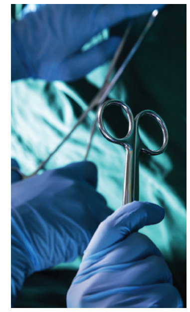


Chapter 19

Task-Sharing or Public Finance for Expanding Surgical Access in Rural Ethiopia: An Extended Cost-Effectiveness Analysis

Mark G. Shrime, Stéphane Verguet, Kjell Arne Johansson, Dawit Desalegn, Dean T. Jamison, and Margaret E. Kruk

INTRODUCTION

A large fraction of the disease burden is attributable to conditions potentially amenable to surgical treatment (Bickler and others 2015; Mock and others 2015; Shrime, Sleemi, and Thulasiraj 2014). In low- and middle-income countries (LMICs), however, the utilization of surgical services is low, often because of a lack of surgical capacity, sociocultural factors, and cost (Chao and others 2012; Hsia and others 2012; Ilbawi, Einterz, and Nkusu 2013; Knowlton and others 2013; Linden and others 2012). Numerous policies have been proposed to improve access, including making surgery free at the point of care and task-sharing (Bucagu and others 2012; Jadidfard, Yazdani, and Khoshnevisan 2012; Kruk and others 2007).

In Ethiopia, more than 80 percent of the population of 92 million people lives in rural areas (WHO 2012; World Bank 2012), while surgeons are primarily located in urban centers (Berhan 2008; Surgical Society of Ethiopia 2013). As a consequence, access to surgery is particularly low. For example, in 2010, 3.3 percent of women delivered their most recent child by cesarean section—20 percent of the women in Addis Ababa, but as few as 0.5 percent of the poorest women in rural Ethiopia (Central Statistical Agency [Ethiopia] and ICF International 2012). Although traditional preferences for home delivery play a role, rural women also point to the high cost of care and a lack of providers as reasons for low utilization (Central Statistical Agency [Ethiopia] and ICF International 2012; Shiferaw and others 2013). A patient undergoing surgery in Ethiopia would face, on average, 1,125 Ethiopian birr (Br; I$204) in direct medical costs, as well as Br 1,633 to Br 3,358 (I$297 to I$611) in direct nonmedical costs (Kifle and Nigatu 2010; UN 2014). Even if surgery were publicly financed, the patient would still face direct nonmedical costs, which, in some settings, may be large enough to cause impoverishment.

The World Health Organization (WHO) has stated that health systems have three objectives: to improve health, to provide financial protection, and to advance the equitable distribution of the two (WHO 2007). While health policies typically focus on the first objective, improving health may be in tension with an improvement in either of the other two objectives. In addition, standard health economic evaluations of policies sometimes ignore their expected impact on the private economy of households. Methods for extended cost-effectiveness analyses (ECEAs) have recently been developed to examine all three objectives simultaneously (Verguet, Laxminarayan, and Jamison 2014).

This chapter studies the health and financial risk protection benefits of policies for improving access to

Corresponding author: Mark G. Shrime, MD, MPH, FACS, Harvard University, shrime@mail.harvard.edu

surgical care in rural Ethiopia. Using the ECEA framework (Verguet, Gavreau, and others 2015; Verguet, Laxminarayan, and Jamison 2014; Verguet, Murphy, and others 2013), we compare the following:

- A policy of universal public financing (UPF) that makes surgery free at the point of care but does not pay for nonmedical costs
- A policy of task-sharing of surgery with nonsurgeon providers
- A combination of UPF and task-sharing

In addition, because direct nonmedical costs to patients—for transportation, food, and lodging—can be significant drivers of both catastrophic expenditures and decisions to avoid care (Kowalewski, Mujinja, and Jahn 2002), we examine two additional policies:

- UPF with the addition of travel vouchers
- A combination of UPF, task-sharing, and travel vouchers

Finally, we quantify the distribution of these benefits across wealth groups.

METHODS

Selection of Interventions

We defined a basic package of surgery to study in rural Ethiopia, comprising nine surgical procedures treating 13 conditions (table 19.1). This package was chosen because the associated conditions have large, immediate risks of death, and, as a result, the interventions have potentially large individual benefits. For this surgical package, we looked at six scenarios:

- Keeping surgical delivery at the status quo
- Implementing UPF, in which direct medical costs for included procedures are fully paid by the government
- Task-sharing, in which nonsurgeon providers are trained to provide these surgeries, but the cost of accessing care is unchanged from the status quo
- A combination of UPF and task-sharing, in which surgery can be provided by nonsurgeon providers and in which medical costs are fully funded by the public sector
- A policy that implements UPF and provides vouchers to patients for nonmedical costs
- A policy combining UPF, task-sharing, and vouchers, such that surgery can be provided by nonsurgeon providers with no out-of-pocket (OOP) costs for patients

Table 19.1 Surgical Procedures and Treated Conditions Included in the Model

Procedure	Conditions
Appendectomy	Acute appendicitis, complicated or uncomplicated
Exploratory laparotomy	Abdominal trauma
Cesarean section	Obstructed labor
	Other fetal indications
Salpingectomy	Ectopic pregnancy
Hysterectomy	Postpartum hemorrhage
	Uterine rupture
Vacuum aspiration	Spontaneous abortion
	Postpartum sepsis
Chest tube placement	Thoracic trauma
Amputation	Gangrene
Traction	Uncomplicated long-bone fracture

