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

Supplemental material for: Shrime, MG, Verguet, S, Johansson, KJ, Desalegn, D, et al. 2015. Task-Sharing or Public Finance for Expanding Surgical Access in Rural Ethiopia: An Extended Cost-Effectiveness Analysis. In: *Essential Surgery*, edited by Debas HT, Donkor P, Gawande A, Jamison DT, Kruk ME and Mock CN. Volume 1 of *Disease Control Priorities, third edition*. Washington, DC: World Bank.

## Model Inputs Derived from the 2011 Ethiopia Demographic and Health Survey

Annex table 19A.1 gives the estimated utilization for surgical services under each policy. Under the status quo, utilization of services by the poorest and richest quintiles was calculated from the 2011 Ethiopia Demographic and Health Survey (DHS) (Central Statistical Agency [Ethiopia] and ICF International 2012). Utilization by intermediate quintiles represents a linear extrapolation between these two quintiles. Price elasticity in the demand for services in Uganda (Ssewanyana and others 2004) was used as a proxy for responsiveness of patients to universal public financing (UPF) and vouchers, with the demand increase proportional to the total cost of care (direct medical + direct nonmedical) that was averted by each policy, respectively. Utilization in Addis Ababa is taken to represent utilization when all necessary surgical providers are present.

The assumption is made that, under task-sharing, no cross-over exists: the few patients who were already receiving care from a surgeon in the status quo continue to do so under task-sharing and new demand only goes to the task-shifted provider. Under the combination of UPF and task-sharing, in which surgery is made free and provider quantity is increased, patients utilize surgeons first, with the assumption being that, if the cost of medical care is free, the provider with the higher perceived quality will be chosen first; any excess demand is then borne by the task-shifted provider. Data for task-sharing in nonobstetric surgical conditions were sparse. To calculate this gradient, we anchored on the highest utilization in urban Ethiopia for medical services, found the average utilization, and constructed a gradient to maintain that average and maximum utilization.

Each of these assumptions is tested with sensitivity analyses (see "Baseline Utilization" and "Own-Price Elasticity of Demand" in the "Additional Sensitivity Analyses" section).

**Table 19A.1** Estimated Access to Surgical Services under Each Scenario

| | **Obstetric conditions** | | | | | | **Nonobstetric conditions** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Wealth quintile* | *Status quo* | *UPF* | *UPF + voucher* | *Task-sharing* | *UPF + task-sharing* | *UPF + task-sharing + voucher* | *Status quo* | *UPF* | *UPF + voucher* | *Task-sharing* | *UPF + task-sharing* | *UPF + task-sharing + voucher* |
| Poorest | 0.03 | 0.06 | 0.11 | 0.21 | 0.24 | 0.29 | 0.34 | 0.37 | 0.42 | 0.53 | 0.56 | 0.61 |
| Poor | 0.06 | 0.08 | 0.11 | 0.31 | 0.32 | 0.35 | 0.42 | 0.44 | 0.47 | 0.59 | 0.61 | 0.64 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Middle | 0.10 | 0.11 | 0.13 | 0.40 | 0.41 | 0.44 | 0.50 | 0.51 | 0.53 | 0.66 | 0.67 | 0.69 |
| Rich | 0.13 | 0.14 | 0.16 | 0.50 | 0.51 | 0.52 | 0.57 | 0.58 | 0.60 | 0.72 | 0.73 | 0.75 |
| Richest | 0.19 | 0.19 | 0.20 | 0.69 | 0.69 | 0.69 | 0.64 | 0.65 | 0.65 | 0.79 | 0.79 | 0.79 |

*Note:* See text for details. UPF = universal public financing.

## Assessment of Health Gains and Financial Risk Protection Afforded

### Deaths Averted

The model follows the rural population of Ethiopia over one year and uses inputs varying by income group in order to quantify the reduction in surgery-related mortality in each income group. For each intervention, the expected number of total deaths averted (TDA) is estimated based on incidence and mortality data, intervention effectiveness, and case fatality rate.

For each surgical intervention treating condition $j$ in wealth quintile $k$, total deaths, $TD_{j,k}$, can be determined using parameters listed in annex tables 19A.2 and 19A.3 and the chain of events exhibited in figure 19.1, in the main text. We estimate the deaths occurring in the status quo using the combination of probabilities of events, $p_{i,j,k}$, and of death $d_{i,j,k}$. $TD_{j,k}$ can then be expressed in the form of equation (19A.1):

$$TD_{j,k} = [p_{a,j,k} d_{a,j,k} + (1 - p_{a,j,k}) d_{n,j,k}] \times N_k \times p_j \quad , \qquad (19A.1)$$

in which $N_k$ represents the overall population in quintile $k$, $p_j$ represents the probability of an individual getting disease $j$ (assumed not to vary across wealth quintiles), $p_{a,j,k}$ represents the probability of accessing care by patients in wealth quintile $k$ for disease condition $j$, and $d_{a,j,k}$ represents the probability of death given access to care. Similarly, $d_{n,j,k}$ represents the probability of dying for patients in wealth quintile $k$ with disease $j$, conditional on not accessing care.[1]

Under task-sharing, the probability of accessing care from a surgeon versus a task-sharing provider is estimated as described above. In this case, $d_{a,j,k}$ varies by type of provider.

