Does HIV Services Decentralization Protect against the Risk of Catastrophic Health Expenditures? Some Lessons from Cameroon

Sylvie Boyer, Mohammad Abu-Zaineh, Jérôme Blanche, Sandrine Loubière, Renée-Cécile Bonono, Jean-Paul Moatti, and Bruno Ventelou

Objective. Scaling up antiretroviral treatment (ART) through decentralization of HIV care is increasingly recommended as a strategy toward ensuring equitable access to treatment. However, there have been hitherto few attempts to empirically examine the performance of this policy, and particularly its role in protecting against the risk of catastrophic health expenditures (CHE). This article therefore seeks to assess whether HIV care decentralization has a protective effect against the risk of CHE associated with HIV infection.

Data Source and Study Design. We use primary data from the cross-sectional EVAL-ANRS 12-116 survey, conducted in 2006–2007 among a random sample of 3,151 HIV-infected outpatients followed up in 27 hospitals in Cameroon.

Data Collection and Methods. Data collected contain sociodemographic, economic, and clinical information on patients as well as health care supply-related characteristics. We assess the determinants of CHE among the ART-treated patients using a hierarchical logistic model ($n = 2,412$), designed to adequately investigate the separate effects of patients and supply-related characteristics.

Principal Findings. Expenditures for HIV care exceed 17 percent of household income for 50 percent of the study population. After adjusting for individual characteristics and technological level, decentralization of HIV services emerges as the main health system factor explaining interclass variance, with a protective effect on the risk of CHE.

Conclusion. The findings suggest that HIV care decentralization is likely to enhance equity in access to ART. Decentralization appears, however, to be a necessary but insufficient condition to fully remove the risk of CHE, unless other innovative reforms in health financing are introduced.

Key Words. Catastrophic health expenditures, decentralization, multilevel modeling, HIV treatment, Cameroon

Given the lack of formal health insurance and the dominance of user fees in health financing-mix in low-income countries, health shocks are fully borne by households, contributing to income and expenditures' uncertainty, which play a key role in determining household welfare (Dercon 2005). Like other chronic diseases, HIV infection, which is associated with large health expenditures (HE), is likely to severely affect household welfare (Gertler and Gruber 2002; Russell 2004). The "welfare" effect of HE can be approximated using cross-sectional data through the share of the household budget dedicated to them (Wagstaff and Van Doorslaer 2003; Xu et al. 2003; Van Doorslaer et al. 2007). HE may be considered "catastrophic" (CHE) when they exceed a certain threshold of household budget, as this entails a substantial sacrifice of household's consumption, possibly including basic needs, and/or the usage of extra resources such as savings, assets, debts, and transfers from friends and family (Russell 1996; Wagstaff 2002; Flores et al. 2008). While such coping mechanisms help smooth consumption and protect household welfare from health shocks in the short run, they can contribute to the households' asset depletion and accumulation of debt, increasing their vulnerability to future shocks (Sauerborn et al. 1996; Van Damme et al. 2004; Flores et al. 2008).

Protecting the population against the risk of CHE and the subsequent impoverishing effect has been widely supported as a desirable policy objective for the health systems (WHO, 2000, Xu et al. 2003; Kruk and Freedman 2008). Nonetheless, the fight against HIV/AIDS epidemic has entered a new era with scaling-up antiretroviral treatment (ART) through decentralizing the provision of HIV care being increasingly recommended as a leading strategy to ensure equitable and universal access to treatment (Gilks et al. 2006).

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Address correspondence to Sylvie Boyer, Ph.D., INSERM UMR 912/ORS PACA, 23 rue Stanislas Torrents, 13006 Marseille, France; e-mail: sylvie.boyer@inserm.fr. Sylvie Boyer, Ph.D., Mohammad Abu Zaineh, Ph.D., Jérôme Blanche, M.Sc., and Sandrine Loubière, Ph.D., are with the INSERM, U912 (SE4S), Marseille, France and the Université Aix Marseille, IRD, UMR-S912, Marseille, France and ORS PACA, Observatoire Régional de la Santé Provence Alpes Côte d'Azur, Marseille, France. Renée-Cécile Bonono, M.Sc., is with the Socio-Anthropological Research Institute (IRSA), Catholic University of Central African States, Yaoundé, Cameroon. Jean-Paul Moatti, Ph.D., is with the INSERM, U912 (SE4S) Marseille, France and, Université Aix Marseille, IRD, UMR-S912, Marseille, France and ORS PACA, Observatoire Régional de la Santé Provence Alpes Côte d'Azur, Marseille, France. Bruno Ventelou, Ph.D., is with the INSERM, U912 (SE4S), Marseille, France, and Université Aix Marseille, IRD, UMR-S912, Marseille, France, and ORS PACA, Observatoire Régional de la Santé Provence Alpes Côte d'Azur, and GRECAM, CNRS, Marseille, France.

A standard economic hypothesis, formulated by Oates (1972) in his *decentralization theorem*, postulates that the transfer of certain functions to lower levels of governments, which are closer to the beneficiaries of local public services, can have, under some conditions,¹ a positive effect on the provision of such services by improving (1) allocative efficiency due to better information about local preferences, and therefore better adaptation of public policy to citizen's needs, and (2) technical efficiency, due to the declining number of hierarchical levels, and therefore, lower transaction costs. On the basis on these theoretical arguments, decentralization of health systems has long been recommended to enhance the delivery of health care services, especially in the low- and middle-income countries (World Bank 1993; Shah 1994). However, given the relatively mixed evidence on the impact of this policy on health care system performance in these countries, several authors (e.g., Atkinson et al. 2000; Saltman, Bankauskaite, and Vrangbæk 2007; Bossert and Mitchell 2011) have recently contended that an appropriate decision space in tandem with adequate institutional capacity and accountability are required for decentralization to help improve the delivery of health care through making public choices consistent with local health needs and households' capacity to pay.

Although the issue of decentralization has been at the heart of the international debate on scaling-up interventions for specific diseases such as HIV/AIDS, there have been hitherto few attempts to empirically examine its performance, in particular, its role in matching health care services' prices with the households' financial capacity and in protecting households against CHE. The present study attempts to fill the gap in the literature by examining the relationship between decentralization of health care provision and the financial protection against the risk of catastrophic HIV expenditures. Specifically, the study seeks to test the hypothesis that the policy of HIV care decentralization can have a *protective effect* against the financial risk associated with HIV infection given the capacity of the local providers to adapt their services to local populations' preferences as well as their ability to pay. We use data from a national representative survey—the EVAL survey (ANRS 12-116)—conducted in 2006–2007 as part of the independent evaluation of the national ART program in Cameroon (Boyer et al. 2010). First, we examine the magnitude of out-of-pocket (OOP) payments for HIV care, and second, we identify the characteristics of the health care system and those of individuals that can protect households from the risk of catastrophic payments, with a particular focus on the role played by the geographic level of decentralization of HIV services delivery.