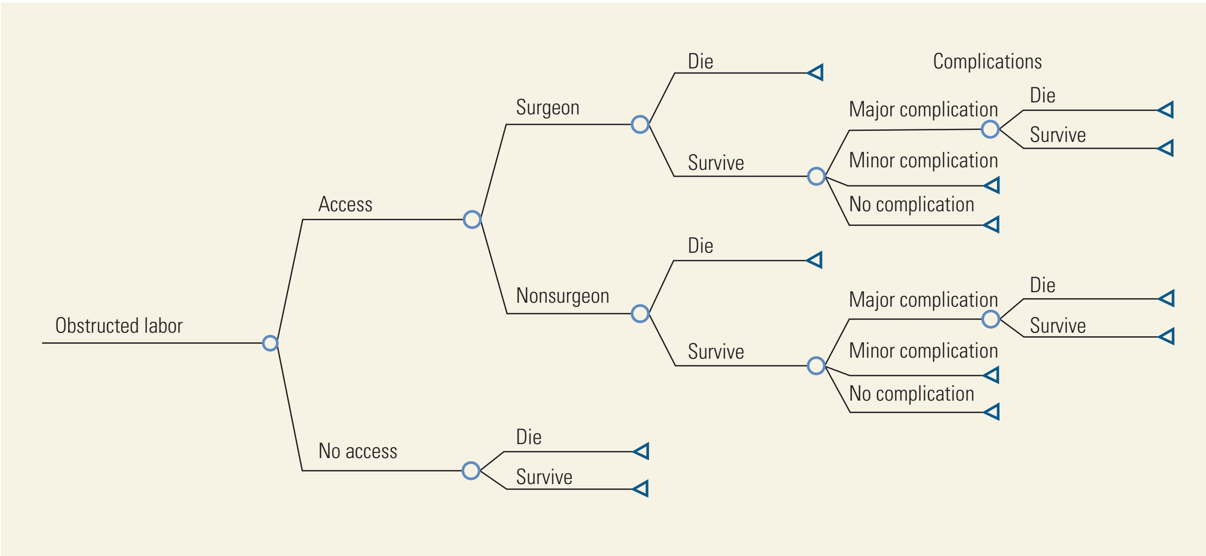
Model Structure, Outcomes, and Data Sources

Model Structure and Outcomes of Interest. We applied ECEA methodology, which is described in annex 19A (Verguet, Murphy, and others 2013; Verguet, Laxminarayan, and Jamison 2014).

We followed a synthetic population of 1 million individuals similar to that in rural Ethiopia and normalized to identically sized wealth quintiles. The structure of the model is given in figure 19.1, which shows one of the 13 surgical conditions. A patient with obstructed labor will seek care conditional on utilization barriers. If she seeks care, she experiences perioperative morbidity or mortality, with probabilities as shown in table 19.2. Total costs, patient-borne costs, direct nonmedical costs, and overall effectiveness are calculated. This structure is essentially identical for the other surgical conditions. The model assumes a single-event analytic horizon and, as such, assumes no discounting of costs or benefits.

Our outcomes of interest were deaths averted, cases of impoverishment averted, cases of catastrophic expenditure averted, average household cost savings (or "private expenditure crowded out" for medical treatment), and governmental costs needed to sustain the program. Note that ECEA methodology does not explicitly calculate the economic benefits of better health, as would be done in a benefit-cost analysis. These benefits are addressed in sensitivity analyses that follow.

Figure 19.1 Basic Chance Tree Structure for Each Surgical Intervention in the Model



Note: Circles represent chance nodes; triangles represent outcome nodes.

Table 19.2 Condition- and Procedure-Specific Model Inputs

Probability

	Procedure cost (I$)	Perioperative mortality	Mortality, untreated	Major complication rate	Minor complication rate	Prevalence
Cesarean section for obstructed labor	251.81	0.003	0.300	0.109	0.074	Obstetric conditions: 0.020354
Vacuum aspiration for postpartum sepsis	103.07	0.022	0.300	0.154	0.220	
Hysterectomy for uterine rupture	441.02	0.214	0.300	0.140	0.270	
Hysterectomy for postpartum hemorrhage	441.02	0.020	0.300	0.140	0.270	
Salpingectomy	251.81	0.030	0.750[a]	0.046	0.046	
Vacuum aspiration for spontaneous abortion	103.07	0.022	0.300	0.154	0.220	
Cesarean section for other fetal conditions	251.81	0.003	0.300	0.109	0.074	
Appendectomy	301.29	0.012	0.700	0.035	0.140	Appendicitis: 0.0003
Exploratory laparotomy	393.81	0.133	0.923	0.500	0.242	Traumatic conditions: 0.06285
Traction	352.43	0[a]	0.060	0.200	0.067	
Chest tube placement	393.81	0.160	1.000[a]	0.105	0.263	
Amputation	352.43	0.290	0.750	0.086	0.248	

