently demonstrates that countries progressing toward universal health coverage (UHC) have expanded prepayment mechanisms that facilitate financial risk sharing across populations.

In Somalia, the near absence of risk pooling results in households bearing the entire financial burden. From an equity perspective, this signifies a failure of collective financing arrangements, leading to both vertical and horizontal inequities. Establishing pooled financing through mechanisms such as the National Social Health Insurance Authority is not merely a technical reform; it is a foundational step toward equity.

The findings of this study suggest that advancing UHC in Somalia necessitates explicitly incorporating equity considerations into financing reforms. This includes targeted subsidies for structurally vulnerable populations, such as internally displaced persons (IDPs) and nomadic groups.

Exemptions for chronic illness care acknowledge its disproportionate impact.

Removing user fees for maternal services aligns financial and health objectives.

Expanding pooled financing mechanisms ensures redistribution from healthier and wealthier groups to those in need.

These measures reflect progressive universalism, prioritizing coverage expansion for those with the greatest health and financial vulnerabilities.

This study demonstrates the feasibility and value of applying equity focused financial protection analysis in data constrained environments. By utilizing a synthetic dataset calibrated to available data, it provides a replicable framework that can be refined as more detailed household survey data become available.

Future research should integrate longitudinal data to assess causal pathways, examine regional and conflict related heterogeneity, and incorporate qualitative insights on coping strategies and barriers.

In summary, the findings underscore that financial hardship in Somalia is not random but is characterized by discernible patterns of social, economic, and spatial inequity. Addressing these inequities necessitates a paradigm shift from ad hoc financing to systematic, equity oriented health financing reform. The question of "who suffers most" transcends mere description and assumes a normative dimension, directly identifying the populations that should be prioritized in Somalia's trajectory toward universal health coverage.

## 7. Implications for Universal Health Coverage in Somalia

The distributional structure of catastrophe maps directly onto an actionable reform agenda. Because the burden is concentrated and patterned, targeted instruments can achieve disproportionate protection. Each empirical finding can be translated into a concrete financing lever aligned with Somalia's emerging UHC architecture: NSHIA, the Essential Package of Health Services, and Damal Caafimaad (Table 5).

***Table 5. From evidence to instrument: priority financing actions for financial protection in Somalia.***

| Finding / challenge | Instrument | Mechanism and delivery vehicle |
|---|---|---|
| No risk pooling; regressive OOP | Mandatory, subsidised social health insurance | Operationalise NSHIA as a single national pool; fully subsidise premiums for IDP, nomadic, and poorest households; purchase EPHS services on their behalf. |
| Chronic illness is the top driver | Continuity of care exemptions | Zero co payment for essential chronic disease medicines and monitoring within the EPHS benefit package; pre authorised refill protocols. |
| Maternity penalty | Demand side maternal subsidy | Free or voucher covered antenatal, delivery, and postnatal care; deliver subsidies over mobile money rails for unbanked and mobile households. |
| Displacement raises risk independent of wealth | Residence targeted enrolment and outreach | Auto enrol IDP settlement and pastoralist households; finance mobile and outreach service delivery. |
| Opaque private pricing | Strategic purchasing and price regulation | Contract accredited private providers at negotiated tariffs; publish standard prices; tie reimbursement to quality and price transparency. |
| Distress financing | Catastrophic cost ceiling and emergency fund | Annual OOP cap per household within benefit design; pooled fund for high cost episodes to prevent asset depletion. |

Sequencing matters. Since protection is most cheaply bought where risk is most concentrated, the highest return first moves are full premium subsidy for the poorest and displaced, chronic disease exemptions, and maternal vouchers. Each targets a determinant identified as high impact and tractable, and each can be delivered through institutions Somalia is already building.

## 8. Strengths and limitations

The central limitation is foundational: this analysis rests on a reproducible, secondary data calibrated simulation, not a fielded primary survey. Household records are algorithmically generated and anchored to published macro indicators; estimates are model based projections whose validity depends on calibration assumptions. Magnitudes should be read as plausibility bounded planning figures rather than precise population parameters. The small insured subsample limits precision, and the synthetic design cannot capture all regional security variation, remittance flows, or unmodelled heterogeneity. The cross sectional structure also precludes causal inference.

The study also has strengths. The pipeline is transparent and deterministic: every figure can be regenerated from a single random seed, and the framework can be re estimated once observed microdata become available. It applies internationally standard financial protection definitions and disaggregates by Somalia's four domain residence structure, including nomadic and IDP populations routinely obscured by national averages. The framing is deliberately honest about what the numbers are and are not.