Expected total yearly deaths in the status quo can be determined by simply summing the deaths due to each condition in each wealth quintile, making the assumption that, over the course of one year, the chance that any individual gets more than one unrelated condition is minimal.

$$TD_{SQ,k} = \sum_j TD_{j,k} \qquad (19A.2)$$

Similar calculations are done for each policy intervention (UPF, task-sharing, and combination). The TDA under each policy is the difference between total deaths under the status quo and total deaths under the policy. For UPF, this becomes

$$TDA_{UPF,k} = TD_{SQ,k} - TD_{UPF,k} \qquad (19A.3)$$

with identical calculations for the other three policies.

### Consequences for Household Expenditures and Government Costs

Total system costs for each surgical intervention treating condition *j* in wealth quintile *k*, $SC_{j,k}$, can be determined following the conventions of equation (19A.1), with the addition of a cost-assignment factor, *OOP* (for the proportion of a cost that is not borne by patients out-of-pocket), which is 66 percent in the status quo and task-sharing, and 100 percent in policies including the free provision of surgery.

$$SC_{j,k} = \left[OOP \times p_{a,j,k}c_{a,j,k} + \left(1 - p_{a,j,k}\right) \times OOP \ \times c_{n,j,k}\right] \times N_k \times p_j \qquad (19A.4)$$

As above, $c_{a,j,k}$ represents the cost to the government when care is sought and $c_{n,j,k}$ represents cost when care is not sought (assumed, in this case, to be zero). System costs are estimated linearly for the first 10 percent increase in utilization, and then twice that for each additional increase, to approximate increasing marginal costs. Total and incremental costs are calculated identically to equations (19A.2) and (19A.3).

Private expenditure due to surgical conditions is calculated similarly, with the inclusion, under the status quo, of the direct, nonmedical costs of care, $D_{j,k}$.

$$PE_{j,k} = \left[p_{a,j,k}\left[(1 - OOP)c_{a,j,k} + D_{j,k}\right] + \left(1 - p_{a,j,k}\right) \times (1 - OOP) \times c_{n,j,k}\right]N_k p_j \qquad (19A.5)$$

In this case, the out-of-pocket expenditure for medical care is the proportion not spent by the government, and again, $c_{n,j,k}$ is assumed to be zero. Expenditure averted is calculated identically to equations (19A.2) and (19A.3).

### Financial Risk Protection Afforded

We quantify the financial risk protection (FRP) benefits brought to households by the program in number of cases of poverty averted. FRP is measured by estimating the number of cases of poverty averted by each intervention within the program. Cases of poverty created under the status quo and each policy are calculated following the "head-count" method described previously (Garg and Karan 2009; Niens and others 2012).

Briefly, each individual has an income, *y*. Because reported income is not a valid indicator of overall wealth in low- and middle-income countries (Reddy and others 2013), individual income, *y*, is extracted from an income distribution for Ethiopia,[2] denoted *f(y)* (Salem and Mount 1974). Before the institution of any policy, each individual, *s*, in wealth quintile, *k*, with condition, *j*, has the following expected value of income:

$$E_{SQ,s,j,k}(y) = p_{a,j,k}\left(y_s - \left[(1 - OOP)c_{a,j,k} + D_{j,k}\right]\right) + \left(1 - p_{a,j,k}\right)y_s. \qquad (19A.6)$$

After the program, each individual has an expected value of income, $E_{policy,s,j,k}(y)$, which is calculated as in equation (19A.6), with the new cost and utilization parameters. A national poverty line, $Th$, is defined for Ethiopia as the income level below which 25 percent of the income distribution falls (World Bank 2012; WHO 2012). The number of cases of poverty averted, $TPA_{policy,k}$, by each policy in wealth quintile, $k$, is

$$TPA_{UPF,k} = \left[\sum_s \sum_j I\left(E_{SQ,s,j,k}(y) < Th\right)\right] - \left[\sum_s \sum_j I\left(E_{UPF,s,j,k}(y) < Th\right)\right], \quad (19A.7)$$

in which $I(a < b)$ represents an indicator random variable that takes the value 1 when the expression in brackets evaluates as true, and takes the value 0 otherwise. From equation (19A.7) it can be seen that a negative value for $TPA_{policy,k}$ implies that the policy creates cases of poverty.

#### *Cases of Catastrophic Expenditure Averted*

A second accepted measure of financial impact involves counting cases of catastrophic expenditure induced or prevented by a policy. The calculation for cases of catastrophic expenditure is identical to that shown in equations (19A.6) and (19A.7), with the exception that, for each individual, a threshold, $Th_s$, is calculated as a proportion of that individual's starting income, $y_s$. Following the methods outlined by multiple authors (Habicht and others 2006; Murphy and others 2013; Reddy and others 2013), this proportion is set at 0.6, representing expenditure of 40 percent of the starting income. This represents the most conservative of the proposed thresholds (Habicht and others 2006).

## Supplemental Results and Sensitivity Analyses

### Additional Measures of Financial Risk Protection

#### *Private Expenditure Crowded Out*

On average, UPF led to crowding out of $0.85 of private expenditure on surgical conditions per person, ranging from $1.09 in the richest quintile to $0.72 in the poorest quintile. Task-sharing led to crowding out of $0.38 per person, highest in the poorest quintile ($0.41) and lowest in the richest quintile ($0.35). A combination of the two policies crowded out $2.14 per person, highest in the richest quintile ($2.59) and lowest in the poorest quintile ($1.89).

Adding vouchers to UPF led to crowding out of $5.19 per person ($4.50, poorest; $6.53, richest), while adding them to UPF + task-sharing had the highest crowding out impact on average household savings ($9.11 average; $7.86 poorest; $11.42 richest).