Sources: Procedure cost: Alkire and others 2012; Hu and others 2009; Kifle and Nigatu 2010; Vlassoff and others 2008, 2012. Perioperative mortality: Admasu 2004; Admasu, Haile-Mariam, and Bailey 2011; Alemayehu, Ballard, and Wright 2013; Demissie 2001; Deneke and Tadesse 2001; Gessessew and others 2011; Goyaux and others 2003; Gulam-Abbas and others 2002; Hailu 2000. Mortality, untreated: Abbas and Archibald 2005a, 2005b; Anderson and others 2007; Cobben, Otterloo, and Puylaert 2000; Gulam-Abbas and others 2002; Neilson and others 2003; Thomas and Meggitt 1981. Major complication rate: Ali 1995; Gaym 2002; Hailu 2000; Harris and others 2009; Igberase and Ebeigbe 2008; Mawalla and others 2011; Okeny, Hwang, and Ogwang 2011; Thomas and Meggitt 1981; Thonneau and others 2002. Minor complication rate: Adinma and others 2011; Ali 1995; Gaym 2002; Hailu 2000; Harris and others 2009; Hu and others 2009; Okeny, Hwang, and Ogwang 2011; Razavi and others 2005; Sohn and others 2002; Thomas and Meggitt 1981; Thonneau and others 2002. Obstetric conditions: Admasu, Haile-Mariam, and Bailey 2011; Fantu, Segni, and Alemseged 2010; Gessessew and others 2011; Singh and others 2010; Singh, Remez, and Tartaglione 2010; Thonneau and others 2002; Worku and Fantahun 2006. Appendicitis: Andersson 2007; Groen and others 2012; WHO 2008. Traumatic conditions: Groen and others 2012; Hailu 2000.
a. Assumption.

Data Sources. Parameter estimates (table 19.2) draw on national surveys and published studies. When possible, estimates were derived from rural Ethiopia. If this was impossible, estimates were taken from studies performed—in order—in urban Ethiopia, other Sub-Saharan African countries, and other developing countries. Finally, if no other data were available, estimates from high-income countries and upper-middle-income countries were used.

Costs and Assumptions. All costs, including those from outside the Ethiopian context, are adjusted to and reported in international dollars, using purchasing power parity conversions and GDP deflator estimates published by the United Nations and the World Bank (United Nations 2014; World Bank 2013). Methodology for this conversion has been described previously (Schreyer and Koechlin 2002).

Before the introduction of each program, individuals pay 34 percent of medical costs out-of-pocket, ranging from 19 percent to 78 percent (Vlassoff and others 2012; WHO 2012). Direct nonmedical costs to the patient (for example, for transportation) are paid out-of-pocket under the UPF, task-sharing, and UPF + task-sharing scenarios, and shift to the public sector in the UPF + vouchers and UPF + task-sharing + vouchers scenarios.

To remain conservative, complication and mortality rates for nonsurgeons were assumed to be 1.125 times those of surgeons (Gessessew and others 2011). Similarly, the costs of procedures performed by surgeons were assumed to be 1.47 times higher than those performed by nonsurgeons (Alkire and others 2012; Vlassoff and others 2008). In the base-case analysis, the cost of complications was set at I$25.50 (Vlassoff and others 2008) and varied in sensitivity analyses.

Direct medical costs included the inpatient costs of surgical delivery. Provider salaries are not explicitly added because this analysis is an incremental analysis and, as such, provider salaries would not change with the implementation of UPF or vouchers. Provider salaries in the setting of task-sharing are addressed in a sensitivity analysis below.

Direct nonmedical costs included the costs of transportation, food, and lodging; they did not include the costs of lost productivity due to disease. Because of likely increases in travel costs to centralized providers, nonmedical costs were assumed to be more expensive when care was sought from surgeons than when sought from nonsurgeons (I$611.66 and I$297.45, respectively) (Kifle and Nigatu 2010). Indirect costs were not considered in the base-case analysis, but they were considered in sensitivity analyses.

Catastrophic expenditure was assumed if patients' expenditures brought their incomes to either less than zero or less than 40 percent of their initial nonhealth expenditure, following methods described previously (Habicht and others 2006; Reddy and others 2013). More details are provided in annex 19A. Analyses were conducted using the R statistical software[1] and TreeAge 2013 (TreeAge Software, Williamstown, Massachusetts). Funders had no role in study design, data collection, writing, or submission for publication.

SENSITIVITY ANALYSIS

The base-case analysis did not include the start-up costs for a task-sharing program. These costs, based on estimates from Mozambique (Kruk and others 2007), were included in the sensitivity analysis. These costs included the costs of salaries, training, library buildings, books, computers, and travel. We scaled these estimates linearly for differences in population size and distributed the costs evenly across the population. The linear scale-up results were lower than unpublished estimates from Ethiopia itself; therefore, these unpublished estimates were also used in a separate sensitivity analysis.

Sensitivity analyses of assumptions around baseline utilization, price elasticity of demand for care, the magnitude of direct nonmedical costs, the risk of mortality from untreated disease, the cost of complications, the inclusion of indirect costs, and the effects of taxation were all performed (annex 19A). Finally, heterogeneity in our estimates was modeled using first-order Monte Carlo simulation.

RESULTS

Model Contextualization and Validation

From the 2011 Ethiopia Demographic and Health Survey (Central Statistical Agency [Ethiopia] and ICF International 2012), we calculated an overall rate of obstetric delivery in a medical facility of 16.5 percent, which is nearly identical to published estimates (Shiferaw and others 2013).

