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Household costs of care in children under five attending primary care in Burkina Faso, Guinea, Mali and Niger: a cross-sectional study nested in the AIRE project

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ABSTRACT

Introduction Out-of-pocket payments limit access to care in Africa. The Amélioration de l'Identification des détresses Respiratoires de l'Enfant/Improving Identification of Respiratory Distress in Children (AIRE) project evaluated the implementation of pulse oximetry within Integrated Management of Childhood Illness (IMCI) guidelines at primary health centres (PHCs) in Burkina Faso and Niger (with total exemption policies) and in Mali and Guinea (with partial exemption policies). We measured households' out-of-pocket expenditures for treating children under 5 years of age and analysed the associated factors.

Methods Between June 2021 and May 2022, all children under 5 years of age attending IMCI consultations, excluding simple non-respiratory cases, aged 2–59 months, were enrolled in the AIRE study with parental consent. Five non-severe cases and five severe cases (followed up over 14 days) per PHC were randomly selected every month. We collected medical and non-medical direct costs and indirect costs. We described the median costs and investigated the factors associated with medical direct costs (MDCs) using two-part models for countries with total exemption and a general linear model for those with partial exemption.

Results Overall, 940 non-severe cases and 745 severe cases were selected. The median MDCs were US$0.0, US$7.1, US$5.0 and US$3.6 for non-severe cases and US$1.6, US$8.6, US$7.4 and US$14.4 for severe cases, in Burkina Faso, Guinea, Mali and Niger, respectively. Medicine expenditures were the main MDC items, accounting for 79% of costs for non-severe cases and 59% for severe cases. In all countries, disease severity and the unavailability of prescribed medicines at PHCs or referral hospital depots were associated with out-of-pocket payments and higher expenses.

Conclusion With the exception of Burkina Faso, household out-of-pocket payments for children under five remain high despite free care policies, particularly for treating severe cases. This is mainly explained by medicines expenditures. Action is needed to identify efficient financing systems that ensure the regular and adequate supply of medicines in public health facilities and to support free healthcare policies.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ In sub-Saharan Africa, various studies have shown that user fee total or partial exemption policies do not succeed in eliminating or significantly reducing healthcare costs borne by households.

⇒ Few studies have examined household out-of-pocket expenditure on healthcare for children under 5 years of age in the West African context.

WHAT THIS STUDY ADDS

⇒ Despite user fee exemption policies, household out-of-pocket payment remains high for taking care of children under five at primary care and referral hospital.

⇒ Most expenditures were associated with purchasing medicines outside of primary healthcare centres and referral hospitals, which is likely the result of stock-outs in public facilities.

⇒ Both the probability of an out-of-pocket expenditure and its amount were associated with the purchasing of medicines outside of the public health system.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Our study underlines the importance of further investigations to determine effective funding methods aimed at ensuring a regular and adequate supply of medicines in public healthcare facilities.

INTRODUCTION

Under five mortality remains a challenge in sub-Saharan Africa, despite the progress

made in child health management worldwide. According to the World Bank, the mortality rate was 73 deaths per 1000 live births in 2021 in this region, with infectious diseases remaining the main cause of death.[1] Structural factors, such as the limited geographical and financial accessibility of primary care, particularly in rural areas, the lack of adequate diagnostic tools and shortages of essential medicines contribute to this high mortality.[2 3]

Various interventions have been implemented along the continuum of care to improve the accessibility and quality of healthcare services, in order to make progress towards achieving Sustainable Development Goal 3 by 2030.[4] In September 1987, many African countries adopted the Bamako Initiative with the support of the WHO and the UNICEF, in response to economic crises and difficulties in financing the recurrent costs of primary healthcare.[5] This initiative was presented as a major approach to improve maternal and child health by ensuring the availability of essential medicines at the primary healthcare level.[6] As part of the Bamako Initiative, direct payments at the point of delivery care were introduced, with local management of revenues by management committees for the purchase of medicines and healthcare provider activities.[7 8] However, out-of-pocket payments have been identified in several studies as a major barrier to access to healthcare, exposing households to catastrophic expenditures and a risk of impoverishment.[9 10] Since the 2000s, a number of sub-Saharan African countries have implemented selective free care policy, which varies according to the health services covered, the populations benefiting, the level of cost alleviation and the mode of financing. Regarding care policies for children under 5 years of age, Burundi and Niger were the first to implement a free care policy, in 2006, followed by Burkina Faso 10 years later.[11] Mali and Guinea both introduced a free user fee policy for malaria treatment in 2010 and 2011, in addition to the national programmes to fight HIV infection, tuberculosis and malnutrition in these countries.[12] Although user fee exemption policies have significantly increased the use of health services, especially among the poorest, out-of-pocket payments in maternal healthcare persist.[13–17] Few studies have examined the expenditure incurred by households and their determinants for children under 5 years of age in the context of partial or total exemption policies.[18]

With the goal to reduce under five mortality, WHO and UNICEF introduced in 1995 Integrated Management of Childhood Illness (IMCI), a clinical symptom-based algorithm aimed to help healthcare workers (HCWs) to better diagnose and manage serious illnesses in primary health centres (PHCs).[19–22] However, IMCI does not allow early detection of hypoxemia, which has been identified as a risk factor for death, increasing by three the risk of death in children with severe illnesses, respiratory or non-respiratory.[23 24] To identify new approaches to reduce hypoxaemia-related mortality, the Amélioration de l'Identification des détresses Respiratoires de l'Enfant/Improving Identification of Respiratory Distress in Children (AIRE) project was implemented in four West African countries in 2021–2022.[25] The aim was to assess the feasibility and added value of the routine use of pulse oximeter (PO) into IMCI for the early identification of hypoxaemia in PHCs, enabling rapid and appropriate care management.

The AIRE project offered a unique opportunity to carry out a nested costing study to measure and explore factors associated with household expenditure for children under 5 years old attending IMCI consultations at PHC level.

METHODS

Context

The AIRE project, funded by UNITAID, evaluated the implementation of POs integrated into IMCI in Burkina Faso, Guinea, Mali and Niger.[25] The healthcare systems in these four countries studied are based on a three-tier pyramid structure. The PHCs at the first level are the theoretical population-entry points to the healthcare system. Based on their condition, patients are referred to their district hospital, with possible transfer to regional hospitals at the secondary level or national hospitals at the third level of the pyramid. The AIRE interventions were implemented in 202 public PHCs, with support to their seven referral hospitals (RHs).