#### *Cases of Catastrophic Expenditure Averted*

Per $100,000 spent, UPF forced 355 cases of catastrophic expenditure, task-sharing created 40 cases, and the combination of the two created 120 cases. In all three policy configurations, catastrophic expenditure fell primarily on the poorest wealth quintiles. The richest quintile saw protection against forced borrowing and selling from UPF and the combination policy (figure 19A.1).

Adding vouchers averted catastrophic expenditure across all wealth quintiles, with nearly 4,000 cases averted per $100,000 spent for UPF + vouchers, and 512 cases averted for UPF + task-sharing + vouchers.

## Additional Sensitivity Analyses

### *Baseline Utilization*

Under base-case assumptions, the status quo utilization for nonobstetric services is proxied by utilization of the health system in general. This is likely an upper bound.

For this sensitivity analysis, we used the proportion of all respondents in the DHS who accessed care from a hospital specifically, pooled with data from a 1994–97 household survey (Collier, Dercon, and Mackinnon 2002). Price elasticities were applied as in the "Model Inputs Derived from the 2011 Ethiopia DHS Survey" section, leading to utilization numbers shown in table 19A.2.

**Table 19A.2** Estimated Access to Surgical Services under the Status Quo

| | ***Obstetric conditions*** | | | | | | ***Nonobstetric conditions*** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Wealth quintile* | *Status quo* | *UPF* | *UPF + voucher* | *Task-sharing* | *UPF + task-sharing* | *UPF + task-sharing + voucher* | *Status quo* | *UPF* | *UPF + voucher* | *Task-sharing* | *UPF + task-sharing* | *UPF + task-sharing + voucher* |
| Poorest | 0.03 | 0.057 | 0.11 | 0.21 | 0.24 | 0.29 | 0.10 | 0.12 | 0.18 | 0.11 | 0.14 | 0.19 |
| Poor | 0.06 | 0.080 | 0.11 | 0.31 | 0.32 | 0.35 | 0.14 | 0.16 | 0.19 | 0.21 | 0.24 | 0.26 |
| Middle | 0.10 | 0.11 | 0.13 | 0.40 | 0.41 | 0.44 | 0.18 | 0.20 | 0.22 | 0.32 | 0.34 | 0.36 |
| Rich | 0.13 | 0.14 | 0.16 | 0.50 | 0.51 | 0.52 | 0.23 | 0.24 | 0.26 | 0.43 | 0.44 | 0.46 |
| Richest | 0.19 | 0.19 | 0.20 | 0.69 | 0.69 | 0.69 | 0.27 | 0.28 | 0.28 | 0.54 | 0.54 | 0.55 |

*Note:* UPF = universal public financing. Table shows estimated access to surgical services under each scenario under a sensitivity analysis allowing decreased utilization for nonobstetric services under the status quo.

Results are given in figure 19A.2. Most policies have higher benefits and harms per dollar spent. This effect is most pronounced with UPF. Both task-sharing alone and UPF + task-sharing still induce impoverishment on average.

### *Own-Price Elasticity of Demand*

The assumptions about increased demand under UPF are relatively inelastic, consistent with estimates for own-price elasticity for public services in Uganda. We then assumed an increased own-price elasticity for health services, consistent with those found for private health provision (Ssewanyana and others 2004). The resultant utilization functions are given in table 19A.3.

**Table 19A.3 Estimated Access to Surgical Services under Own-Price Elasticity**

| | Obstetric conditions | | | | | | Nonobstetric conditions | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Wealth quintile* | *Status quo* | *UPF* | *UPF + voucher* | *Task-sharing* | *UPF + task-sharing* | *UPF + task-sharing + voucher* | *Status quo* | *UPF* | *UPF + voucher* | *Task-sharing* | *UPF + task-sharing* | *UPF + task-sharing + voucher* |
| Poorest | 0.03 | 0.13 | 0.35 | 0.21 | 0.33 | 0.53 | 0.34 | 0.46 | 0.66 | 0.53 | 0.67 | 0.84 |
| Poor | 0.06 | 0.11 | 0.20 | 0.31 | 0.36 | 0.44 | 0.42 | 0.47 | 0.56 | 0.59 | 0.65 | 0.73 |
| Middle | 0.10 | 0.12 | 0.18 | 0.40 | 0.43 | 0.48 | 0.49 | 0.52 | 0.57 | 0.66 | 0.69 | 0.74 |
| Rich | 0.13 | 0.14 | 0.17 | 0.50 | 0.51 | 0.53 | 0.57 | 0.58 | 0.61 | 0.72 | 0.74 | 0.76 |
| Richest | 0.19 | 0.19 | 0.19 | 0.69 | 0.68 | 0.68 | 0.64 | 0.64 | 0.64 | 0.79 | 0.78 | 0.78 |

*Note:* UPF = universal public financing. Table shows estimated access to surgical services under each scenario under a sensitivity analysis allowing increased own-price elasticity.

Results are given in figure 19A.3. Minor changes are noted in the amount of health benefit and FRP benefit when compared with the base-case scenario. UPF results in less FRP per dollar than in the base-case scenario because the increased price elasticity exposes more patients to direct nonmedical costs; it does, however, result in a marginal increase in health protection per dollar. The same pattern is seen in task-sharing alone and task-sharing + UPF. The programs with vouchers show an increase in both health and FRP benefits, as expected.

No differences were noted in the distribution of benefits across wealth quintiles for any of the proposed policies.