METHODS

Setting: The HIV Services Decentralization Policy in Cameroon

In 2001, the government of Cameroon—a country facing a generalized HIV epidemic (UNAIDS, OMS, and UNICEF 2008)—has launched an initiative to expand access to ART using a progressive decentralization of HIV services while relying on the preexisting decentralized framework of the health care delivery system (Ministry of Public Health 2006). The latter is structured into three tiered pyramidal levels, with district-level hospitals at the bottom, provincial, and central-level hospitals at the middle and top levels, respectively. During the years 2001–2002, 23 Accredited Treatment Centers (ATC) have been created in the central- and provincial-level hospitals, and then from 2005 to 2008, about 100 HIV Management Units (MU) have been set up in the district-level hospitals (Koulla-Shiro and Delaporte 2008). In addition, provincial and district-level hospitals were granted a high level of management autonomy through health care system decentralization. Analysis of the decision space afforded to the district-level providers, following the analytical framework proposed by Bossert (1998; Bossert and Mitchell 2011), suggested that a relatively large range of choice was allowed for two key functions of HIV care delivery: (1) HIV care organization including ART delivery organization (e.g., in a public or private services counter), places and time schedule of HIV services, conception and planning of activities related to information and education on HIV infection, task-shifting of health care staff; and (2) design of “user fees” schemes and management of local resources (see Table 1 for a full description of the HIV services decentralization policy in Cameroon) (Gruénais 2001; Eboko et al. 2010). The large autonomy afforded to this latter function has resulted in large differences between facilities in user fees for various HIV services. Exceptions to this were prices for biological monitoring and antiretroviral drugs which were fixed and subsidized by the government.² Moreover, patients identified as “indigent”³ were entitled to free access to ART up to a maximum of 10 percent of the total number of patients in each facility.

In 2009, OOP were estimated at 78.8 percent of the total HE (which is one of the largest percentages in the world), whereas total and public HE amounted to U.S.\$94 and U.S.\$20 per capita, respectively (WHO, 2009). Although the contribution of Cameroonian government has increased from U.S.\$2.4 million in 2002 to U.S.\$9.6 million in 2007, HIV financing still relies heavily on international aid, which constituted 85 percent of the total

Table 1: The HIV Services Decentralization Policy in Cameroon

<i>Key Dimensions of Decentralization Policy</i>	<i>Description</i>
1. Institutional form	<ul style="list-style-type: none"> • Deconcentration: administrative decentralization within the public health sector from the central services to district health services • Delegation of management toward public care providers (e.g., hospitals) and toward the private health sector through i) integrating the private health care sector into the national health system and ii) entrusting ART delivery to a number of private providers, mostly not-for-profit hospitals managed by faith-based organization
2. Geographic level	<ul style="list-style-type: none"> • Health district and care providers
3. Functions and range of autonomy afforded to care providers involved in HIV services	
<i>Financing</i>	
Budgeting and resource mobilization	<ul style="list-style-type: none"> • Large to moderate autonomy for resources mobilized through user fees: Payment mechanisms and amounts of user fees are determined by care providers, except for some key HIV services whose prices are fixed by the health ministry (such as antiretroviral drugs and biological monitoring) • Narrow for government subsidies
Resource allocation	<ul style="list-style-type: none"> • Large autonomy for resources mobilized through user fees • Narrow for government subsidies
<i>Service organization</i>	
Patient progression	<ul style="list-style-type: none"> • Large
Places and schedule of HIV services	<ul style="list-style-type: none"> • Large
ART delivery organization	<ul style="list-style-type: none"> • Large
Task-shifting between health care workers	<ul style="list-style-type: none"> • Large
Conception and planning of information and education on HIV	<ul style="list-style-type: none"> • Large
<i>Human resources</i>	
Hiring	<ul style="list-style-type: none"> • Large to moderate for contractual staff (some possibility of hiring staff are given through the income generated by user fees) but narrow for civil servants
Allocation	<ul style="list-style-type: none"> • Narrow
Sanction	<ul style="list-style-type: none"> • Narrow: decisions of allocation, sanction, and layoff remain at the central level with little follow-up by the central level to the relevant requests of care providers

Note. ART, antiretroviral therapy.

expenditures allocated to the infection during 2004–2007 (Nkoa, Eboko, and Moatti 2010).

Study Design

The EVAL-ANRS 12-116 is a nationally representative cross-sectional survey conducted between September 2006 and March 2007 among a random sample of 3,151 HIV-infected outpatients. The sample covered 27 hospitals (8 and 6 ATCs at the central and provincial levels, respectively, and 13 MU at the district level) located in six⁴ of the 10 provinces of Cameroon. These provinces were selected to best represent the country's cultural and socioeconomic diversity as well as the regional differences in HIV prevalence (Boyer et al. 2010). Outpatients having at least 3 months HIV-positive diagnosis and aged 21 years or above were randomly selected for inclusion in the survey following a procedure previously described by Boyer et al. (2011). Participants were asked for their written approval and interviewed, after their consultation, using a face-to-face questionnaire, by social science students who received training on data collection tools by the research team. Refusals to participate, both by patients and hospital staff, were recorded together with associated basic patient characteristics. After the interviews, blood samples were collected for CD4 count assessment. Clinical data from both clinical examination and retrospective medical files were recorded by care providers using a standardized medical questionnaire. In addition, data on the characteristics of the 27 hospitals participating in the study were obtained through interviews of managers and nursing staff, in situ observations, and cross-validation with data recorded in hospital activity reports. Prior to study implementation, a pilot survey was conducted in six hospitals. The EVAL research project was approved by the Ministry of Public Health in Cameroon and the Cameroonian National Ethics Committee.

Variables

For the purpose of this study, the following sets of patient/household variables were used.