Briefly, IMCI classifies children as green (mild condition requiring simple care at home), yellow (condition manageable at the PHC level, mostly requiring medicines and follow-up) and red (severe condition requiring urgent referral). In the AIRE project, at all PHCs, all newborns (<2 months of age) and children aged between 2 and 59 months (except those classified as non-respiratory green) attending IMCI consultations at the PHC level were eligible for pulse oxygen saturation (SpO_2) measurement. Two groups, related to the severity of the disease, were defined according to the IMCI classification integrating PO.[25] Children classified as 'respiratory green' or 'yellow', were defined as non-severe cases and those classified as 'red' and those with severe hypoxemia ($SpO_2 \leq 90\%$) regardless of IMCI were defined as severe cases. All non-severe cases were treated at PHCs on an outpatient basis or underwent observation, followed by treatment at home. Severe cases, in theory, were referred to the RH.

Furthermore, as part of the AIRE project, donation of medicines was provided to the health districts involved in the project for all children treated at the PHCs and their RHs.

Free care policy

Free care, that is, Total Exemption Policy (TEP) of direct payments for consultations, medicines and consumables, was implemented for the care of children under 5 years of age in Niger and Burkina Faso in 2006 and 2016, respectively. This means that theoretically, all the available care is provided free of charge at all levels of the health

pyramid, regardless of the disease.[26] In Niger, facilities receive a lump sum per child treated, after submitting invoices for free treatment to the Ministry of Health's steering committee for free healthcare, which validates them beforehand. The funds are then disbursed by the Ministry of Finance. In Burkina Faso, facilities are reimbursed the actual costs of care consumed in caring for the child. The government pre-deposits the funds with the health district before the treatment is provided.[11 27] This approach was preferred in Burkina Faso in order to avoid reimbursement delays that could affect the proper functioning of the policy.[18 28]

In Mali and Guinea, there is a partial exemption policy (PEP) for direct payments, for the care of malaria, malnutrition, tuberculosis and HIV; though medical visit fees persist.[29 30] Outside these four diseases, all healthcare services and care are subject to direct payments borne by households.[12] Regarding the mode of financing, medicines are directly allocated to health facilities by central medicine purchasing agencies on the instructions of the government with the support of its partners who are responsible for paying the bills.

Study design and population

AIRE research activities were carried out in 16 PHCs (four PHCs selected per country) and their RHs. All children under five attending IMCI consultations, excluding simple non-respiratory cases aged 2–59 months, eligible for PO use were enrolled in the AIRE study with written parental consent. Those classified as severe cases were then enrolled in a cohort with a 14-day follow-up.

The costing substudy sample was a cross-sectional study carried out in the first five non-severe cases and first five severe cases enrolled in each PHC, over a random week each month. The selection was carried out over a 12-month period, with a weekly rotation of the selection week over the 4 weeks of the month to account for seasonal variations in diseases (such as malaria during the rainy season and pneumonia during the dry season), as well as variations in households' ability to pay for care throughout the month. The data collection period ran from June 2021 to May 2022.

Data collection

Household costs are defined in the online supplemental table 1. Briefly, direct costs were separated into: (1) medical direct costs (MDCs), defined as costs of consultation, medication, additional examination and inpatient care at both the primary care and RH levels (observation or hospitalisation, including oxygen therapy). These costs are also referred to out-of-pocket expenditures and (2) non-MDCs, defined as cost of transport to and from the PHC and caregiver accommodation during hospitalisation. Indirect costs represented the loss of income due to the interruption of work or the household's income-generating activity (IGA) due to the illness. Because of the rural settings, we used the daily income from agricultural work as a proxy; this was US$ 1.8 in Burkina Faso, US$3.6 in Guinea and US$ 4.5 in Mali and Niger according to an ad hoc survey of households carried during the period. Expenses related to food and drink, as well as those incurred after death, were not considered.

Cost data were collected after discharge from the PHC, outside the facility, on day five after the index IMCI consultation for non-severe cases and during hospital stay, then after day 14 hospital discharge for severe cases. The costs were obtained through face-to-face interviews conducted by field workers trained in cost data collection during the implementation phase of the project. Interviews were conducted with the child's main caregiver (the person who looked after the child throughout the care process) based on a standardised questionnaire. In order to guarantee the reliability of the data, interviewers collected payment receipts to support information. In the absence of receipts, reported data were based on statements made at dates very close to the event in order to limit recall bias. Data completion was done at distance of the child's consultation during home visits or phone calls. Costs were collected in the national currency of each country and converted into US$ using the official average exchange rate for 2021 (US$1=9838.05 Guinean francs and US$1=554.53 CFA francs).[31 32] Cost data have not been adjusted or discounted.

Sociodemographic and clinical data, as well as the main diagnosis based on the IMCI diagnosis blocks or the International Statistical Classification of Diseases –10th revision code, were collected.[33]

Analysis

Distributions of characteristics between children selected for the cost study and children not selected and characteristics of all children enrolled in the cost study stratified according to the disease severity and by country were described and compared using the Pearson's χ^2 test, Wilcoxon signed-rank test or Student's t-test, where appropriate, at the 5% significance level.

Qualitative variables were presented as numbers and percentages, while quantitative variables were expressed as mean and SD or median and IQR (Q1: first quartile ; Q3: third quartile), depending on their distribution. For descriptive comparisons, χ^2 tests were used for categorical variables and Kruskal-Wallis tests were applied to compare medians across multiple groups, as appropriate.

Costs in 2021 US$ were described in median terms (Q1; Q3) for all children by country. To determine the proportion of households with high health expenditure, we used the concept of excessive expenditure rather than catastrophic expenditure due to lack of information on household consumption and/or income.[34 35] In each country, households with direct medical costs above a threshold amount determined by the Tukey method (Q3+k*(Q3–Q1), k=1.5) defined excessive expenditure.[36]

Where TEP was implemented (Burkina Faso and Niger), factors associated with direct costs were investigated in two-part models. The first part was a logistic regression to estimate the probability of incurring any

out-of-pocket expenditure. The second part, conditional on positive expenditure, modelled the amount of out-of-pocket spending using a generalised linear model with gamma distribution and a log link function, appropriate for the positively skewed nature of cost data.[37] In PEP contexts, where direct costs were borne by nearly all households, factors associated with the amount of direct payments were investigated in standard generalised linear models. In these settings, if no payments were made (45/442 children in Guinea, and 10/440 in Mali), direct payments were set at US$0.1 for modelling purposes. Across all models, a random intercept was included at the PHC level to account for clustering of observations within PHCs. The coefficients represent absolute differences in direct healthcare costs. Values indicate how much more or less was spent, on average, relative to the reference category.