### *Magnitude of Direct Nonmedical Costs*

In our base-case analysis, the direct nonmedical costs for services were approximately three times the cost of any actual medical services. In this sensitivity analysis, those costs are divided by three. Utilization is recalculated using the resultant new total cost of care. As shown in figure 19A.4, all policies now avert more cases of impoverishment, and only task-sharing creates impoverishment overall. However, although UPF + task-sharing now has an overall FRP effect, it continues to *create* impoverishment in the poorest two quintiles (not shown).

### *Risk of Mortality from Untreated Disease*

Under the base case, the assumed risk of mortality from untreated disease in six of the examined conditions (obstructed labor, maternal sepsis, uterine rupture, other conditions requiring cesarean section, other conditions requiring hysterectomy, and conditions requiring abortion) is 30 percent. Although this assumption is supported by the literature (see Table 19.2), it will necessarily bias the results away from the implementation of any policy when health benefits are of interest. As a result, this sensitivity analysis explores the impact of these policies, conditional on an untreated mortality of 90 percent for any of these six conditions. Results are shown in figure 19A.5. Per dollar spent, UPF and UPF + vouchers are essentially unchanged from the base-case results. Policies involving task-sharing, however, avert more deaths per dollar spent, with the largest difference seen in the policy of task-sharing alone. The additional health benefit per dollar gained under task-sharing in this sensitivity analysis is diluted when additional policies (UPF and vouchers) are included. There is no change in the overall distribution of benefits across wealth quintiles (not shown).

#### *Cost of Complications*

The cost of complications is low relative to the cost of any individual procedure. We therefore varied the cost of complications up to a maximum of three times the cost of the procedure. The results at this upper bound are shown in figure 19A.6. As expected, all policies avert fewer deaths per dollar than under base-case assumptions; this effect is most obvious for task-sharing alone, in which the probability of complications is highest. Also, because these policies become more expensive, financial impacts per dollar decrease. The distribution of benefits across wealth quintiles remains unchanged (not shown).

#### *Inclusion of Indirect Costs*

There are two possible sources of indirect costs in this model: the first is the indirect cost involved in care seeking (due, for example, to lost wages for patients and caretakers). This indirect cost has been estimated elsewhere, at $371.74 for care sought through the referral system and $243.52 when care is sought through an outreach program (Kifle and Nigatu 2010). Taking the arguably conservative assumption that these indirect costs factor into the patient's decision to seek care (which, given the life-threatening nature of the conditions examined, is unlikely), the model was rerun, with results as shown in figure 19A.7. More impoverishment is created and less impoverishment averted for each policy under this assumption than under the base-case assumptions. These differences are, again, seen most strongly in task-sharing but occur under all policies. The decreased FRP accrues across all wealth quintiles, and is most marked under task-sharing—the rich now see impoverishment when indirect costs are included, which is not seen in the base case.

Under the more realistic assumption that patients' demand for care is sensitive only to their direct out-of-pocket costs, the inclusion of these indirect costs leads to the creation of more impoverishment across the entire population (figure 19A.8) when compared with the base case and the sensitivity analysis in figure 19A.7. The salutary effects of UPF ameliorated some of that increased impoverishment when added to task-sharing, but not all of it. The distributional impacts were similar to those seen in the sensitivity analysis in figure 19A.7.

Including the second source of indirect costs becomes more problematic. From a societal perspective, the loss of economic productivity due to the death of a patient is significant. However, given the perspective of this model, accounting for this cost becomes difficult and runs the risk of double-counting deaths and impoverishment. As a result, a third sensitivity analysis was done to approximate a benefit-cost analysis. As a back-of-the-envelope calculation, we valued a death as follows: we took the average income of an adult in Ethiopia (593.3; Ethiopian birr; Kifle and Nigatu 2010), assumed that most patients facing these conditions would be 25 years old and would, therefore, have a life expectancy, conditional on achieving that age, of 38.4 additional years, and therefore calculated every death to have a cost to society of $49,798.30. Per 1 million population, keeping surgical delivery at the status quo has a cost of $50.563 million. Task-sharing + UPF, at $38.28 million, is the preferred option, followed by task-sharing alone ($38.48M), task-sharing + UPF + vouchers ($44.02M), and UPF alone ($50.41M). UPF + vouchers is more expensive than keeping delivery at the status quo.

#### *The Effects of Taxation*

Although the model does not specifically adopt a societal standpoint, the costs of any intervention are assumed to be borne exogenously. This sensitivity analysis looks at the effect of making these costs endogenous through taxation. For this sensitivity analysis, a flat tax is applied to the entire population. The effects of progressive and regressive taxation schemes are not explicitly modeled. Results are shown in figure 19A.9. Taxation to pay for full implementation of these policies leads to impoverishment, on average, across all policies. This impoverishment load is borne by the poorest two quintiles in policies with vouchers and the poorest three quintiles in policies without vouchers. FRP continues to accrue to the rich in all policies and to the middle quintile in policies with vouchers, but this risk protection effect is blunted when compared with the base-case scenario.