The model was then validated against published mortality results from WHO, UNICEF, UNFPA, and World Bank (2012). Because these estimates are for the country as a whole, and, in some cases, for low-income countries as a group, and because the model focuses solely on rural Ethiopia, we allowed the model to predict slightly higher mortality than published estimates. Our model estimated 9,112 maternal deaths per year in Ethiopia, consistent with estimates of 9,000 (WHO 2012); this translates to a predicted maternal mortality ratio of 368 deaths per 100,000 live births, which is also consistent with World Bank estimates of 350 (World Bank 2012). Our model predicted 0.62 deaths per 1,000 population from traumatic conditions and 0.012 deaths per 1,000 population from appendicitis, consistent with World Bank estimates (0.61 and 0.012, respectively) (WHO 2013a).

Base-Case Analysis, without Travel Vouchers

Health Impacts. Nominal health benefits measured in deaths averted are shown in annex table 19A.4, and health benefits per I$100,000 spent are shown in table 19.3. Per 1 million people per year in rural Ethiopia, UPF averted 21 deaths, at a cost of I$895,000 (2.4 averted deaths per I$100,000 spent, or I$42,600 per death averted). Health gains from UPF varied across disease conditions: per I$100,000 spent, UPF was predicted to avert 40 deaths from obstetric conditions (I$2,500 per death averted), 24 deaths from appendicitis (I$4,200 per death averted), and two deaths from trauma (I$50,000 per death averted).

Task-sharing was predicted to avert 250 deaths per 1 million population per year in rural Ethiopia, at a cost of I$377,200 (65 averted deaths per I$100,000; or I$1,500 per death averted). As with UPF, this

Table 19.3 Summary of Health Gains, Financial Risk Protection, and Costs per 1 Million Population, by Model Scenario

			Wealth quintile					
			Poorest	Poor	Middle	Rich	Richest	Overall
Deaths averted per I$100,00 spent	UPF (no vouchers)	Obstetric	79	47	29	18	4	40
		Appendicitis	45	25	16	11	3	24
		Trauma	5	3	2	1	0	2
		Total	6	3	2	1	0	3
	UPF with vouchers	Obstetric	27	17	11	8	2	15
		Appendicitis	17	10	6	4	1	9
		Trauma	2	1	1	1	0	1
		Total	3	1	1	1	0	1
	Task-sharing	Obstetric	249	249	249	249	249	249
		Appendicitis	495	495	495	495	495	495
		Trauma	57	57	57	57	57	57
		Total	62	64	66	68	72	65
	UPF + task-sharing	Obstetric	137	131	127	124	121	129
		Appendicitis	128	106	90	77	64	99
		Trauma	15	13	11	10	8	12
		Total	17	15	13	12	11	14
	UPF + task-sharing + vouchers	Obstetric	42	39	37	36	35	38
		Appendicitis	33	25	20	17	13	23
		Trauma	4	3	3	2	2	3
		Total	5	4	3	3	2	4
Cases of poverty averted per I$100,000 spent	UPF (no vouchers)	Obstetric	0	–72	–91	216	0	21
		Appendicitis	0	–7	–24	182	0	37
		Trauma	0	–24	–20	221	0	44
		Total	0	–24	–21	221	0	44

table continues next page

Table 19.3 Summary of Health Gains, Financial Risk Protection, and Costs per 1 Million Population, by Model Scenario (continued)

			Wealth quintile					
			Poorest	Poor	Middle	Rich	Richest	Overall
	UPF with vouchers	Obstetric	0	53	96	29	0	35
		Appendicitis	0	91	127	30	0	52
		Trauma	0	88	124	38	0	52
		Total	0	88	124	38	0	52
	Task-sharing	Obstetric	0	–587	–314	0	0	–178
		Appendicitis	0	–531	–307	0	0	–175
		Trauma	0	–454	–287	0	0	–154
		Total	0	–458	–288	0	0	–155
	UPF + task-sharing	Obstetric	0	–307	–166	32	0	–84
		Appendicitis	0	–110	–72	76	0	–20
		Trauma	0	–98	–57	92	0	–10
		Total	0	–101	–59	91	0	–11
	UPF + task-sharing + vouchers	Obstetric	0	20	34	10	0	13
		Appendicitis	0	52	73	18	0	30
		Trauma	0	50	71	22	0	30
		Total	0	50	70	22	0	30
System cost (I$)	UPF (no vouchers)	Obstetric	837	866	1,025	1,213	1,581	5,522
		Appendicitis	345	378	426	478	521	2,147
		Trauma	142,375	155,964	175,976	197,415	215,286	887,016
		Total	143,557	157,208	177,427	199,106	217,388	894,686
	UPF with vouchers	Obstetric	8,005	7,561	8,473	9,687	12,039	45,765
		Appendicitis	2,463	2,654	2,973	3,321	3,597	15,009
		Trauma	889,577	955,658	1,068,886	1,192,590	1,290,102	5,396,812
		Total	900,044	965,874	1,080,332	1,205,597	1,305,738	5,457,585
	Task-sharing	Obstetric	1,896	2,576	3,255	3,934	5,293	16,955
		Appendicitis	193	183	173	163	153	867
		Trauma	80,143	76,009	71,875	67,740	63,606	359,373
		Total	82,233	78,768	75,303	71,838	69,053	377,195
	UPF + task-sharing	Obstetric	4,047	5,296	6,696	8,131	10,990	35,160
		Appendicitis	902	971	1,057	1,148	1,229	5,307
		Trauma	372,217	400,402	435,985	473,213	506,330	2,188,147
		Total	377,166	406,668	443,739	482,492	518,549	2,228,614
	UPF + task-sharing + vouchers	Obstetric	16,464	19,720	24,333	29,247	38,999	128,762
		Appendicitis	4,258	4,648	5,166	5,712	6,188	25,972
		Trauma	1,550,875	1,688,750	1,873,770	2,069,266	2,238,571	9,421,232
		Total	1,571,597	1,713,118	1,903,268	2,104,225	2,283,758	9,575,967