All models were adjusted for sociodemographic variables (age, sex, level of education of the head of the household, IGA of the main child's caregiver), accessibility to PHC variables (delay since the onset of symptoms, transport means used and length of the transport from home to PHC) and structural variables (place of acquisition of prescribed medicines: PHC or RH depot or private pharmacies). The place of medicines acquisition was used as an indicator of their actual availability at PHC or RH depot, assuming that households would prefer to obtain medicines from the PHC depot, as they are provided free of charge in Burkina Faso and Niger or at more affordable prices than in private pharmacies in Guinea and Mali.

All analyses were performed in Stata V.14.2 software (Stata Corporation, Texas, USA).

Patient and public involvement

This study was conducted using individual data collected with the ethical committee and MoH authorisation. Patients were not involved in the analysis plan or result interpretation. Patients did not contribute to the writing or editing of this manuscript.

RESULTS

Study sample

Between June 2021 and May 2022, of the 39 360 children under 5 years attending IMCI consultations in the 16 AIRE research PHCs, 15 836 were included in the AIRE main analyses in Burkina Faso, Guinea, Mali and Niger.[38] A detailed description of children enrolled is provided elsewhere.[25] At the PHC level, 941 (6.8%) of the 13 838 non-severe IMCI cases identified and 757 (37.9%) of the 1998 severe cases were selected for the cost study. After exclusion of children lost to follow-up and missing data, 940 (99.8%) non-severe cases and 745 (98.4%) severe cases were included for the current analysis (figure 1). A comparison of individual and family characteristics between children included in the cost sample and those not included according to illness severity and country showed no significant differences between the two groups, except in Mali. There, the proportion of children whose principal caregiver has an IGA was significantly higher in those included in the cost study than those not selected, for both severe and non-severe cases (online supplemental table 2).

The median age of children included ranged from 13 months (8 months–26 months) in Niger to 26 months (3 months–43 months) in Burkina Faso. In more than half to 80% of households, the head of household had never attended school, and with the exception of Guinea, only less than a third of child's main caregivers has an IGA. Overall, IMCI visits to PHC were mostly carried out later than 2 days after the onset of symptoms, with higher proportions for severe cases compared with non-severe cases. The transport duration from home to the PHC was less than 30 min for most households. Overall, malaria was the most frequent main diagnosis retained, ranging from 31% to 50% for non-severe cases and from 48% to 90% for severe cases, followed by respiratory diseases and malnutrition. Among severe cases in Niger, 74% were referred to RH, which was much higher than those in other countries (29% in Burkina Faso, 13% in Mali and 19% in Guinea). In Burkina Faso, Guinea and Mali, medicines were purchased within the PHC or hospital depot, subsidised according to country-specific payment exemption policies. In Niger, 86% of non-severe cases and 54% of severe cases purchased medicines outside of PHCs or hospitals (table 1).

Costs

The median (Q1–Q3) MDCs for the management of non-severe cases at the PHC were US$0 (0–1.4), US$3.6 (1.9–5.6), US$5.0 (3.8–6.7) and US$7.1 (5.1–9.1) in Burkina Faso, Niger, Mali and Guinea, respectively (table 2). Among non-severe cases, the main item of household health expenditure was the purchase of medicines, ranging from 79% of total MDC in Guinea to 100% in Burkina Faso. In addition, consultation fees at the PHC level represented 21%, 12% and 1% in Mali, Guinea and Niger, respectively (online supplemental figures 1 and 2).

The MDC for the management of severe cases, wherever their place of management (PHC and RH) ranged from US$1.6 (0–6.0), US$7.4 (0.9–13.9) and US$8.6 (3.1–13.2) to 14.4 (6.7–22.7) in Burkina Faso, Mali, Guinea and Niger, respectively (table 2). As with non-severe cases, the main item of expenditure was the purchase of medicines, representing 75%, 90%, 73% and 59% of total MDC in Burkina Faso, Niger, Mali and Guinea, respectively (online supplemental figure 2). Online supplemental table 3 presents mean medicine costs per episode of illness among children whose households incurred expenses according to disease severity and country. The second item of expenditure was dependent on the exemption policy. In countries with TEP, it was the cost of transferring children from the PHCs to the RH, reaching 23% in Burkina Faso. Among households that paid for the transfer from PHC to RH, the mean expenditure