## Supplemental Tables and Figures

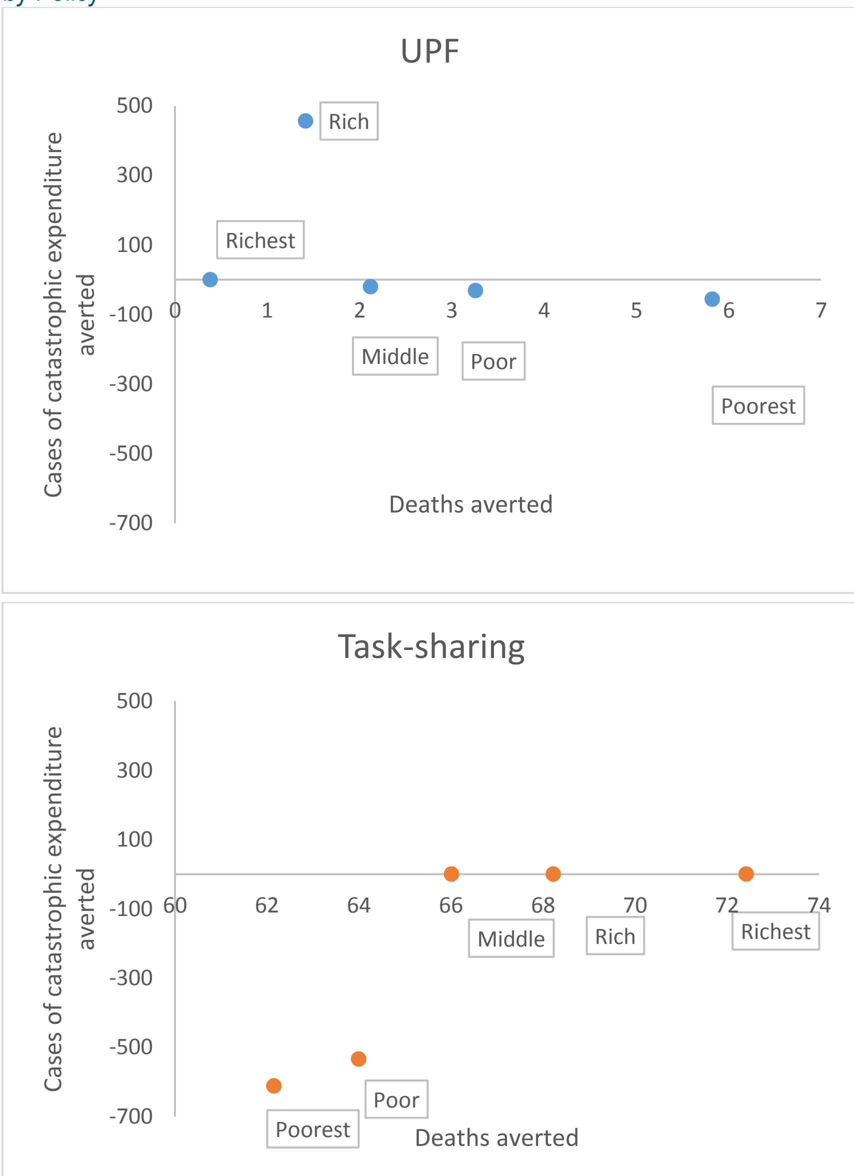
**Table 19A.4** Health Gains and Financial Risk Protection by Policy Option in Rural Ethiopia

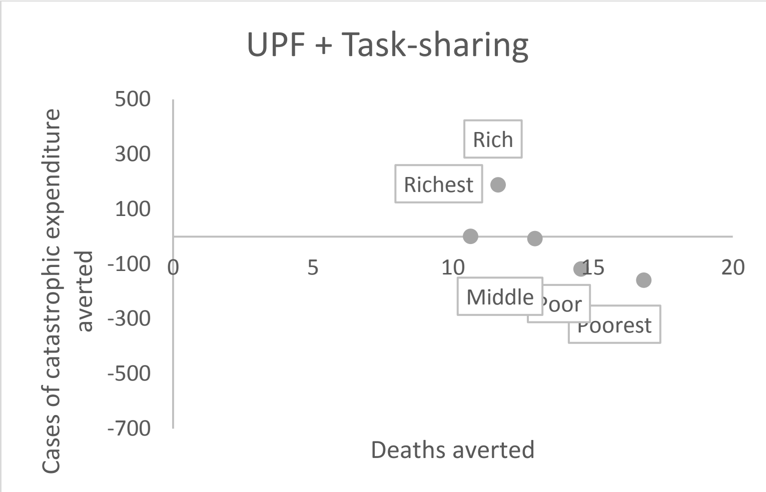
| | | | *Wealth quintile* | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | *Poorest* | *Poor* | *Middle* | *Rich* | *Richest* | *Overall*[a] |
| Deaths averted (nominal) | UPF (no vouchers) | Obstetric | 1 | 0 | 0 | 0 | 0 | 2 |
| | | Appendicitis | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Trauma | 8 | 5 | 3 | 3 | 1 | 19 |
| | | Total | 8 | 5 | 4 | 3 | 1 | 21 |
| | UPF with vouchers | Obstetric | 2 | 1 | 1 | 1 | 0 | 5 |
| | | Appendicitis | 0 | 0 | 0 | 0 | 0 | 1 |
| | | Trauma | 21 | 13 | 9 | 7 | 2 | 51 |
| | | Total | 23 | 14 | 10 | 8 | 2 | 58 |
| | Task-sharing | Obstetric | 5 | 6 | 8 | 10 | 13 | 42 |
| | | Appendicitis | 1 | 1 | 1 | 1 | 1 | 4 |
| | | Trauma | 45 | 43 | 41 | 38 | 36 | 204 |
| | | Total | 51 | 50 | 50 | 49 | 50 | 250 |
| | UPF + task-sharing | Obstetric | 6 | 7 | 9 | 10 | 13 | 44 |
| | | Appendicitis | 1 | 1 | 1 | 1 | 1 | 5 |
| | | Trauma | 57 | 51 | 48 | 45 | 41 | 242 |
| | | Total | 63 | 59 | 57 | 56 | 55 | 291 |
| | UPF + task-sharing + vouchers | Obstetric | 7 | 8 | 9 | 11 | 13 | 48 |
| | | Appendicitis | 1 | 1 | 1 | 1 | 1 | 5 |
| | | Trauma | 68 | 58 | 53 | 49 | 42 | 271 |
| | | Total | 76 | 67 | 63 | 60 | 56 | 324 |
| Cases of poverty averted (nominal) | UPF (no vouchers) | Obstetric | 0 | –1 | –1 | 3 | 0 | 1 |
| | | Appendicitis | 0 | 0 | 0 | 1 | 0 | 1 |
| | | Trauma | 0 | –37 | –36 | 437 | 0 | 364 |
| | | Total | 0 | –38 | –37 | 440 | 0 | 366 |
| | UPF with vouchers | Obstetric | 0 | 4 | 8 | 3 | 0 | 15 |
| | | Appendicitis | 0 | 2 | 4 | 1 | 0 | 7 |
| | | Trauma | 0 | 844 | 1,327 | 457 | 0 | 2,628 |
| | | Total | 0 | 850 | 1,339 | 461 | 0 | 2,650 |
| | Task-sharing | Obstetric | 0 | –15 | –10 | 0 | 0 | –25 |
| | | Appendicitis | 0 | –1 | –1 | 0 | 0 | –2 |
| | | Trauma | 0 | –345 | –206 | 0 | 0 | –551 |
| | | Total | 0 | –361 | –217 | 0 | 0 | –578 |
| | UPF + task-sharing | Obstetric | 0 | –16 | –11 | 3 | 0 | –25 |
| | | Appendicitis | 0 | –1 | –1 | 1 | 0 | –1 |
| | | Trauma | 0 | –392 | –248 | 437 | 0 | –203 |
| | | Total | 0 | –409 | –260 | 440 | 0 | –229 |
| | UPF + task-sharing + vouchers | Obstetric | 0 | 4 | 8 | 3 | 0 | 15 |
| | | Appendicitis | 0 | 2 | 4 | 1 | 0 | 7 |
| | | Trauma | 0 | 844 | 1,327 | 457 | 0 | 2,628 |
| | | Total | 0 | 850 | 1,339 | 461 | 0 | 2,650 |