1. *Sociodemographic indicators*: gender, age, educational level (higher versus lower than university), marital status, being the head of the

- household, and residence location (living in a rural area versus living in an urban or semi-urban area).
2. *Household socioeconomic status (SES) assessed by two variables:* (a) an asset index to capture the “permanent” household resource constraint (Okunade, Suraratdecha, and Benson 2010; see details on construction of the asset index in Table 2); (b) monthly income including all resources reported by the household. The use of these two variables was motivated by the fact that they represent separate and sufficiently uncorrelated aspects of the household resource base driving spending decisions—as reflected by the low correlation coefficients between the two variables across quantile groups.
 3. *Clinical characteristics:* date of ART initiation, CD4 count at ART initiation and at the time of the survey, and number of treatment-related side effects during the previous 4 weeks assessed by the HIV symptom index of Justice et al. (2001).
 4. *Health care utilization during the previous 6 months:* hospitalization, consultation of a private physician outside the treatment center, consultation of a traditional healer, self-medication, defined as the use of a drug without professional advice or prescription (all assessed by dummy variables), and frequency of visits in the treatment center (one visit, between 2 and 6, more than 6 visits).
 5. Total monetary health expenditures (HE_i) during the previous month (including payments for ART and other drugs, medical consultations, hospitalization, biological tests, traditional healer consultation, and transportation) and free access to care (dummy variable).
 6. *Quality of HIV care:* average monthly gain in CD4 cells/ μ l, adherence to ART during the previous 4 weeks assessed by a previously validated scale (Carrieri et al. 2001), and perceived physical and mental quality of life assessed using the 12-item Medical Outcomes Study Short-Form General Health Survey.
 7. *Patients’ satisfaction with HIV services quality and health care accessibility:* level of trust in health care staff and difficulties getting a consultation (assessed using a 4-point Likert items), perception of the attention paid by the health care staff (assessed using a visual scale graduated on 6 points), waiting time before consultation (greater versus less than 1 hour), experience of ART shortage in hospital pharmacies (at least once versus never), and transport duration to hospital (greater versus less than 1 hour).

Table 2: Descriptive Statistics According to the Three Levels of HIV Care Decentralization (EVAL Survey, ANRS 12-116, $n = 2,412$)

	<i>n (%) or Mean (SD) or Median [IQR]</i>				
	<i>Total Level (n = 2,412)</i>	<i>Central Level (n = 838)</i>	<i>Provincial Level (n = 842)</i>	<i>District Level (n = 732)</i>	<i>p-value</i>
Sociodemographic, economic, and clinical characteristics					
Male gender	706 (29.3)	250 (29.8)	237 (28.1)	219 (29.9)	.67
Age (years), mean (SD)	38.35 (9.2)	38.57 (9.2)	38.66 (9.2)	37.75 (9.3)	.07
Living in a rural area	514 (21.3)	48 (5.7)	169 (20.1)	297 (40.6)	<10 ⁻³
University educational level	179 (7.4)	88 (10.5)	60 (7.1)	31 (4.2)	<10 ⁻³
Being married	880 (36.5)	305 (36.4)	298 (35.4)	277 (37.8)	.60
Monthly household income per equivalent adult × 10 ³	10.0 [5.3; 20.0]	13.9 [7.8; 27.3]	10.0 [5.0; 19.2]	7.4 [4.0; 14.3]	<10 ⁻³
FCFA ^{*,†}					
Asset index [‡]	0.6 [0.4; 0.7]	0.6 [0.5; 0.8]	0.5 [0.4; 0.7]	0.4 [0.2; 0.6]	<10 ⁻³
No. of self-reported side effects during the previous 4 weeks	6 [3; 9]	6 [4; 9]	6 [4; 10]	5 [2; 7]	<10 ⁻³
Time since ART initiation (months)	16.3 [7.7; 28.6]	15.2 [6.4; 27.9]	19.8 [9.2; 33.5]	13.9 [7.5; 24.3]	<10 ⁻³
Episode of hospitalization [§]	282 (11.7)	80 (9.5)	104 (12.4)	98 (13.4)	.05
CD4 cell count at the time of survey (cells/mm ³)	345 [220; 448]	349 [215; 426]	340 [220; 449]	344 [229; 484]	.12
Health care use and health expenditures (HE)					
Frequency of visits in the treatment center [§]					
One visit	708 (29.3)	303 (36.2)	182 (21.6)	223 (30.5)	<10 ⁻³
Between 2 and 6 visits	1554 (64.4)	464 (55.1)	619 (73.5)	474 (64.7)	
More than 6 visits	150 (6.2)	74 (8.8)	41 (4.9)	35 (5.0)	
Consultation of a private physician outside the treatment center [§]	352 (14.6)	110 (13.1)	141 (16.7)	101 (13.8)	.08
Self-medication [§]	539 (22.3)	184 (21.0)	226 (26.8)	129 (17.6)	<10 ⁻³
Consultation of a traditional healer [§]	217 (9.0)	84 (10.0)	77 (9.1)	56 (7.6)	.26

continued

Table 2. Continued

	<i>n</i> (%) or Mean (SD) or Median [IQR]				<i>p</i> -value
	Total (<i>n</i> = 2,412)	Central Level (<i>n</i> = 838)	Provincial Level (<i>n</i> = 842)	District Level (<i>n</i> = 732)	
Detailed monthly HE (FCFA)*					
<i>Consultations</i>					
<i>n</i> (%) paying >0	791 (32.8)	497 (59.3)	110 (13.1)	184 (25.1)	<10 ⁻³
Mean (median) for those paying >0	2,122 (1,600)	2,438 (2,000)	2,187 (1,000)	1,230 (1,000)	
<i>Lab tests</i>					
<i>n</i> (%) paying >0	241 (10.0)	139 (16.6)	69 (8.2)	33 (4.5)	.001
Mean (median) for those paying >0	10,433 (3,500)	13,862 (4,000)	5,030 (3,000)	7,288 (4,500)	
<i>ART</i>					
<i>n</i> (%) paying >0	2125 (88.1)	730 (87.1)	766 (100.0)	629 (86.0)	<10 ⁻³
Mean (median) for those paying >0	4,337 (3,000)	4,954 (3,000)	4,100 (3,000)	3,909 (3,000)	
<i>Other drugs</i>					
<i>n</i> (%) paying >0	487 (20.2)	239 (28.5)	135 (16.0)	113 (15.4)	<10 ⁻³
Mean (median) for those paying >0	7,887 (3,000)	9,289 (5,000)	9,229 (5,000)	3,317 (1,500)	
<i>Hospitalization</i>					
<i>n</i> (%) paying >0	55 (2.3)	28 (3.3)	10 (1.2)	17 (2.3)	.01
Mean (median) for those paying >0	48,941 (32,000)	66,714 (49,500)	30,640 (26,000)	30,432 (25,900)	
<i>Consultation of a traditional healer</i>					
<i>n</i> (%) paying >0	47 (1.9)	16 (1.9)	15 (1.8)	16 (2.2)	.77
Mean (median) for those paying >0	18,706 (6,000)	28,037 (8,250)	17,840 (4,000)	10,187 (5,500)	
<i>Transport</i>					
<i>n</i> (%) paying >0	2066 (85.7)	787 (93.9)	691 (82.1)	588 (80.3)	<10 ⁻³
Mean (median) for those paying >0	3,041 (1,200)	2,776 (1,000)	4,310 (1,200)	2,960 (2,000)	