Note: Health and financial risk protection benefits are measured per I$100,000 spent in the indicated quintile (or overall). Hence, the overall column is close to the average, not the total, of the quintile-specific columns. Negative numbers of cases of poverty averted represent cases of impoverishment created by the policy. Note that rows and columns do not sum directly because these reported results are ratios of benefit per dollar spent.

prediction varies by disease condition: per I$100,000 spent, task-sharing averted 249 deaths from obstetric conditions (I$400 per death averted), 495 deaths from appendicitis (I$200 per death averted), and 57 deaths from trauma (I$1,750 per death averted).

Finally, combining task-sharing with UPF was predicted to cost the system I$2,230,000 per million people per year, and to avert 291 deaths, for a total of 14 deaths averted per I$100,000 spent (I$2,222 per death averted). Obstetric conditions accounted for 129 deaths per I$100,000 (I$775 per death averted), appendicitis for 99 deaths per I$100,000 (I$1,000 per death averted), and traumatic conditions for 12 deaths per I$100,000 (I$8,300 per death averted).

Health benefits were not equal across wealth quintiles. The primary beneficiaries of the health benefits of UPF were the poorest quintiles. Under task-sharing, health benefits overall were similar across wealth quintiles, with a slightly higher benefit per dollar spent in the richest. The combination of the two policies maintained a gradient similar to that seen in UPF, with additional health benefits accruing to the richest quintile.

Financial Risk Protection. *Poverty Cases Averted.* Without vouchers, only UPF had financial risk protection effects. Task-sharing alone and task-sharing + UPF both induced impoverishment on average (table 19.3 and annex table 19A.4). UPF averted 366 cases of poverty per million population, amounting to approximately 44 cases of poverty averted for every I$100,000 spent. Poverty was, however, created among the poor. Only the rich saw a financial benefit from UPF.

Task-sharing created 578 cases of poverty per million in the population, or approximately 155 cases created for every I$100,000 spent. No impoverishment was averted, and most of the impoverishment accrued to the poor.

Finally, a policy that combined task-sharing with UPF created 229 cases of poverty, or 11 cases per I$100,000 spent. The distribution of financial risk protection, or lack thereof, was similar to that seen in UPF.

Other measures of financial risk protection—cases of catastrophic expenditure, as well as the crowding out of private expenditure—by policy can be found in annex 19A.

Health and Financial Benefits with Vouchers

When direct nonmedical costs of care-seeking were transferred from patients, overall health benefits increased because of increased demand. However, as a result of the more expensive nature of these interventions, the amount of health benefit bought per dollar (of public money) decreased.

In contrast, financial risk protection benefits increased significantly with this transfer. UPF + vouchers averted only 1 death per I$100,000 spent but averted 52 cases of poverty (I$1,900 per case of poverty averted). Combining UPF, task-sharing, and vouchers averted 4 deaths and 30 cases of poverty per I$100,000 spent (I$25,000 per death averted and I$3,333 per case of poverty averted). Distributionally, financial risk protection continued to accrue primarily to the rich, while health benefits accrued to the poorest.

A comparison of the health benefits and the financial risk protection benefits for each policy, on average, is provided in figure 19.2. These summary statements, however, mask significant variability in outcomes across wealth quintiles, as shown in figure 19.3.