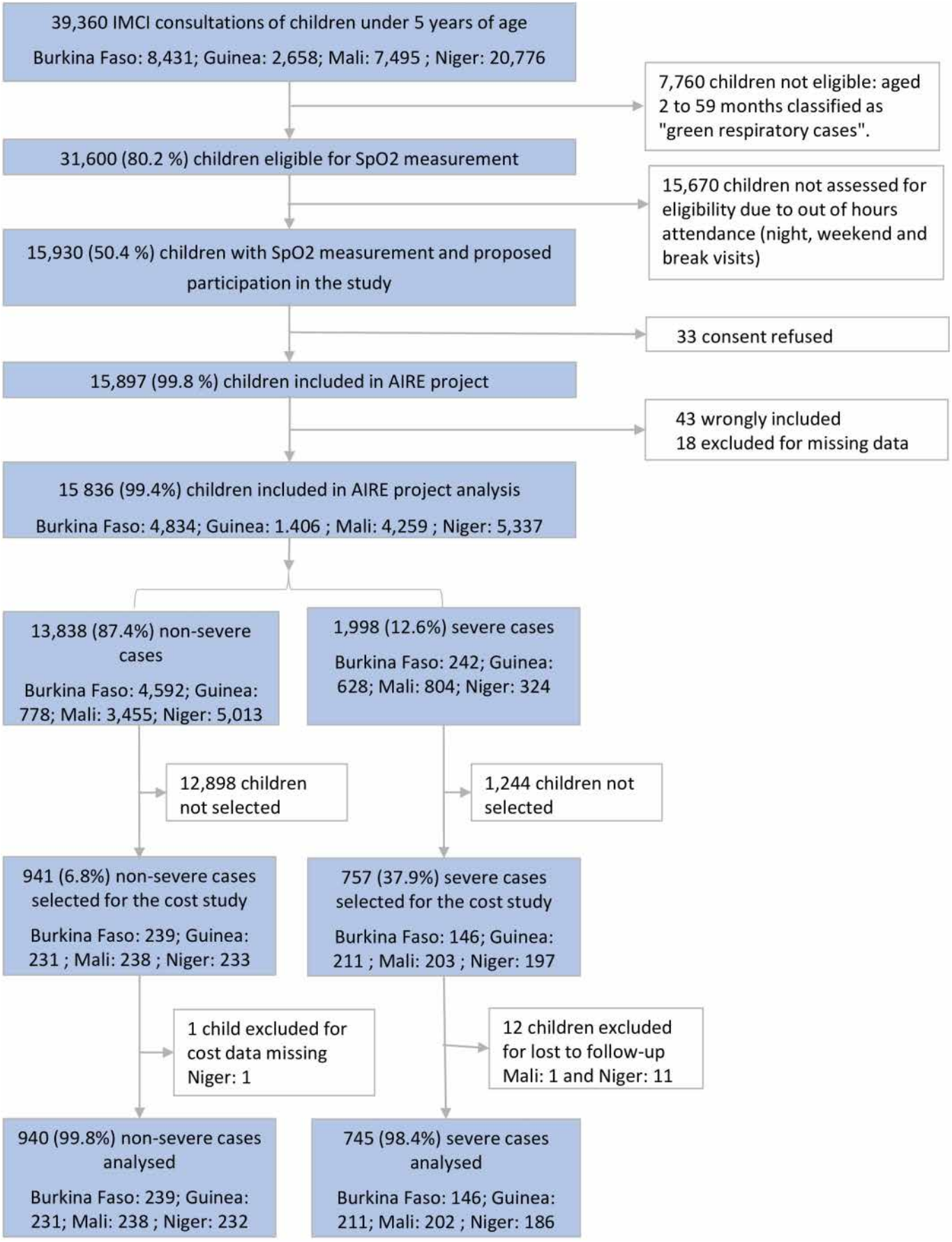

Figure 1 Flow chart of children selected and included in the cost analysis in the AIRE project, June 2021 to May 2022. AIRE, Améliorer l'Identification des détresses Respiratoires chez l'Enfant; IMCI, Integrated Management of Childhood Illness.

Table 1 Characteristics of children included at PHCs in the cost analysis according to exemption user fees policy, severity of the disease and country, AIRE project, June 2021–May 2022

	Non-severe cases				Severe cases			
	Total exemption policy		Partial exemption policy		Total exemption policy		Partial exemption policy	
	Burkina Faso (n=239)	Niger (n=232)	Guinea (n=231)	Mali (n=238)	Burkina Faso (n=146)	Niger (n=186)	Guinea (n=211)	Mali (n=202)
Median age, months (q1–q3)	18 (7-36)	13 (8-26)	19 (8-34)	17 (8-36)	26 (3-43)	16 (9-24)	24 (11-36)	19 (7-36)
Male sex, n (%)	132 (55)	124 (53)	114 (49)	138 (58)	87 (60)	101 (54)	113 (54)	104 (51)
Education level of the head of household, n (%)								
None	192 (80)	133 (57)	120 (52)	152 (64)	123 (84)	138 (74)	111 (53)	140 (69)
Primary level and up	47 (20)	99 (43)	111 (48)	86 (36)	23 (16)	48 (26)	100 (47)	62 (31)
Income-generating activity of the child's caregiver, n (%)	61 (26)	57 (25)	126 (55)	76 (32)	24 (16)	26 (14)	107 (51)	56 (28)
Time since onset of symptoms ≥2 days, n (%)	135 (56)	128 (55)	195 (84)	160 (67)	80 (55)	153 (82)	182 (86)	145 (72)
Means of transport to PHC, n (%)								
Foot/cart/bike	192 (81)	186 (80)	84 (37)	64 (27)	85 (59)	117 (63)	71 (34)	36 (18)
Taxi car/motorcycle/bus	46 (19)	46 (20)	145 (59)	172 (73)	60 (41)	68 (37)	140 (60)	161 (82)
Transport duration from home to PHC ≥30 min, n (%)	131 (55)	58 (25)	50 (22)	49 (21)	15 (10)	79 (42)	65 (31)	54 (27)
Main diagnosis of child illness*, n (%)								
Malaria	87 (36)	73 (31)	116 (50)	81 (34)	82 (56)	79 (48)	189 (90)	133 (68)
Respiratory disease	64 (27)	60 (25)	66 (29)	54 (23)	11 (8)	38 (23)	5 (2)	26 (13)
Malnutrition	8 (3)	30 (13)	19 (8)	39 (16)	11 (8)	39 (23)	3 (1)	10 (5)
Place of care management, n (%)								
At PHC	239 (100)	232 (100)	231 (100)	238 (100)	103 (71)	50 (27)	192 (91)	168 (83)
At PHC, then referral hospital (RH)					43 (29)	136 (73)	19 (9)	34 (17)
Place of purchase of medicines n (%)								
PHC or RH	169 (71)	33 (14)	194 (84)	214 (90)	131 (90)	85 (46)	170 (81)	185 (92)
At least one purchased outside of PHC or RH	70 (29)	199 (86)	37 (16)	24 (10)	15 (10)	101 (54)	41 (19)	17 (8)
Death at 14 days	NA	NA	NA	NA	8 (5)	19 (10)	1 (0)	15 (7)

Note: all reported characteristics showed statistically significant differences between groups (p<0.05).
* IMCI diagnosis for non-severe cases, or ICD-10 code for severe cases
AIRE, Amélioration de l'Identification des détresses Respiratoires de l'Enfant; PHC, primary health centre; RH, Referral hospital.

was US$3.0 in Burkina Faso and US$6.1 in Niger (online supplemental table 4). In countries with PEP, the second item of expenditure was related to PHC visit and hospital admission fees (32%) in Mali and to exam costs (16%) in Guinea (online supplemental figure 2).