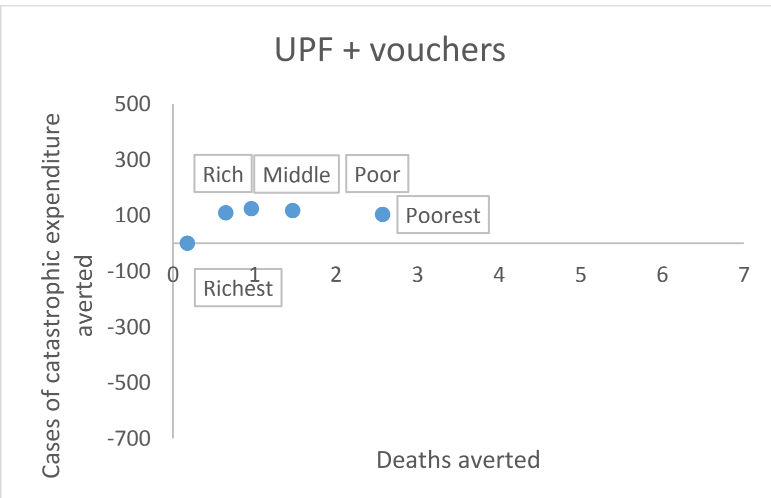
*Note:* UPF = universal public financing. Table shows nominal (not per dollar spent) health gains and financial risk protection afforded (measured as cases of poverty averted).

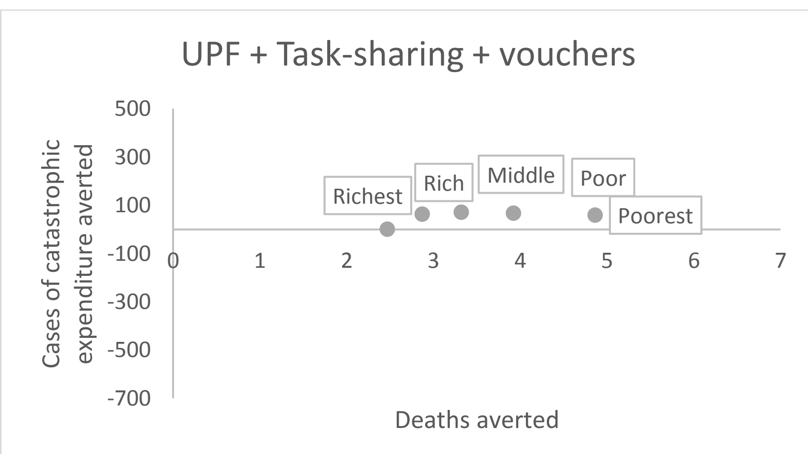
a. Rows may not sum to totals because of rounding.

**Figure 19A.1** Distribution of Health Benefits and Cases of Catastrophic Expenditure Averted, per $100,000 Spent, by Policy






*Note:* UPF = universal public financing. Panels show distribution of health benefits and cases of catastrophic expenditure averted, per $100,000 spent, for each policy across wealth quintiles. Negative cases of catastrophic expenditure averted are cases created.