Sensitivity Analysis

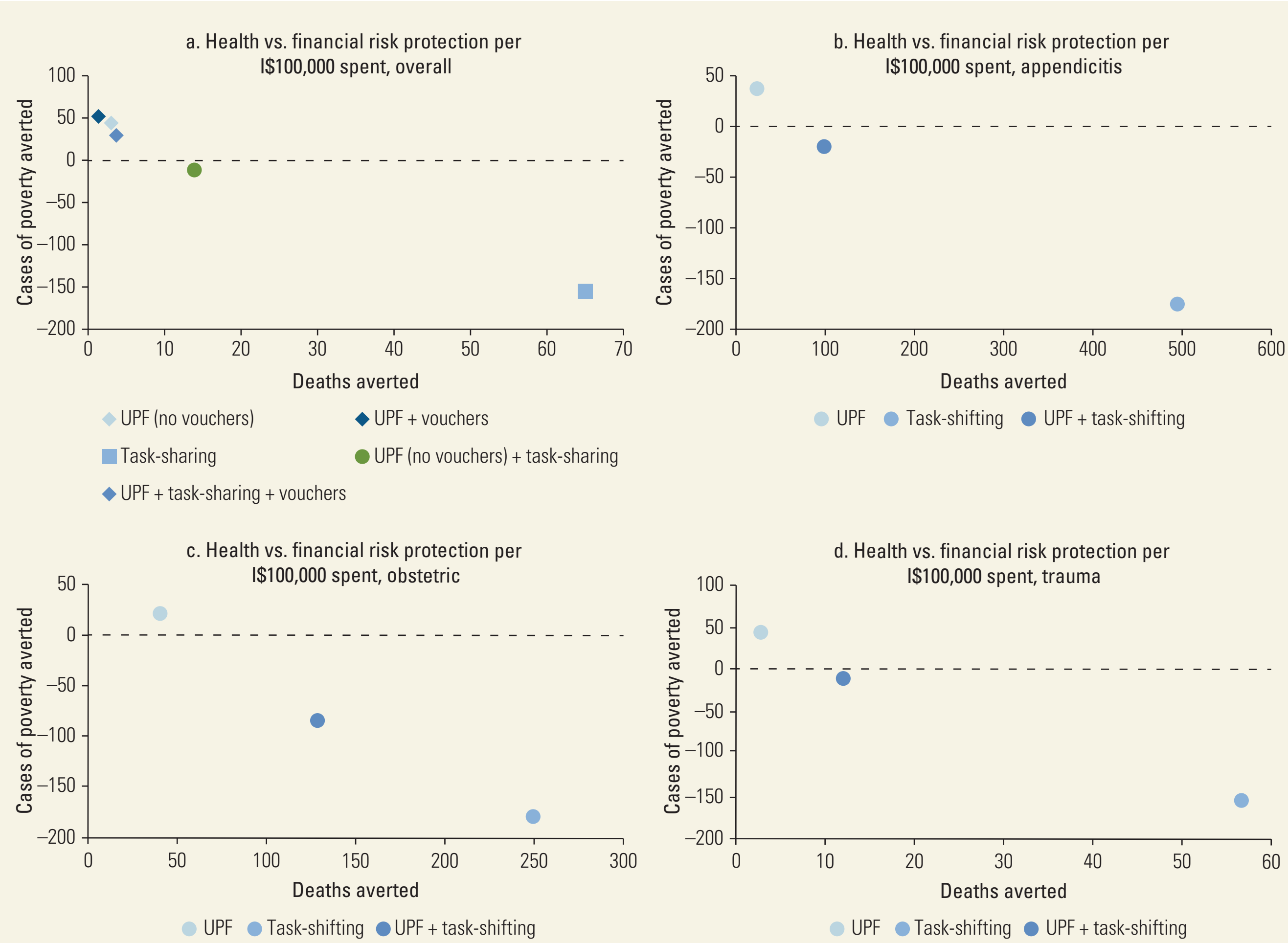
Adding the costs for the scaling up of task-sharing—either published from Mozambique or unpublished from Ethiopia—decreased, by a small amount, the health benefit per dollar of any policy that included task-sharing; it had a similarly marginal effect on the distributional equity of health and financial risk protection outcomes. The addition of heterogeneity to the model is shown in figure 19.4. Other sensitivity analyses—on baseline utilization, the price elasticity of demand, the magnitude of direct nonmedical costs, the risk of mortality from untreated disease, the cost of complications, the inclusion of indirect costs, and the impact of taxation to pay for these policies—are in annex 19A.

DISCUSSION

Using an ECEA framework (Verguet, Laxminarayan, and Jamison 2014), this chapter examines the health and financial risk protection benefits of five policies for improving access to surgical services in rural Ethiopia: making surgery free at the point of care (UPF); task-sharing; a combination of UPF and task-sharing; UPF with the addition of travel vouchers; and a combination of UPF, task-sharing, and travel vouchers.

Although surgical services in Addis Ababa approximate those offered in many higher-income countries (Cadotte and others 2010), care in rural Ethiopia is sparse (WHO and GHWA 2008). Because of a lack

Figure 19.2 Health Protection versus Financial Risk Protection per I$100,000 Spent, by Policy



Note: In the absence of vouchers, policies create cases of poverty, driven in large part by direct nonmedical costs. These cases of poverty are averted by the introduction of vouchers. UPF = universal public finance.