Overall, in Burkina Faso and Niger, where TEP exists, 38% (148/385) and 89% (374/418), respectively, of the households made at least one direct payment for their child's care. Of these, the mean MDC was US$7.0 in Burkina Faso and US$11.8 in Niger. In Mali and Guinea with PEP, the mean cost was US$8.8 and 10.6, respectively. For severe cases, MDC mean costs ranged from US$ 9.9 in Burkina Faso to US$20.2 in Niger; online supplemental table 5 presents the costs per episode for children whose households incurred expenses, according to disease severity, type of cost and country. MDCs were defined as excessive for 26.4%, 10.2%, 7.3% and 11.9% of the households in Burkina Faso, Niger, Guinea and Mali, respectively. Online supplemental table 6 presents the number of households with excessive expenditure among those who paid out of pocket for their child's care.

For all countries, the median non-MDC was US$0 (0–0) for non-severe cases and ranged from US$0.6 (0–1.8) in Burkina Faso to US$1.4 (0–2.7) in Niger for severe cases.

Table 2 Direct and indirect costs for households (median cost for all children and mean cost for children whose households have incurred expenses) in 2021 US$ per child under 5 years seen in IMCI consultations at PHCs and referral hospital, according to case severity, exemption policy and country, AIRE project, June 2021–May 2022.

	Total exemption policy				Partial exemption policy			
	Burkina Faso		Niger		Guinea		Mali	
	Non-severe cases (n=239)	Severe cases (n=146)	Non-severe cases (n=232)	Severe cases (n=186)	Non-severe cases (n=231)	Severe cases (n=211)	Non-severe cases (n=238)	Severe cases (n=202)
Medical direct cost								
Median cost (q1–q3) of all children included	0 (0–1.4)	1.6 (0–6.0)	3.6 (1.9–5.6)	14.4 (6.7–22.7)	7.1 (5.1–9.1)	8.6 (3.1–13.2)	5.0 (3.8–6.7)	7.4 (0.9–13.9)
PHC visit/hospital admission fees	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0.5 (0.5–1.0)	1.1 (0–1.1)	0.9 (0.9–0.9)	0.9 (0.9–0.9)
Medicines prescribed at PHC and/or hospital	0 (0–1.4)	0 (0–5.2)	3.6 (1.9–5.5)	13.6 (6.3–21.3)	6.1 (4.6–7.6)	7.1 (0–10.7)	4.1 (2.9–5.6)	5.9 (0–10.8)
Complementary exams	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	1.1 (0–2.0)	0 (0–0)	0 (0–0)
Transfer from PHC to hospital	NA	0 (0–1.1)	NA	0 (0–1.8)	NA	0 (0–0)	NA	0 (0–0)
Other of direct medical cost item*	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Mean (SD) cost:								
All children included	0.9 (2.1)	5.6 (10.3)	4.0 (2.9)	18.8 (16.8)	7.3 (3.7)	12.1 (14.3)	5.5 (3.0)	12.2 (18.4)
Children with household expenditures (cost >0)	3.4 (2.8)	9.9 (12.1)	4.6 (2.7)	20.2 (16.6)	7.5 (3.6)	14.9 (14.5)	5.5 (2.9)	12.8 (18.6)
Non-medical direct cost								
Median cost (q1–q3) of all children included	0 (0–0)	0.6 (0–1.8)	0 (0–0)	1.4 (0–2.7)	0 (0–0)	1.0 (0–2.0)	0 (0–0)	1.2 (0.7–2.2)
Transport: home to the PHC, purchase of medication and tests and PHC to home	0 (0–0)	0.6 (0–1.8)	0 (0–0)	1.4 (0–2.7)	0 (0–0)	1.0 (0–2.0)	0 (0–0)	1.3 (0.7–2.2)
Other direct non-medical cost items**	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Mean (SD) cost:								
All children included	0.0 (0.2)	2.1 (5.5)	0.0 (0.2)	2.4 (3.1)	0.1 (0.6)	1.3 (1.3)	0.0 (0.0)	2.2 (7.2)
Children with household expenditures (cost >0)	1.2 (0.4)	3.7 (6.9)	1.5 (0.6)	3.2 (3.3)	1.9 (1.0)	1.8 (1.2)	0 (0.0)	2.6 (7.8)
Indirect cost								
Median cost (q1–q3) of all children included	0 (0–0)	0 (0–3.6)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–3.6)	0 (0–0)	4.5 (0–9.0)
Mean (SD) cost:								
All children included	0.0 (0.0)	3.2 (5.5)	0.0 (0.0)	0.7 (5.9)	1.1 (3.2)	3.4 (5.4)	0.6 (1.6)	6.5 (11.5)
Children with household expenditures (cost >0)	0.0 (0.0)	8.0 (6.2)	0.0 (0.0)	29.7 (22.9)	6.1 (5.4)	7.9 (5.7)	4.8 (1.1)	12.7 (13.4)

Note: all reported characteristics showed statistically significant differences between groups ($p<0.05$).

* Medical and surgical care, including oxygen therapy and day hospitalization for medical monitoring or hospitalisation

** Parental housing during hospitalisation and care for children left at home

AIRE, Amélioration de l'Identification des détresses Respiratoires de l'Enfant; IMCI, Integrated Management of Childhood Illness; PHC, primary health centre.

Non-MDCs were mainly transport expenses from home to the PHC (table 2).

Among severe cases in Burkina Faso, Guinea and Mali, over a third of households' family members stopped working to care for their child; in Niger, this proportion was 2.7%. The average estimated loss of income per episode of serious illness ranged from US$7.9 in Guinea to US$29.7 in Niger (online supplemental table 4).

MDCs, non-MDCs and indirect costs were significantly higher for severe cases compared with non-severe cases in all of the countries (table 2).

Factors associated with direct payments

Table 3 presents factors associated with direct payments and amount of expenditures for Burkina Faso and Niger, where TEP is implemented.