**Figure 19A.2** Health and Financial Risk Protection per $100,000 Spent under Decreased Utilization for Nonobstetric Conditions in the Status Quo

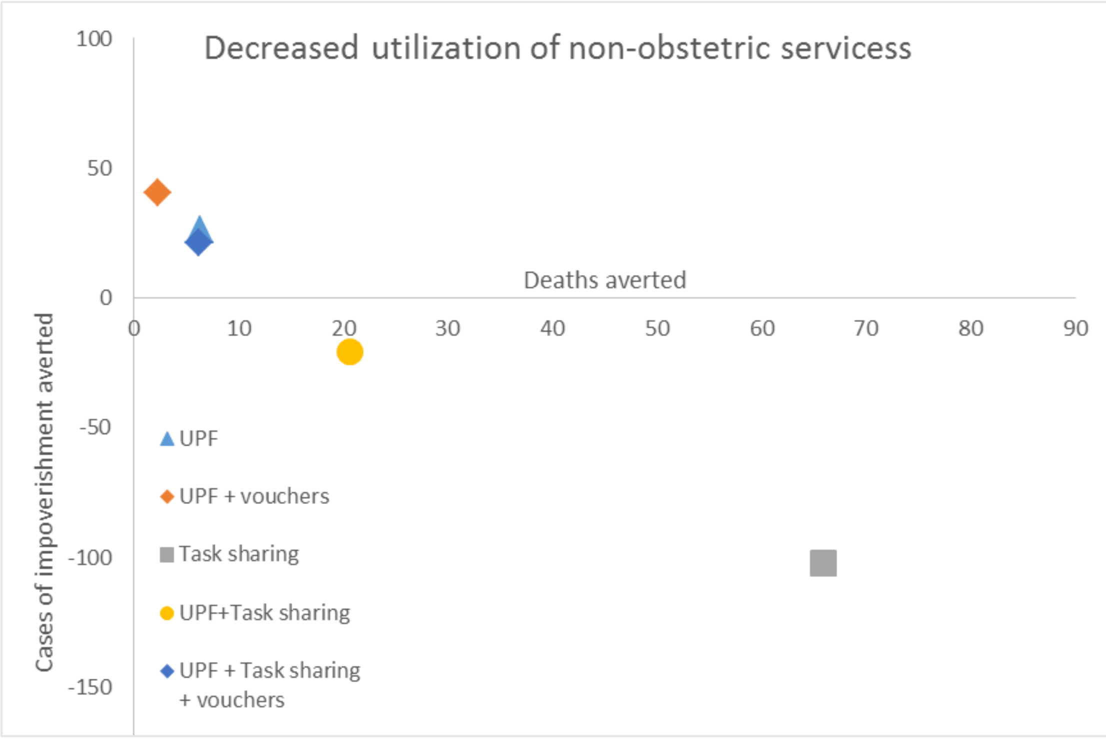
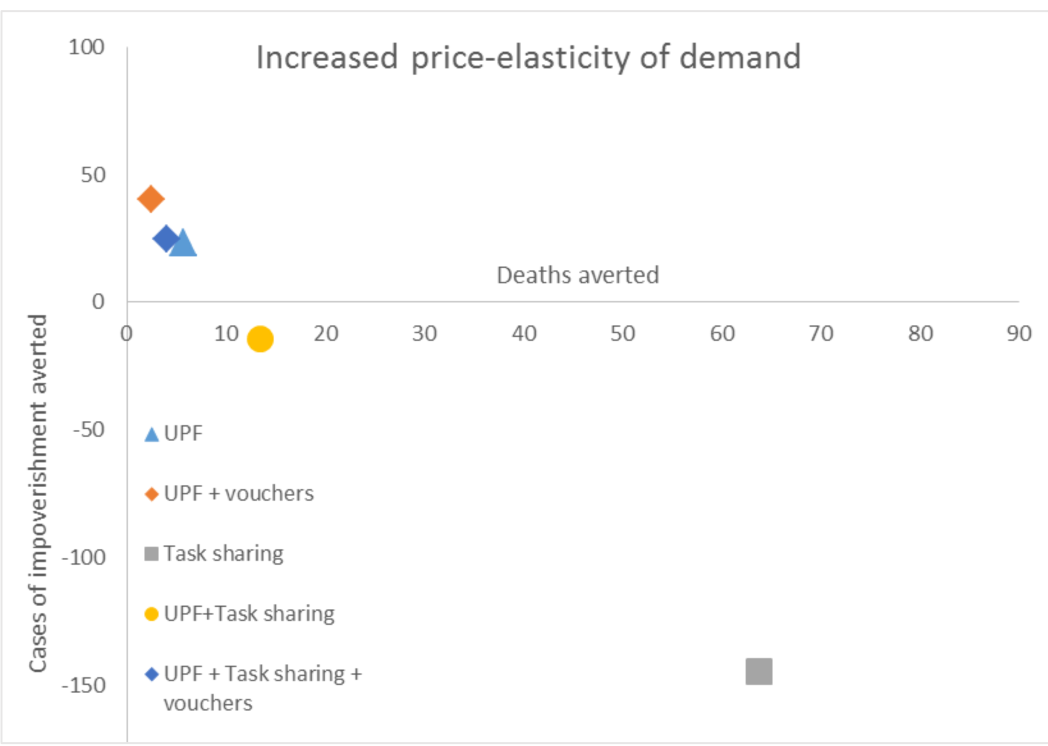



**Figure 19A.3** Health and Financial Risk Protection per $100,000 Spent under Increased Own-Price Elasticity Assumptions




*Note:* UPF = universal public financing.