continued

Table 2. Continued

	<i>n</i> (%), or Mean (SD), or Median [IQR]				<i>p</i> -value
	Total (<i>n</i> = 2,412)	Central Level (<i>n</i> = 838)	Provincial Level (<i>n</i> = 842)	District Level (<i>n</i> = 732)	
<i>Total</i>					
<i>n</i> (%) paying >0	2356 (97.7)	833 (99.4)	823 (97.7)	700 (95.6)	<10 ⁻³
Mean (median) for those paying >0	11,148 (7,000)	16,178 (8,600)	9,605 (6,600)	8,121 (5,800)	
Share of HE in household income					
Mean (SD)	39.6 (118.3)	44.5 (175.9)	34.9 (68.9)	39.4 (72.6)	.17
Median [IQR]	17.1 [7.7; 37.4]	15.73 [7.5; 36.8]	17.0 [7.4; 37.3]	18.62 [8.6; 38.2]	
Share of HE in household income across household quantile ^{*,†}					
1 st quantile median [IQR]	14.0 [3.4; 46.2]	27.2 [10.5; 72.2]	9.0 [1.9; 37.7]	16.0 [3.6; 40.7]	.02
2 nd quantile median [IQR]	9.2 [2.5; 24.1]	11.0 [4.0; 27.5]	8.0 [1.8; 25.0]	8.8 [2.4; 21.8]	
3 rd quantile median [IQR]	5.8 [1.8; 11.2]	8.4 [3.3; 18.1]	4.0 [1.3; 15.5]	4.1 [1.2; 13.3]	
4 th quantile median [IQR]	4.2 [1.2; 11.2]	4.8 [2.2; 13.9]	2.8 [0.6; 8.9]	4.3 [1.3; 11.0]	
5 th quantile median [IQR]	2.7 [0.8; 9.0]	3.5 [1.3; 11.9]	2.3 [0.4; 7.4]	2.0 [0.4; 6.0]	
Catastrophic HE (≥ 20% of household income)	1,073 (44.5)	355 (42.3)	373 (44.3)	345 (47.1)	.16
Access to free ART					
<i>Total</i>	219 (9.0)	78 (9.3)	58 (6.9)	83 (11.3)	.009
Poor (< poverty threshold)	201 (8.3)	71 (8.5)	52 (6.2)	78 (10.6)	.007
Nonpoor (≥ poverty threshold)	18 (0.7)	7 (0.8)	6 (0.7)	5 (0.7)	.57
HIV care quality and patients' satisfaction with services					
Monthly gain in CD4 cells count, median [IQR]	12.38 [5.2; 24.4]	13.47 [6.2; 25.8]	10.20 [4.0; 20.1]	14.54 [6.0; 28.4]	<10 ⁻³
Physical quality of life score, median [IQR]	51.19 [43.8; 55.8]	51.20 [43.5; 55.7]	51.0 [43.6; 55.8]	51.37 [44.4; 55.9]	.53

continued

Table 2. Continued

	<i>n</i> (%) or Mean (SD) or Median [IQR]				<i>p</i> -value
	<i>Total</i> (<i>n</i> = 2,412)	<i>Central</i> <i>Level</i> (<i>n</i> = 838)	<i>Provincial</i> <i>Level</i> (<i>n</i> = 842)	<i>District</i> <i>Level</i> (<i>n</i> = 732)	
Mental quality of life score, median [IQR]	44.45 [37.8; 50.6]	43.21 [35.7; 49.7]	44.86 [38.7; 51.4]	45.09 [38.9; 51.0]	<10 ⁻³
Adherence during the previous 4 weeks					
<i>Low</i>	214 (8.9)	78 (9.3)	73 (8.7)	63 (8.6)	<10 ⁻³
<i>Medium</i>	891 (36.9)	391 (46.7)	285 (33.8)	215 (29.4)	
<i>High</i>	1307 (54.2)	369 (44.0)	484 (57.5)	454 (62.0)	
Trust in health care staff					
<i>Little or no trust</i>	61 (2.5)	47 (5.6)	11 (1.3)	3 (0.4)	<10 ⁻³
<i>Full trust</i>	2351 (97.5)	791 (94.4)	831 (98.7)	729 (99.6)	
Great deal of attention paid to patients by health staff	1658 (68.7)	456 (54.4)	556 (66.0)	646 (88.2)	<10 ⁻³
Waiting time before consultation ≥ 1 hour	651 (27.0)	468 (55.8)	145 (17.2)	38 (5.2)	<10 ⁻³
Easy to get a consultation with a physician	750 (31.1)	189 (22.6)	251 (29.8)	310 (42.3)	<10 ⁻³
Transport duration to hospital of follow-up ≥ 1 hour	668 (27.7)	191 (22.8)	225 (26.7)	252 (34.4)	<10 ⁻³
Experience of ARV shortages in hospital pharmacies ^a	264 (10.9)	118 (14.2)	101 (12.1)	45 (6.2)	<10 ⁻³

^aThe number of equivalent adults in the household was computed as the number of adults + 0.5 × the number of children living in the household at the time of the survey.

^b1 U.S.\$ ≈ 492.6 FCFA (exchange rate at time of survey).

^cThe asset index was constructed on the basis of principal components analysis using the following data on household's possession of durable goods and household appliances: having a television, a radio, a mobile phone, a fridge, a bicycle, a motorcycle, a car, cattle, being owner of one's own house, possessing land in rural areas, and/or in urban areas.

^dDuring the previous 6 months.

^eDuring the previous 3 months.

ART, antiretroviral therapy; ARV, antiretroviral drugs; IQR, interquartile range.

The health system setting explanatory variables comprised a decentralization indicator indicating the health care supply level (central, provincial, or district) and the following health care supply-related characteristics used to control for possible confounding effects associated with the decentralization level: size of the facility (number of hospital beds); legal status (public/private); availability of equipment and laboratory tests; prices of services, and skills of human resources in charge of people living with HIV/AIDS (PLWHA).