In these settings, the probability of an out-of-pocket payment was associated with the purchase of at least one prescribed medicine outside the PHC or RH depot. Additionally, in Burkina Faso, families of children under 2 months were over four times more likely to make an out-of-pocket payment compared with older children, 2–59 months (adjusted Odd Ratio (aOR)=4.83; 95% CI 2.35 to 10.03). Among those making out-of-pocket payments, expenditure was associated with an educated household (aOR: 1.60; 95% CI 1.11 to 2.31) and duration >2 days between onset of symptoms and PHC visit (aOR: 1.52, 95% CI 1.1 to 2.08). While purchasing medicines outside of the PHC or RH was associated with a higher likelihood of out-of-pocket payment, we found that among those who incurred expenditures, the amounts were actually lower for those who purchased medicines outside the public system (aOR: 0.51; 95% CI 0.36 to 0.73). In Niger, in addition to purchasing outside of the system, sex was also associated with out-of-pocket payments, more likely for boys than girls (aOR=2.73; 95% CI 1.20 to 6.50) and in families where the main caregiver had an IGA (aOR=3.32; 95% CI 1.01 to 12.18). Among those with expenditures, these were higher in families who attended PHCs >2 days since onset of symptoms (aOR: 1.63, 95% CI : 1.31 to 2.02) and in those who lived furthest from the PHC (≥30 min) (aOR: 1.63, 95% CI 1.26 to 2.09).

Factors associated with expenditures in Mali and Guinea, where PEP is implemented, are presented in table 4. As for TEP settings, expenditure was associated with purchasing medicines outside of the PHCs (aOR: 2.1, 95% CI 1.56 to 3.05 in Guinea and aOR: 1.46, 95% CI 1.06 to 2.02 in Mali). In Guinea, we also found an association with age, where expenditure was lower in younger children <2 months compared with 2–59 month-olds (aOR: 0.54, 95% CI 0.34 to 0.86). In Mali, age was not significant, however, expenditures were lower in households with an IGA (aOR: 0.75, 95% CI 0.59 to 0.95).

DISCUSSION

Our study provides original findings on the estimation of household costs of care and associated factors for children under 5 years with IMCI symptoms seeking care at PHCs across four West African countries, according to disease severity. We report several findings. We found that out-of-pocket expenditures persist in all the countries, regardless of the existence of exemption policies. These expenses are predominantly incurred through the purchase of medicines outside PHCs and RHs. Multivariate analyses indicate that determinants of out-of-pocket payments and their magnitude vary by context; however, the procurement of medicines outside the public sector consistently emerges as a significant predictor of the likelihood of out-of-pocket expenditure.

Overall, Burkina Faso recorded the lowest MDC, whereas it exhibited the highest reaching US$ 14.4. This is notable given the total exemption policies in both Burkina Faso and Niger for the healthcare of children under 5 years. In Mali and Guinea, where PEP is implemented, out-of-pocket payments reached to US$ 7.4 and US$ 8.6, respectively, despite malaria being the predominant diagnosis in over two-thirds of the severe cases, and malaria care being threoretically exempt from direct charges. Beyond MDC, families also faced considerable transport costs and income loss, exacerbating the economic burden in settings where the minimum wage ranges between US$ 49 and US$ 72, and 13.8% to 50.6% of the population live below the extreme poverty line (US$ 2.15/day).[39–43] This finding underscores that removing user fees alone does not guarantee financial protection or universal health coverage; persistent indirect costs and medicine stock-outs continue to impede access and affordability.

A critical and consistent driver of out-of-pocket costs across all countries was the purchase of medicines in private pharmacies, outside of the PHCs and RHs, likely due to frequent stock-outs in public facilities. This was particularly evident for younger children (<2 months) in Burkina Faso, where medicine availability, especially paediatric formulations, appears limited. Interestingly, this contrasts with Guinea, where younger age appeared to be protective against incurring out-of-pocket payments, suggesting that caregivers of younger children might benefit from targeted exemptions, preferential care practices or different care-seeking behaviours. This warrants further investigation to understand the underlying health system or sociocultural factors influencing these patterns. Differences in stock-out mechanisms between countries may be influenced by financing arrangements: in Burkina Faso and Niger, reimbursement delays to health facilities for free care are well documented and contribute to persistent medicine shortages.[27 44] For example, Niger's unpaid reimbursement reached 25 billion CFA francs in 2015 leading to only 14% of non-severe cases receiving all prescribed medicines free of charge, compared with 71% in Burkina Faso, highlighting the extent to which families still face out-of-pocket payments despite exemption policies.[45] In Mali and Guinea, stock-outs may stem more from insufficient or delayed deliveries from pharmaceutical depots.[30 46] Furthermore, inappropriate prescribing

Table 3 Factors associated with direct payments for the care of children under 5 years attending IMCI consultations in Burkina Faso and Niger in the AIRE project, June 2021 to May 2022

	No medical expenditure	Medical expenditure	Part 1: factors associated with direct payment			Part 2: determinants of the amount of expenditure		
	N (%)	N (%)	aOR	95% CI	P value	aOR	95% CI	P value
Burkina Faso	(*n=237*)	(*n=148*)			(*n=385*)			(*n=148*)
Sex								
Female (ref)	107 (64)	59 (36)	1			1		
Male	130 (59)	89 (41)	1.34	(0.75–2.42)	0.324	0.84	(0.62–1.12)	0.235
Age of the child								
≥2 months (ref)	215 (65)	114 (35)	1			1		
<2 months	22 (39)	34 (61)	4.83	(2.35-10.03)	0.000	0.70	(0.47–1.04)	0.074
Education level of the head of household								
No (ref)	199 (63)	116 (37)	1			1		
Primary level and up	38 (54)	32 (46)	1.16	(0.53–2.45)	0.706	1.60	(1.11–2.31)	0.012
Income-generating activity of the main child caregiver								
No (ref)	190 (63)	110 (37)	1			1		
Yes	47 (55)	38 (45)	0.68	(0.3–1.48)	0.345	0.87	(0.6–1.26)	0.460
Time to visit PHC since onset of symptoms								
<2 days (ref)	103 (61)	67 (39)	1			1		
From the second day	134 (42)	81 (38)	1.09	(0.61–1.96)	0.777	1.52	(1.11-2.08)	0.009
Transport duration to PHC								
<30 min (ref)	213 (62)	128 (38)	1			1		
≥30 min	24 (55)	20 (45)	1.44	(0.54–3.64)	0.445	1.15	(0.74–1.81)	0.537
All medicines delivered at PHC or RH depot								
Yes (ref)	231 (78)	64 (22)	1			1		
No	6 (7)	84 (93)	66.32	(27.84-188.2)	0.000	0.51	(0.36–0.73)	0.000
Niger	(*n=44*)	(*n=374*)			(*n=418*)			(*n=374*)
Sex								
Female (ref)	26 (13)	167 (87)	1			1		
Male	18 (8)	207 (92)	2.73	(1.2-6.5)	0.019	1.04	(0.87–1.25)	0.680
Age of the child								
≥2 months (ref)	38 (10)	339 (90)	1			1		
<2 months	6 (15)	35 (85)	0.32	(0.11–1.07)	0.051	1.18	(0.86–1.63)	0.310
Education level of the head of household								
No (ref)	27 (10)	244 (90)	1			1		
Primary level and up	17 (12)	130 (88)	0.64	(0.25–1.66)	0.354	1.05	(0.85–1.29)	0.651
Income-generating activity of the main child caregiver								
No (ref)	37 (11)	298 (89)	1			1		
Yes	7 (8)	76 (92)	3.32	(1.01-12.18)	0.057	1.12	(0.87–1.45)	0.390
Time to visit PHC since onset of symptoms								
<2 days (ref)	19 (14)	118 (86)	1			1		
From the second day	25 (9)	256 (91)	1.51	(0.63–3.53)	0.344	1.63	(1.31-2.02)	0.000
Transport duration to PHC								
<30 min (ref)	32 (11)	249 (89)	1			1		
≥30 min	12 (9)	125 (91)	0.42	(0.15–1.14)	0.089	1.63	(1.26-2.09)	0.000
All medicines delivered at PHC or RH depot								
Yes (ref)	32 (49)	33 (51)	1			1		