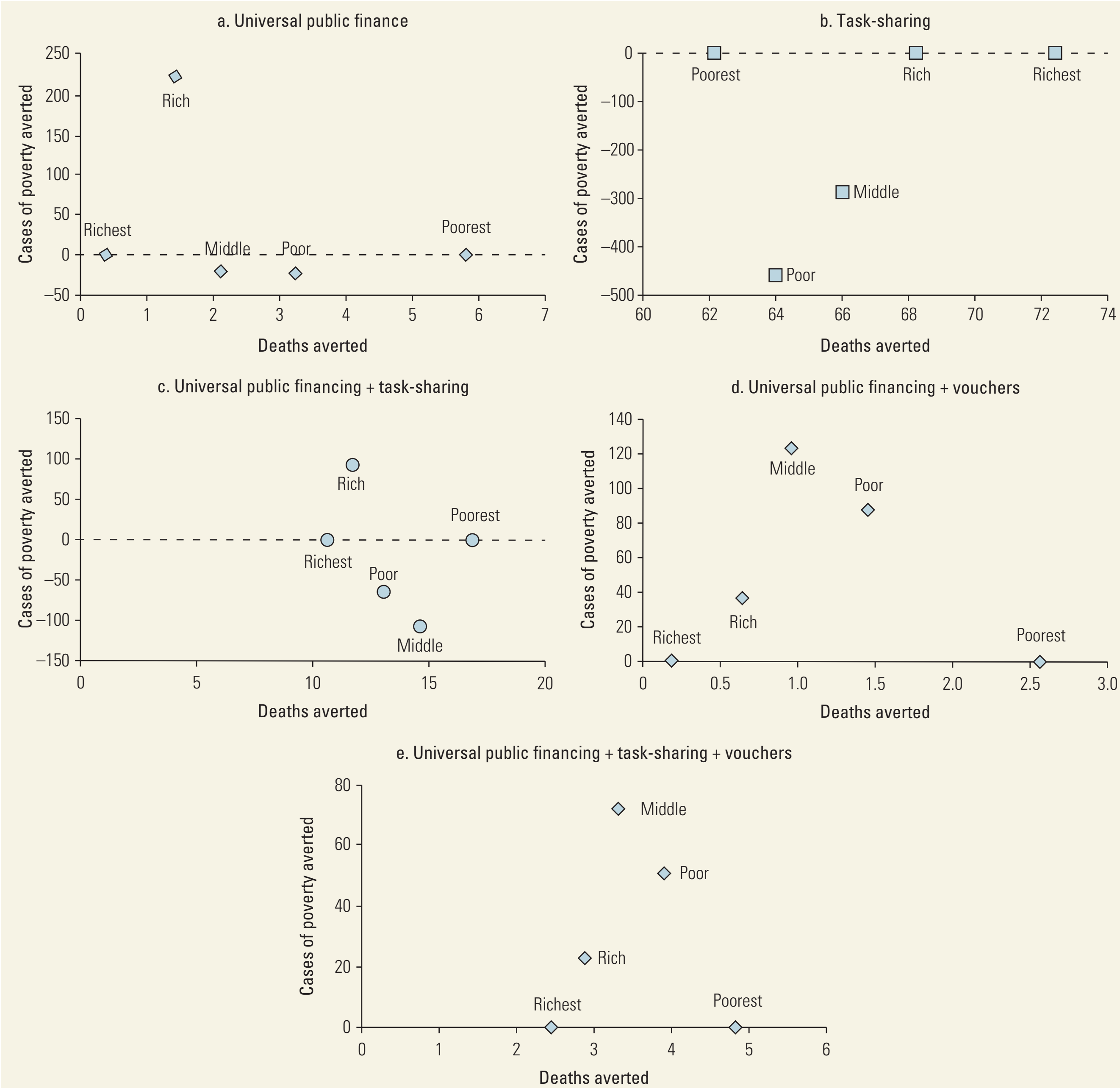
of providers—most of the few surgeons in the country live and work in urban centers (Berhan 2008; Surgical Society of Ethiopia 2013)—as well as high costs, many surgical conditions go untreated, contributing to a large burden of surgical disease in this country. Accordingly, evaluations of policy strategies to improve access to surgical care in this setting are needed.

The provision of universal health care is a focus of the WHO (WHO 2013b). Thus, UPF has been proposed for interventions ranging from rotavirus vaccination (Verguet, Murphy, and others 2013) to dental services (Jadidfard, Yazdani, and Khoshnevisan 2012) to emergency obstetric care (Bucagu and others 2012). Task-sharing has also been promoted, with nonspecialist doctors and nonphysicians increasingly filling a deficit in medical services (Scott and Campbell 2011) and emergency obstetric care (Ejembi and others 2013; Kruk and others 2007; Sitrin and others 2013). We examined both policies in the setting of surgery.

Unlike many global health interventions, surgery is a relatively nebulous service with indistinct borders. As a result, it is often provided by disparate, poorly organized platforms (Shrime, Sleemi, and Thulasiraj 2014). To facilitate analysis, a bundle of nine surgical procedures for 13 conditions was defined and a model built based on data from nationwide surveys and the published literature (Central Statistical Agency [Ethiopia] and ICF International 2012). This model proved to be well calibrated to current health outcomes in Ethiopia (Shiferaw and others 2013).

The results of this analysis explicitly illustrate tradeoffs between health and financial risk protection. We found,

Figure 19.3 Distribution of Health Benefits and Cases of Poverty Averted, per I$100,000 Spent, across Wealth Quintiles



for example, that per I$100,000 spent, task-sharing averts approximately 65 deaths while simultaneously impoverishing 155 individuals. The health benefits accrue preferentially to the wealthiest, whereas the financial burden falls on the poor, in part because the rich, in this model, tended to be more sensitive to a lack of provider than to price.

However, UPF averts only 3 deaths per I$100,000 spent but prevents impoverishment in 44 individuals; the decreased magnitude of this effect when compared with task-sharing is due to a demand function that is relatively inelastic to price, as well as to the fact that UPF is a more expensive policy. Unlike with task-sharing, the health benefits of UPF accrue to the poor because they are the most price sensitive; they also, however, face the greatest risk of impoverishment. Combining task-sharing with UPF buys more health benefit for all quintiles than does UPF alone, but it does

Figure 19.4 Heterogeneity in Results for Each of the Five Policies

Note: UPF = universal public financing.

so more markedly for the rich. Impoverishment continues to weigh on the poor.