Theoretical Model and Statistical Analysis

The level of catastrophic payments incurred by a household (O_i) can be defined as:

$$O_i = \frac{HE_i}{y_i} - \tau$$

where y_i is the current household income.⁵ A positive O_i indicates that the household faces catastrophic payments. The proportion of household spending more than τ percent of their disposable income on HIV expenditures (H_{cat}) is as follows:

$$H_{cat} = \frac{1}{N} \sum_i^N E_i \quad \text{with } E_i = 1 \quad \text{if } O_i > 0 \text{ and } 0 \text{ otherwise}$$

where N is the sample size. The threshold of 20 percent which is commonly used in the literature was retained to define catastrophic expenditures (Wagstaff and Van Doorslaer 2003; Su, Kouyate, and Flessa 2006; Xu et al. 2006).

Individual and health system determinants of CHE related to HIV care were identified using a hierarchical logistic model which enabled us to take into account the correlation between individuals within each hospital-level unit (Rice and Jones 1997). Thus, considering patient i receiving care in the health care facility j , the general specification of the model can be written as:

$$O_{ij}^* = \beta_{0j} + \sum_k \beta_{kj} X_k + e_{ij} \quad (\text{individual/house hold})$$

with: $O_{ij}^* = \text{logit}(P(O_{ij} = 1))$; $e_{ij} \sim N(0, \sigma^2)$; and

$$\begin{cases} \beta_{0j} = \gamma_{00} + \sum \gamma_{0h} W_h + u_{0j} \\ \beta_{kj} = \gamma_{k0} + \sum \gamma_{kh} W_h + u_{kj}, \forall k \end{cases} \quad (\text{health care facility})$$

where X_k is a set of k individual variables related to patient i and her/his household, W_h is a set of h variables related to health care facility j , $u_{0j} \sim N(0, \sigma_{00}^2)$ are the random deviations from the overall mean γ_{00} , and u_{kj} are random effects for covariates X_k assumed to follow a complex variance structure:

$$U_{kj} \sim N\left(0, \Sigma\right) \quad \text{with } \Sigma = \begin{bmatrix} \sigma_0^2 & \sigma_{01} & \cdots & \sigma_{0K} \\ \sigma_{01} & \sigma_1^2 & \cdots & \sigma_{1K} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{0K} & \sigma_{1K} & \cdots & \sigma_K^2 \end{bmatrix}$$

The relevance of using hierarchical logistic modeling (HLM) was confirmed by the interfacility variance estimation in a simple null model containing only β_{0j} —the conditional mean of realization of the event “catastrophic payments”—which was found to be significantly different from 0 ($\sigma^2(u_0) = 0.07$; $p < 10^{-3}$). We also performed a likelihood test comparing the model which included only individual variables (Model 1 hereafter) with the corresponding logistic model. Results confirmed the better performance of HLM specification even with low interfacility variance.

Multivariate models were constructed following the modeling strategy recommended for HLM (Hox 2002). Stepwise backward selection procedures were used to select only the significant individual characteristics at the 10 percent threshold. Moreover, age, gender, time since ART initiation and CD4 cell count were retained in the model even when nonsignificant to control for sociodemographic characteristics and health needs (Model 1). Following the same selection procedure, we then introduced and selected the supply-side variables W_h as a predictor of β_{0j} . Final models were obtained after having tested a complex variance structure (u_{kj}) allowing the influence of individual characteristics on catastrophic payments to vary from one health care facility to another and to test which health care supply characteristics could explain such variations (Model 2).

Finally, we examined the robustness of the results by conducting a sensitivity analysis. First, as there is no consensus on the threshold used to define CHE with cut-off values ranging from 5 percent to 40 percent (Russell 1996; Wagstaff and Van Doorslaer 2003; Xu et al. 2003, 2006; Su, Kouyate, and Flessa 2006), we used two other thresholds: a lower (10 percent) and a more conservative (40 percent) one. Second, to test whether the decentralization effect holds across different levels of income, we estimated the main model (threshold of 20 percent) for two subgroups—defined according to the

household income level per equivalent adult (higher versus lower than the poverty line of U.S.\$1.3 per day).

For each model, we produced interhealth care facility variance terms (σ_0^2 and the σ_k^2) as well as an intraclass coefficient of correlation ρ , which represents the proportion of the interhealth care facility variance compared with the total variance, using the following formula (Goldstein, Browne, and Rasbash 2002):

$$\rho = \frac{\sigma_{u_0}^2}{\sigma_{u_0}^2 + \frac{\pi^2}{3}}$$

Multilevel models were estimated using a predictive quasi-likelihood method, implemented in HLM[®]6 (Raudenbush, Bryk, and Congdon 2004).

MAJOR FINDINGS

Among the 3,488 eligible HIV-infected patients who were randomly selected, 3,170 agreed to participate in the survey and 3,151 filled out completely the questionnaire (global response rate: 90.3 percent). No significant differences were found between participants and nonparticipants regarding the main socioeconomic and clinical characteristics, except the CD4 cell count, which was significantly lower among the nonparticipants (with a median of 212, $p < 10^{-3}$, compared with 321 cells/ μ l for the participants). Our study population consisted of 2,412 respondents (76.5 percent) receiving ART for at least 1 month at the time of the survey. Descriptive statistics for the whole study population and according to the level of HIV care decentralization are summarized in Table 2.

The median household monthly income per equivalent adult was approximately U.S.\$20.3 (10,000 FCFA), indicating that almost three-quarters of the households were estimated living under the poverty line. A large majority (97.7 percent) of patients incurred HE during the previous month, the median being U.S.\$14.2 (7,000 FCFA), which represented 17 percent of the household total income for half of the study population. The most frequent expenditures concerned ART (88.1 percent) and transportation (85.7 percent) with a median of U.S.\$8.80 (4,337 FCFA) and U.S.\$6.17 (3,041 FCFA), respectively. As shown in Table 2, while both household SES and each item of HE were significantly lower among patients followed up in provincial and district facilities (except for transportation), the incidence of CHE was not significantly different across the three levels of decentralization, with

39.6 percent ($n = 1,073$) of the study population estimated to have faced CHE (at 20 percent threshold, $p = 0.16$). Interestingly, however, when considering household income distribution per equivalent adult, the incidence of CHE appears to vary significantly across the three levels of decentralization, especially for the three lowest quantiles. For instance, the median [interquartile range or IQR] share of HE in household income of the lowest quantile was 27.2 percent [10.5; 72.2] at the central level compared with 16 percent [3.6; 40.7] and 9.0 percent [1.9; 37.7] at the district and provincial levels, respectively.