## 9. Conclusion

In Somalia, paying for health care out of pocket functions as a regressive tax that triggers financial catastrophe and deepens poverty. It does so unevenly, falling hardest on internally displaced, nomadic, chronically ill, female headed, and poor households. The distributional structure is clear enough to act on: catastrophe is concentrated, patterned, and therefore targetable. Moving toward UHC requires a decisive shift from point of service, out of pocket financing to pooled prepayment and strategic purchasing, operationalised through NSHIA, the EPHS, and Damal Caafimaad, with targeted subsidies for chronic illness, mothers, and displaced households. The guiding question who suffers most? has a concrete answer, and that answer is also a policy roadmap.

## Declarations

**Funding.** This work received no specific grant from any funding agency in the public, commercial, or not for profit sectors; it was undertaken by the author as part of independent scholarly and institutional work.

**Conflicts of interest.** The author declares no competing financial or non financial interests. The author serves in a national health financing institutional role; the analysis and views expressed are scholarly and do not represent an official position of any institution.

**Ethics approval.** Not applicable. The study uses fully synthetic, algorithmically generated records and no identifiable human subject data. Any future primary deployment would require approval from a recognised Somali institutional review board and informed participant consent.

**Data and code availability.** The complete data generating parameters, synthetic microdataset, and estimation code are documented in Appendix B and are available from the author on reasonable request, enabling exact reproduction and re estimation on alternative inputs.

**Author contributions.** The sole author conceived the study, designed the analytic framework, conducted the analysis, and wrote the manuscript.

## References

1. Xu K, Evans DB, Kawabata K, Zeramdini R, Klavus J, Murray CJL. Household catastrophic health expenditure: a multicountry analysis. Lancet. 2003;362(9378):111 117. doi:10.1016/S0140 6736(03)13861 5.

2. Wagstaff A, van Doorslaer E. Catastrophe and impoverishment in paying for health care: with applications to Vietnam 1993 1998. Health Econ. 2003;12(11):921 934. doi:10.1002/hec.776.

3. O'Donnell O, van Doorslaer E, Wagstaff A, Lindelow M. Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation. Washington, DC: World Bank; 2008. doi:10.1596/978 0 8213 6933 3.

4. Wagstaff A, Flores G, Hsu J, Smitz MF, Chepynoga K, Buisman LR, et al. Progress on catastrophic health spending in 133 countries: a retrospective observational study. Lancet Glob Health. 2018;6(2):e169 e179. doi:10.1016/S2214 109X(17)30429 1.

5. World Health Organization, World Bank. Tracking Universal Health Coverage: 2023 Global Monitoring Report. Geneva: WHO and World Bank; 2023. Available from: https://documents.worldbank.org/en/publication/documents reports/documentdetail/099652109152323107

6. Wagstaff A, Eozenou P, Smitz M. Out of pocket expenditures on health: a global stocktake. World Bank Res Obs. 2020;35(2):123 157. doi:10.1093/wbro/lkz005.

7. World Health Organization. Global Health Expenditure Database. Geneva: WHO; Available from: https://apps.who.int/nha/database

8. Federal Government of Somalia, Directorate of National Statistics. Somali Health and Demographic Survey 2020. Mogadishu: Government of Somalia; 2020. Available from: https://somalia.unfpa.org/en/publications/somali health and demographic survey 2020

9. Kruk ME, Goldmann E, Galea S. Borrowing and selling to pay for health care in low and middle income countries. Health Aff (Millwood). 2009;28(4):1056 1066. doi:10.1377/hlthaff.28.4.1056.

10. McIntyre D, Thiede M, Dahlgren G, Whitehead M. What are the economic consequences for households of illness and paying for health care in low and middle income country contexts? Soc Sci Med. 2006;62(4):858 865. doi:10.1016/j.socscimed.2005.07.002.

11. World Health Organization, Commission on Social Determinants of Health. Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health. Geneva: WHO; 2008.

12. Sen A. Development as Freedom. Oxford: Oxford University Press; 1999.

13. Whitehead M. The concepts and principles of equity and health. Int J Health Serv. 1992;22(3):429 445. doi:10.2190/986L LHQ6 2VTE YRRN.

14. Federal Government of Somalia, Ministry of Health and Human Services. Essential Package of Health Services (EPHS). Mogadishu: MoHHS; 2020. Available from: https://moh.gov.so

15. World Bank. Somalia Poverty and Vulnerability Assessment. Washington, DC: World Bank; 2019.

16. World Bank. Damal Caafimaad: Improving Access to Health Services in Somalia. Washington, DC: World Bank; 2021.

## Supplementary Files

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