Much of the impoverishment created occurs because, although demand for surgical services is induced by their new availability, these services are not always free, and patients still have to pay for the nonmedical costs of obtaining care. For many patients, these costs prove catastrophic (Kowalewski, Mujinja, and Jahn 2002). This effect is made explicit when travel vouchers are included in the model. Poverty is no longer created, but because these policies are significantly more expensive, the amount of health benefit achieved per dollar spent drops drastically. How such tradeoffs are to be handled is less clear and necessitates further substantial ethical and patient-preference analyses.

Although the cost per quality-adjusted life year cannot be calculated using the methodology employed here, a rough approximation using the median age in Ethiopia of 16.8 and average life expectancy, conditional on attaining that age, of 52.1 additional years (WHO 2012) predicts that task-sharing will cost I$7,200 per life year gained; UPF + task-sharing + vouchers, the most expensive policy, will cost I$184,000 per life year gained.

Although the base-case analysis did not include the start-up costs of a task-sharing program, adding these costs (Kruk and others 2007) decreased the amount of any benefit bought per dollar by task-sharing policies but had a minimal impact on the distributional pattern for health and financial benefits.

This analysis has limitations. We used an often-employed head-count approach to measuring impoverishment (Garg and Karan 2009; Habicht and others 2006; Honda, Randaoharison, and Matsui 2011; Niens and others 2012). Some authors, however, suggest that a movable threshold (Ataguba 2012) or measures of depth of poverty (Garg and Karan 2009) are more appropriate. We model the former in annex 19A, and the distributional patterns of health and financial risk protection benefits remain essentially unchanged. It should be noted, however, that the latter measure of poverty makes impoverishment in the poorest quintile much more explicit. In the method presented above, individuals in the poorest quintile all fall below the national poverty line. No poverty can be created or averted in these individuals because of that—an artifact which explains the fact that no cases of impoverishment occur in the poorest in table 19.3. The impoverishing impact of each policy on the poorest quintile is, therefore, best seen in annex 19A.

This method is also limited in that it does not measure counterfactual impoverishment well. Were a breadwinner to suffer a catastrophic health event, that death may throw an entire household into poverty. This is not explicitly addressed in our current analysis and is left to future inquiry.

The strength of this analysis is in what it can show: it highlights the significant tradeoffs inherent in policies for increasing access to care in LMICs, which are not dissimilar from those tradeoffs seen in high-income countries and upper-middle-income countries (Baicker and others 2013). In addition, the distribution of these benefits depends on the policy chosen: on the one hand, making surgery free at the point of care appears primarily to improve financial risk protection among the richer segments of the rural Ethiopian population. On the other hand, the small benefits it has on health accrue to the poorest. Conversely, task-sharing without vouchers creates cases of poverty while averting deaths across the entire population; the latter benefit primarily accrues to the richest, while the former harm accrues to the poorest.

Because these are initially counterintuitive findings, the model was tested with multiple sensitivity analyses, including the following: allowing the demand function to be more price elastic, including the costs of start-up for a task-sharing program; increasing the probability of dying from untreated disease; decreasing the direct nonmedical cost; increasing the cost of complications, including indirect costs in three separate ways; and modeling the effect of taxation to pay for the proposed policies. Although the magnitude of the benefits bought per dollar changes with these sensitivity analyses, the changes are often small. More important, except in the case of taxation, the distribution of the benefits across wealth quintiles is robust to these sensitivity analyses.

How to decide among the modeled policies remains a matter of further research, political debate, and ethical analysis. Normative statements about how these choices should be made and their potential unintended consequences on income inequality are not the goal of this chapter. Instead, we believe that this type of analysis can facilitate open, fair, and well-informed deliberative processes for making these decisions.

CONCLUSION

This chapter is the first to examine, simultaneously, the health and financial benefits of policies for improving access to surgical services in LMICs. It highlights tensions between the two sources of benefit and makes explicit their distributional patterns across wealth quintiles. Task-sharing without vouchers appears to improve the health of rural Ethiopia but to simultaneously put the poorest at risk of impoverishment. Making surgery free protects against impoverishment in the rich; health benefits and impoverishment both accrue to the poor. Perhaps our most important finding is that impoverishment is not fully averted until patients no longer face nonmedical costs of accessing care. Further research is warranted to refine how to choose among these disparate policy benefits.

ANNEX

The annex to this chapter is as follows. It is available at http://www.dcp-3.org/surgery:

- Annex 19A. Extended Cost-Effectiveness Analysis Methodology and Additional Results

NOTES

The World Bank classifies countries according to four income groupings. Income is measured using gross national income (GNI) per capita, in U.S. dollars, converted from local currency using the *World Bank Atlas* method. Classifications as of July 2014 are as follows:

- Low-income countries (LICs) = US$1,045 or less in 2013
- Middle-income countries (MICs) are subdivided:
    - Lower-middle-income = US$1,046 to US$4,125
    - Upper-middle-income (UMICs) = US$4,126 to US$12,745
- High-income countries (HICs)= US$12,746 or more

1. http://www.r-project.org.

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