Two other interesting results highlighted in Table 2 are worth making. First, individual ART outcomes assessed by CD4 gain since ART initiation, adherence to ART, and perceived quality of life were not worse among patients followed up in district treatment centers compared with those followed up in the central one and even better for some of them. Second, all indicators of patient satisfaction with HIV services quality were significantly better at the provincial and district levels than at the central level: patients reported having more trust in health care staff, receiving a great deal of attention to their problems by the health care staff while spending considerably shorter waiting times before consultation. They also reported fewer difficulties getting a consultation with a physician and a lower proportion had experienced ART stock-outs in hospital pharmacies.

Table 3 presents the factors associated with the risk of CHE. The estimated coefficients, standard deviation, interhealth care facility variance terms, and intraclass coefficients of correlation are presented for Models 1 and 2. Model 1 shows that, after adjusting for health needs and sociodemographic characteristics, a lower asset index and household income per equivalent adult were strongly associated with a higher risk of CHE. As is the case in other studies conducted in low-income countries, this finding indicates a *de facto pro-rich health-financing system* (Xu et al. 2006; Ekman 2007; Abu-Zaineh et al. 2008). Moreover, the significance of both these variables in the multivariate models confirms that they are independent predictors of the risk of CHE (Okunade, Suraratdecha, and Benson 2010).

Unsurprisingly, free access to ART also decreased the risk of CHE. However, the incidence of CHE remained relatively high, in particular among the poorest households, indicating a feeble role of the available exemption mechanisms in protecting the poorest segments of the population and in promoting fairness in the financial contributions (Souteyrand et al. 2008). Among the variables associated with health care utilization, our results also emphasized, in line with other studies, that patients who had extra

Table 3: Factors Associated with the Risk of Catastrophic Payments (threshold = 20%) (Multilevel Logit Models; EVAL Survey, ANRS 12-116, n = 2,412)

	Empty Model at Level 2 (Model 1)		Final Model (Model 2)	
	Coefficient (SD)	p-value	Coefficient (SD)	p-value
Individual factors				
Intercept	3.67 (0.32)	***	3.24 (0.54)	***
Male gender (fixed effect)	0.05 (0.12)	NS	0.03 (0.12)	NS
Age, years (fixed effect)	−0.02 (5.1 × 10 ^{−3})	***	−0.02 (5.0 × 10 ^{−3})	***
Being married (fixed effect)	−0.60 (0.09)	***	−0.63 (0.09)	***
Living in urban or semi-urban area of residence (fixed effect)	−0.44 (0.15)	***	−0.56 (0.13)	***
Monthly household income per equivalent adult ^{†‡} (fixed effect)				
1 st quantile (reference)				
2 nd quantile	−0.98 (0.15)	***	−1.07 (0.14)	***
3 rd quantile	−1.68 (0.15)	***	−1.80 (0.15)	***
4 th quantile	−2.27 (0.13)	***	−2.37 (0.12)	***
5 th quantile	−2.89 (0.17)	***	−3.01 (0.18)	***
Asset index [§] (fixed effect)	−1.17 (0.20)	***	−1.33 (0.21)	***
Free access to ART (fixed effect)				
Intercept	−1.64 (0.17)	***	−1.33 (0.12)	***
Free access to ART: provincial level	—		−0.15 (0.32)	NS
Free access to ART: district level	—		−0.89 (0.31)	**
Time since ART initiation (fixed effect)	1.1 × 10 ^{−3} (3.5 × 10 ^{−3})	NS	1.3 × 10 ^{−3} (3.4 × 10 ^{−3})	NS
CD4 cells count at the time of the survey (fixed effect)	2.2 × 10 ^{−4} (2.5 × 10 ^{−4})	NS	1.4 × 10 ^{−4} (2.5 × 10 ^{−4})	NS
No. of self-reported symptoms during the previous 4 weeks (fixed effect)	0.04 (0.01)	***	0.04 (0.01)	***
Transport time to hospital of follow-up <1 hour (fixed effect)	−1.04 (0.09)	***	−1.03 (0.10)	***
Frequency of visits in the hospital of follow-up [¶] (fixed effect)				
One visit (reference)				
Between 2 and 6 visits	−0.20 (0.12)	*	−0.15 (0.11)	NS
More than 6 visits	0.58 (0.33)	*	0.61 (0.33)	*
Consultation of a private physician outside the treatment center [¶] (fixed effect)	0.41 (0.14)	***	0.42 (0.14)	**

continued

Table 3. *Continued*

	<i>Empty Model at Level 2 (Model 1)</i>		<i>Final Model (Model 2)</i>	
	<i>Coefficient (SD)</i>	<i>p-value</i>	<i>Coefficient (SD)</i>	<i>p-value</i>
Consultation of a traditional healer [†] (fixed and random effects)				
<i>Intercept</i>	0.54 (0.23)	**	0.74 (0.25)	**
<i>Variance of interfacility random effect</i>	—		0.69	**
Health system-related factors				
Decentralization level of HIV care (fixed effect)				
<i>Central level (reference)</i>				
<i>Provincial level</i>	—		−0.64 (0.12)	***
<i>District level</i>	—		−0.63 (0.17)	**
Technological level [‡] (fixed effect)	—		0.15 (0.04)	**
Variance of interfacility random effect	0.218	***	0.035	*
Intraclass coefficient of correlation (ρ), %	6.22	***	1.05	*
Decrease in % of the intraclass coefficient of correlation (ρ) (compared with Model 1)	—		83.27	

* Significant at 10%,

** 5%, and

*** 1% levels.

[†] The number of equivalent adults in the household was computed as the number of adults + 0.5 × the number of children living in the household at the time of the survey.[‡] 1 U.S.\$ ≈ 492.6 FCFA (exchange rate at time of survey).[§] The asset index was constructed on the basis of principal components analysis using the following data on household's possession of durable goods and household appliances: having a television, a radio, a mobile phone, a fridge, a bicycle, a motorbike, a car, cattle, being owner of one's own house, possessing land in rural areas, and/or in urban areas. As the correlation coefficients (obtainable from the authors) between asset index and monthly income per equivalent adult are low across quantile, they are likely to represent separate and sufficiently uncorrelated aspects of the household resource base driving spending decisions.[¶] During the previous 6 months.^{||} As assessed by a 10-point score evaluating the possibility of performing the following 10 laboratory tests on site: complete cell blood count, CD4 cell count, transaminases, glycemia, creatinemia, amylasemia, pregnancy test, viral load, triglycerides, and cholesterol.

ART, antiretroviral therapy; NS, not significant at 10% level.

consultations (i.e., consultations with a physician outside the follow-up hospital and/or consultations with traditional healers) faced a higher risk of CHE while patients with a regular follow-up in their treatment centers (circa one visit per month) did not present any increased risk (Russell 2005; Xu et al. 2006).