Continued

Table 3 Continued

	No medical expenditure	Medical expenditure	Part 1: factors associated with direct payment			Part 2: determinants of the amount of expenditure		
	N (%)	N (%)	aOR	95% CI	P value	aOR	95% CI	P value
No	12 (3)	341 (97)	63.57	(24.11–202.05)	0.000	1.00	(0.71–1.41)	0.983

A two-part model including (1) a logistic regression estimating the probability of any out-of-pocket payment and (2) a generalised linear model (gamma distribution, log link).
Note: results from a two-part model including (1) a logistic regression estimating the probability of any out-of-pocket payment and (2) a generalised linear model (gamma distribution, log link) modelling the amount spent among those with a payment. Models include a random effect at the PHC level. Both parts of the model include a random intercept at the PHC level to account for clustering of observations within facilities. We present exponentiated coefficients, to be interpreted as the ratio of expected costs relative to the reference group.
AIRE, Améliorer l'Identification des détresses Respiratoires chez l'Enfant; aOR, adjusted Odd Ratio; CI, Confidence Interval; IMCI, Integrated Management of Childhood Illness; PHC, primary health centre; RH, Referral Hospital.

practices, such as the overuse of antibiotics, even in simple IMCI cases where antibiotics are not recommended, may inflate costs and contribute to medicine shortages. According to the WHO, more than 40% of antibiotic prescriptions in primary healthcare in low- and middle-income countries are inappropriate.[47] More specifically, within the AIRE project, we found high proportions of antibiotic prescriptions among children classified as simple IMCI cases in all countries, even though no antibiotic therapy is recommended for the management of these cases.[48]

Our analyses in Burkina Faso revealed a complex relationship between medicine purchase location and household expenses. While purchasing medicines outside of PHCs significantly increased the likelihood of incurring any out-of-pocket payment, the actual amount spent was paradoxically lower when medicines were bought externally. This may suggest that caregivers who sought medicines outside the public health system were managing less severe illnesses, resulting in smaller overall expenses despite a higher probability of payment. It is important to note that case severity was excluded from these analyses due to strong collinearity with medicine purchase location, which could have introduced residual confounding and influenced these associations. In contrast, in Guinea and Mali, both the likelihood and amount of expenses were higher when medicines were purchased outside public facilities, likely reflecting persistent stock-outs and reliance on more expensive private pharmacies. Several studies have also shown that the purchasing of medicines outside of the public pharmacy depots, due to stock-outs, was the main determinant of direct payments.[35 49] In Niger, medicine purchase location was not significantly associated with cost differences, possibly due to higher referral rates (73% vs 29% in other countries) to RHs where overall care costs are elevated, diminishing the relative impact of medicine procurement source.

Furthermore, we found that in Niger, care of neonates <2 months was less likely to induce expenses. Unfortunately we have data on the survival outcome only for severe cases, but we hypothesise that these youngest children may not have received adequate care due to delayed visits to the PHC (82%) and the lack of medicines in appropriate galenic forms and dosages, which led to early deaths then resulting in the absence of MDC. There is an urgent need to improve financing modalities to ensure a regular and adequate supply of medicines at all levels of the health pyramid. Additionally, in Niger, male children were more likely to incur higher out-of-pocket expenses compared with females, potentially reflecting sociocultural preferences for male children in healthcare-seeking behaviour. This gender disparity warrants further investigation, especially regarding clinical outcomes.[50]

Our results are in line with previous studies conducted in West Africa and other African settings such as Tanzania which have shown that exemption policies do not make it possible to eliminate direct payments.[17 18 44 51–53] In Burkina Faso, studies have reported that although more children were brought to health centres after fees were removed, families still struggled with other costs.[54–56] In another study, authors found that many families in Sub-Saharan Africa spent a large share of their income on surgery for their children, even when care was supposed to be free.[57] Removing fees alone does not fully protect families and inefficiencies in the implementation of TEP and PEP undermine progress.[58] To make care truly affordable, governments should also consider support for transport, cash assistance and making sure medicines are always available. Without these extra measures, many families may still avoid or delay seeking care for their children.[18]

This study presents several limitations. First, importantly, collecting cost-of-care data from parents and caregivers can be subject to recall and social desirability biases, although efforts were made to minimise these through timely data collection and receipt verification. Second, the indirect costs estimate relied on proxies for income which may not fully capture variations across different types of employment. However, given the significant burden of indirect costs on households, it is important to include these costs in the scope of our analysis. Third,

Table 4 Factors associated with direct payments for the care of children under 5 years attending IMCI consultations in Guinea and Mali in the AIRE project, June 2021 to May 2022