Model 2 highlights the positive effect of decentralized HIV services after adjusting for the technological effect of the health care facility counting for differences related to the geographic dimension of HIV services decentralization. As shown in Table 3, technological and decentralization variables explain the greatest part of the variance attributed to the health care supply level, as shown by the significant fall in the intraclass coefficient correlation between Models 1 and 2 ($\rho_1 = 6.22$ percent and $\rho_2 = 1.05$ percent, respectively). Moreover, the decentralization variable emerged as the main contributing health system factor that explains interclass variance. Indeed, when decentralization and technological variables were integrated into the model separately, results showed that the former contributed to the decrease in the intraclass coefficient correlation (ρ) by 65 percent while the latter's contribution amounted to 48 percent (see Appendix A1). Results also showed that while "free access" reduced the risk of incurring CHE, interaction of this variable with the decentralization indicator was only significant at the district level but not at the provincial one, suggesting that "free access" resulted in a reduced risk of CHE only for those patients followed up in district MU.

The analysis of sensitivity conducted using different thresholds to define CHE (10 and 40 percent) confirmed the main study's results (Appendix A2). This also enables us to minimize the effect of possible misclassifications in the dependant variable which might have occurred due to the underdeclaration of income in low-resource setting (Deaton 2006). In addition, when the model is estimated on the two subgroups, the "poor" and "nonpoor," the decentralization indicator remained significantly associated with a reduced risk of CHE regardless of the level of household income (Table 4). Interestingly, results also showed that living in an urban or semi-urban area and transportation time of less than 1 hour to hospital were significantly associated with a lower risk of CHE among poor households, whereas only transportation time was significant among nonpoor households. Inasmuch as the "residence location" variable captures a proximity effect of health care services, this can suggest that the cost component of transportation has a stronger impact on CHE at lower-income levels. Other factors that appeared to be only significant among the poor households include the following: having consulted a traditional healer and having visited a treatment center more than six times during the previous 6 months. Furthermore, when taking into account the decentralization effect on the entitlement to free ART among the poor households, the protective effect of free access to ART works for patients followed up at the district level but not for those followed up at the provincial level.

Table 4: Factors Associated with the Risk of Catastrophic Payments (threshold = 20%) in Poor and Nonpoor Households (Multilevel Logit Models; EVAL Survey, ANRS 12-116, $n = 2,412$)

	Poor ($n = 1,800$)		Nonpoor ($n = 612$)	
	Coefficient (SD)	p-value	Coefficient (SD)	p-value
Individual factors				
Intercept				
Male gender (fixed effect)	3.15 (0.75)	***	3.28 (1.51)	**
Age, years (fixed effect)	-0.04 (0.13)	NS	0.35 (0.22)	NS
Being married (fixed effect)	-0.02 (6.6×10^{-3})	***	-0.04 (0.01)	***
Living in urban or semi-urban area of residence (fixed effect)	-0.47 (0.13)	**	-1.12 (0.16)	***
Monthly household income per equivalent adult ^{†,‡} (fixed effect)	-0.64 (0.17)	***	-0.19 (0.27)	NS
Asset index [§] (fixed effect)	1.6×10^{-4} (1.0×10^{-5})	***	1.5×10^{-5} (0.4×10^{-5})	***
Free access to ART (fixed effect)	-1.12 (0.24)	***	-1.54 (0.62)	**
Intercept				
Free access to ART: Provincial level	-1.49 (0.12)	***	— ^{††}	
Free access to ART: District level	0.08 (0.27)	NS	—	
Time since ART initiation (fixed effect)	-0.55 (0.30)	*	—	
	1.9×10^{-3}	NS	-9.6×10^{-3} (6.9×10^{-3})	NS
	(3.7×10^{-3})			
CD4 cells count at the time of the survey (fixed effect)	4.3×10^{-4}	NS	-6.4×10^{-4} (5.4×10^{-4})	NS
	(2.8×10^{-4})			
	0.04 (0.01)	**	0.07 (0.03)	**
No. of self-reported symptoms during the previous 4 weeks (fixed effect)				
Transport time to hospital of follow-up <1 hour (fixed effect)	-1.09 (0.14)	***	-1.01 (0.16)	***
Frequency of visits in the hospital of follow-up [†] (fixed effect)				
One visit (reference)				
Between 2 and 6 visits	-0.12 (0.16)	NS	-0.33 (0.25)	NS
More than 6 visits	0.62 (0.35)	*	0.25 (0.46)	NS

continued

Table 4. Continued

	Poor (n = 1,800)		Nonpoor (n = 612)	
	Coefficient (SD)	p-value	Coefficient (SD)	p-value
Consultation of a private physician outside the treatment center ^a (fixed effect)	0.44 (0.18)	**	0.60 (0.28)	**
Consultation of a traditional healer ^a (fixed and random effects)				
Intercept				
Variance of interfacility random effect	0.62 (0.24)	**	0.39 (0.49)	NS
Health system-related factors	0.60	NS	0.94	NS
Decentralization level of HIV care (fixed effect)				
Central level (reference)				
Provincial level	-0.48 (0.14)	**	-0.85 (0.26)	**
District level	-0.48 (0.22)	**	-1.24 (0.45)	**
Technological level ^b (fixed effect)	0.14 (0.06)	**	-0.03 (0.13)	NS
Variance of interfacility random effect	0.090	**	0.081	NS
Intraclass coefficient of correlation (ρ), %	2.66	**	2.41	**

^aSignificant at 10%,
**5%, and
***1% levels.

^bThe number of equivalent adults in the household was computed as the number of adults + 0.5 × the number of children living in the household at the time of the survey.

[‡]1 U.S.\$ ≈ 492.6 FCFA (exchange rate at time of survey).

[§]The asset index was constructed on the basis of principal components analysis using the following data on household's possession of durable goods and household appliances: having a television, a radio, a mobile phone, a fridge, a bicycle, a motorbike, a car, cattle, being owner of one's own house, possessing land in rural areas, and/or in urban areas.

[¶]During the previous 6 months.

^{||}As assessed by a 10-point score evaluating the possibility of performing the following 10 laboratory tests on site: complete cell blood count, CD4 cell count, transaminases, glycemia, creatinemia, amylasemia, pregnancy test, viral load, triglycerides, and cholesterol.

^{††}The free access to ART variable has not been included in the non poor model as by definition free access to ART was allocated to the poorest. This was confirmed by the data as only 18 patients among non poor households declared to have access to free ART.

ART, antiretroviral therapy; NS, not significant at 10% level.

DISCUSSION

This study has sought to highlight the role played by the decentralization of HIV care services in protecting households from the risk of CHE. The availability of high-quality cross-sectional data containing detailed information on both HIV-infected patients' characteristics and the health care supply provided us the opportunity to analyze not only the socioeconomic determinants of CHE among households affected by HIV but also the contentious role of the decentralization of health care supply.

Analyses indicated that after adjusting for individual socioeconomic and demographic characteristics at the different levels of the health care system, the protective effect of the decentralization appeared to be significant, suggesting an explicit effect of the delivery of HIV care at the lowest level of the health care system. Analyses of sensitivity confirmed this finding both when using different thresholds for CHE and when controlling for differences in household incomes by conducting separate analyses for the poor and nonpoor households. The overall picture emerging from these detailed analyses is that decentralization enhances the capacity of the health care services in limiting the risk of incurring CHE and facilitates access to the needed health care. The protective effect of HIV care decentralization may be explained by the price differentials observed across different levels of the health care delivery system which may be due to differences in technology (the mean prices of HIV services including medical consultation and most frequent laboratory tests were as follows: 1,676 FCFA in district MU; 2,303 FCFA in provincial ATC; and 3,638 FCFA in central ATC; $p = .007$). Autonomy afforded to local providers with regard to the management of user fees may have also enabled them to better match their pricing with the socioeconomic conditions of the households and to properly identify the indigent segments of the population. This is suggested by the lower risk of CHE among patients followed up at the district level and benefiting from free access to ART while this was not the case for patients followed up at the provincial level.

Another reason for the lowest risk of CHE found in the decentralized health care facilities may be explained by the "closer" link that local providers can establish with their community, resulting in higher responsiveness to qualitatively adapt their services to patients' preferences. This in turn strengthens patients' appreciation vis-à-vis the quality of the health care services, as is shown in Table 2. Moreover, another study conducted using the

EVAL-ANRS 12-116 data (Boyer et al. 2010), has demonstrated that in spite of more limited technical and human resources, HIV services provided at the district levels achieved similar or even better clinical and immunological outcomes compared with the central and provincial levels. In line with the findings reported by others (Dussault 2008), this suggests that experiencing good quality of care is crucial to maintain the continuity of HIV treatment in the long term and thus to get better clinical and immunological outcomes. In addition, this encourages patients to stay in line with the standard process of treatment and, thus, help limit those HE related to extra care which are often found to be responsible of CHE (Russell 2005; Xu et al. 2006; Boyer et al. 2008).

In spite of their importance, some practical limitations that might have influenced our results are worth mentioning. First, comparison of the main characteristics of participants and nonparticipants revealed that this latter group had a lower immunological status, thus raising the risk of selection bias. However, it must be noted that the potential impact of such bias on our results may be relatively limited, given the survey's high participation rate (90.3 percent) and the relatively large study population. Moreover, comparison of basic socioeconomic characteristics showed no other significant differences between participants and nonparticipants. Given that ART in Cameroon is only delivered in accredited treatment centers, our survey provided a fairly comprehensive picture of the HIV population treated by ART through the national Cameroonian AIDS Program during 2006–2007.

Second, the adoption of free access to ART to all eligible patients in Cameroon since May 2007 (i.e., just after the EVAL survey) may have some implications on the study results as this policy can help reduce financial constraints in access to treatment. However, the high level of other HE supported by HIV-infected patients suggested that the detrimental impact of OOP payments has not been fully suppressed through free access to ART.

Third, although the EVAL survey provided detailed data on both the patients' and the health care supply-related characteristics, it did not offer any data on the effective coping strategies that may have been mobilized by patients and their households to face HIV infection. Considering such a particular issue is undoubtedly needed to help better understand the overall impact of HIV infection on households' welfare. This shall be addressed in future studies through, for instance, combining quantitative and qualitative methods.

Finally, another source of limitation, which is inherent in the CHE approach, is related to the fact that the impact of OOP payments on the

households' welfare cannot be fully captured by examining catastrophic expenditures. Many poor households will indeed choose to not seek care. Although these households probably face greater welfare loss than those having access to care, the CHE approach did not allow taking them into account.

CONCLUSION

In spite of their limitations, the results presented in this article should, however, help shape the policy decision toward building an equitable health care delivery system in Cameroon, and they can also be useful for other countries seeking to ensure a more equitable access to ART. Although it is undoubtedly true that health sector reform remains a context-specific dependent process, much can be learned from other countries' experiences about the likely equity implications of reforms to these systems. Indeed, given that sub-Saharan African countries share several common characteristics, our findings while bringing important additional information at the national level can also encourage those countries affected by the HIV epidemic to adopt a strategy of decentralization to improve access to ART and to reduce inequality.

A major policy recommendation to be drawn from our study is that decentralization contributes to reach the goal of equity in access to ART. However, other mechanisms aiming at limiting health care payments at the point of delivery are also required as a complementary tool to enhance equity. This can be achieved, for example, by expanding risk-pooling mechanisms, while increasing national and international public health financing. To sum up, decentralization alone appears to be a necessary but insufficient condition to fully remove the risk of CHE and to improve health care access in developing countries.

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NOTES

1. (1) The lack of economies of scale; (2) the lack of externalities in the production of local public goods, and (3) preferences heterogeneity.
2. At the time of the survey (2006–2007), subsidized prices were fixed at 3,000 FCFA (circa U.S.\$6 at exchange rate 1 U.S.\$ = 492.6 FCFA) for initial and biannual monitoring, 3,000 FCFA (circa U.S.\$6) for monthly treatment by Triomune, and 7,000 FCFA (circa U.S.\$14) for other ARTs.
3. On the basis of an interview with a social worker and using different socioeconomic criteria such as professional activity, matrimonial status, having dependants, and the possibility of financial support from a family member.
4. Center, Littoral, West, Southwest, Northwest, and Far North.
5. Contrary to total health care expenditures, y_i does not include HE financed by coping strategies. It is, therefore, deemed to be a better proxy of household resources available to face a persistent health shock over time—as is the case of HIV infection (Flores et al. 2008).

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Appendix A1: Comparison of the Interfacility Variance and Intraclass Coefficient (ρ) of Correlation between the Different Models of the Risk of Catastrophic Payments.

Appendix A2: Multilevel Logit Models (EVAL Survey, ANRS 12-116, $n = 2,412$)—Sensitivity Analysis with 10 and 40 Percent Thresholds for Catastrophic Payments.

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