	N (%)	aOR	IC 95%	P value
Guinea (n=442)				
Sex				
Female (ref)	215 (49)	1		
Male	227 (51)	0.94	(0.74–1.21)	0.645
Age of the child				
≥2 months (ref)	408 (92)	1		
<2 months	34 (8)	0.54	(0.34–0.86)	0.009
Education level of the head of household				
No (ref)	231 (52)	1		
Primary level and up	211 (48)	0.90	(0.67–1.19)	0.450
Income-generating activity of the main child caregiver				
No (ref)	233 (53)	1		
Yes	209 (47)	0.97	(0.75–1.24)	0.782
Time to visit PHC since onset of symptoms				
<2 days (ref)	65 (15)	1		
From the second day	377 (85)	1.13	(0.8–1.61)	0.477
Transport duration to PHC				
<30 min (ref)	327 (74)	1		
≥30 min	115 (26)	0.97	(0.73–1.3)	0.858
All medicines delivered at PHC or RH depot				
Yes (ref)	364 (82)	1		
No	78 (18)	2.18	(1.56–3.05)	0.000
Mali (n=440)				
Sex				
Female (ref)	198 (45)	1		
Male	242 (55)	1.06	(0.87–1.3)	0.540
Age of the child				
≥2 months (ref)	384 (87)	1		
<2 months	56 (13)	1.31	(0.96–1.79)	0.088
Education level of the head of household				
No (ref)	292 (66)	1		
Primary level and up	150 (34)	1.07	(0.82–1.39)	0.631
Income-generating activity of the main child caregiver				
No (ref)	308 (70)	1		
Yes	132 (30)	0.75	(0.59–0.95)	0.016
Time to visit PHC since onset of symptoms				
<2 days (ref)	135 (31)	1		
From the second day	305 (69)	0.87	(0.69–1.08)	0.207
Transport duration to PHC				
<30 min (ref)	337 (77)	1		
≥30 min	103 (23)	1.16	(0.86–1.57)	0.325
All medicines delivered at PHC or RH depot				
Yes (ref)	41 (9)	1		
No	399 (91)	1.46	(1.06–2.02)	0.021

Continued

Table 4 Continued

	N (%)	aOR	IC 95%	P value

A generalised linear model (gamma distribution, log link).
Note: generalised linear models with a gamma distribution and log link function were used to estimate factors associated with the amount of out-of-pocket payments. Coefficients are presented on the log scale and indicate multiplicative effects on direct costs relative to the reference category. A random intercept for PHC was included to account for clustering at the facility level.
AIRE, Améliorer l'Identification des détresses Respiratoires chez l'Enfant; aOR, adjusted Odd Ratio; IMCI, Integrated Management of Childhood Illness; PHC, primary health centre; RH, referral hospital.

analyses did not account for clustering within PHCs, possibly overstating statistical significance. However, we believe the results still provide a reasonable indication of the overall trends and relationships. Fourth, MDC may be underestimated in these countries due to the medicines being supplied as part of the supply of medicines through the AIRE project could have led to underestimation or overestimation of direct costs. Fifth, data on household income or consumption were not collected limiting the assessment of catastrophic expenditures and coping mechanisms. Finally, cross-country comparisons should be interpreted with caution given the complex interplay of health system performance, policy design, medicine availability and socioeconomic factors beyond exemption policies.

Nonetheless, this study made it possible to quantify both direct and indirect costs borne by families caring for young children in these West African contexts, providing standardised data that enhance understanding of the implementation and impact of exemption policies. Our findings emphasise that while removing user fees is a critical step toward universal health coverage, additional measures, such as ensuring reliable medicine supply, providing transport support and addressing indirect cost, are essential to alleviate the financial burden on vulnerable households and improve access to care.

CONCLUSION

The findings of this study, carried out within the AIRE project, highlight the continued presence of out-of-pocket payments, despite the existence of total or partial exemption policies for children under 5 years. These expenditures remain substantial, particularly in the context of severe illnesses requiring hospitalisation, and likely contribute to delays in seeking care. Both the likelihood and amount of out-of-pocket payments were strongly associated with the purchase of medicines outside of PHCs and RHs, reflecting recurrent stock-outs and the limited capacity of public facilities to consistently provide affordable medications compared with private pharmacies. While it is well recognised that the inadequate mobilisation of financial resources is insufficient to support exemption policies, there is a pressing need for further research into sustainable financing mechanisms that can guarantee a regular and sufficient supply of essential medicines within public health systems. This study provides valuable evidence and raises key hypotheses for shaping more effective health policies towards the affordability of primary care for children under 5 years, thereby supporting progress toward the broader goal of universal health coverage in sub-Saharan Africa.

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Patient and public involvement Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Patient consent for publication Consent obtained from parent(s)/guardian(s).

Ethics approval This study involves human participants and was approved by Ethics approval and consent to participate The AIRE research protocol, the information notice (translated in vernacular languages), the written consent form and any other relevant document have been submitted to each national ethics committee, to the Inserm Institutional Evaluation Ethics Committee (IEEC) and to the WHO Ethics Review Committee (WHO-ERC). All the aforementioned ethical committees reviewed and approved the protocol and other key documents (Comité d'Ethique pour la Recherche en Santé (CERS), Burkina Faso n°2020–4-070; Comité National d'Ethique pour la Recherche en Santé (CNERS), Guinea n°169/CNERS/21; Comité National d'Éthique pour la Santé et les Sciences de la vie (CNESS), Mali n°127/MSDS-CNESS; Comité National d'Ethique pour la Recherche en Santé (CNERS) Niger n°67/2020/CNERS; Inserm IEEC n°20–720; WHO-ERC n° ERC.0003364). This study has been retrospectively registered by the Pan African Clinical Trials Registry on 15 June 2022 under the following Trial registration number: PACTR202206525204526. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data may be obtained from a third party and are not publicly available. The datasets generated and analysed during the current study are not publicly available. Access to processed de-identified participant data will be made available to any third party after the publication of the main AIRE results stated in the Pan African Clinical Trial Registry Study statement (PACTR202206525204526, registered on 06/15/2022), upon a motivated request (concept sheet), and after the written consent of the AIRE research coordinator (Valeriane Leroy, valeriane.leroy@inserm.fr, Inserm U1295 Toulouse, France, orcid.org/0000-0003-3542-8616) obtained after the approval of the AIRE publication committee, if still active.

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