**Figure 19A.4** Health and Financial Risk Protection per $100,000 Spent under Assumptions of Decreased Direct Nonmedical Costs

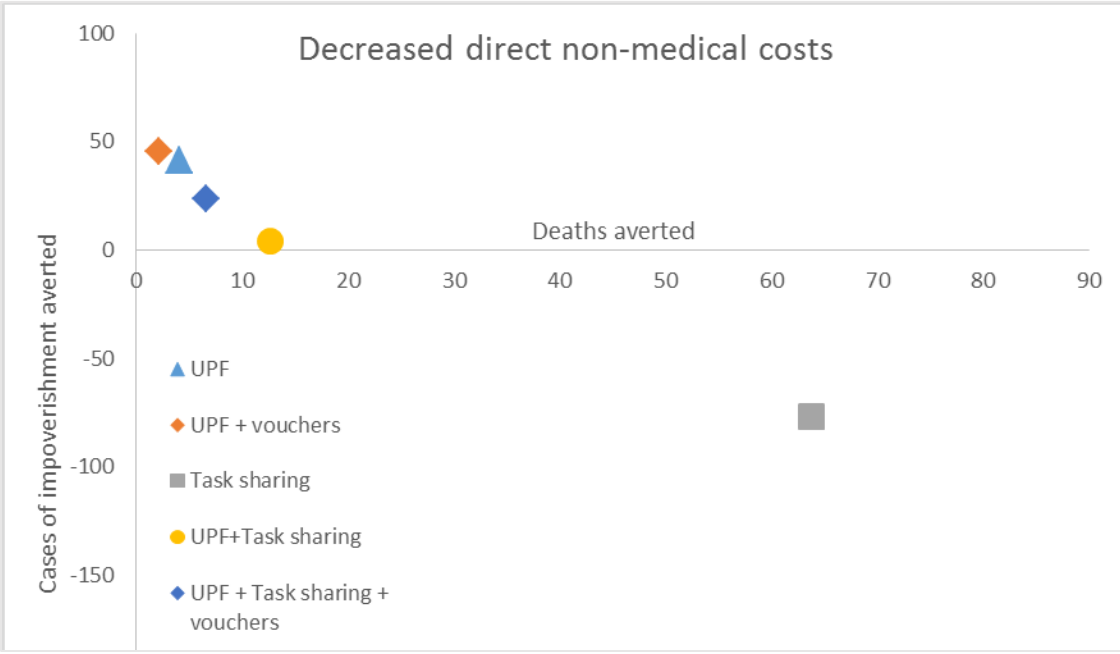
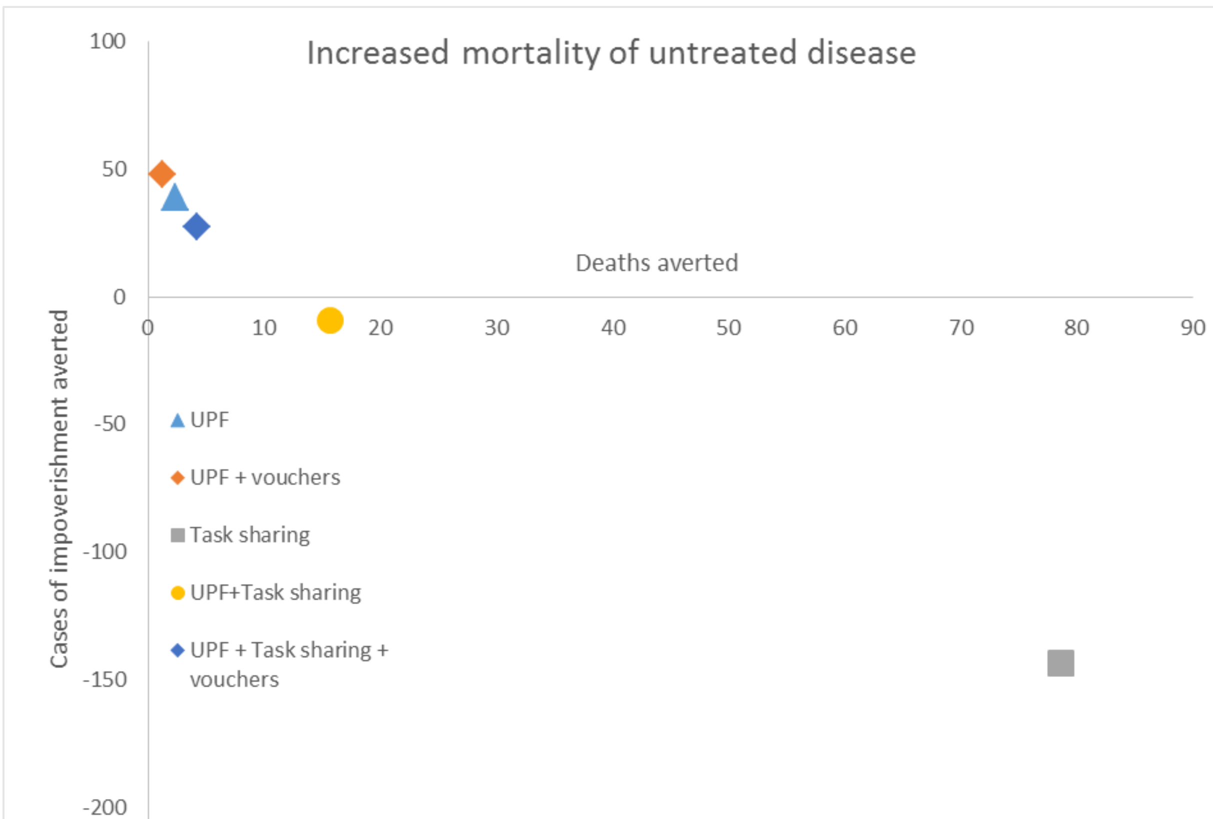
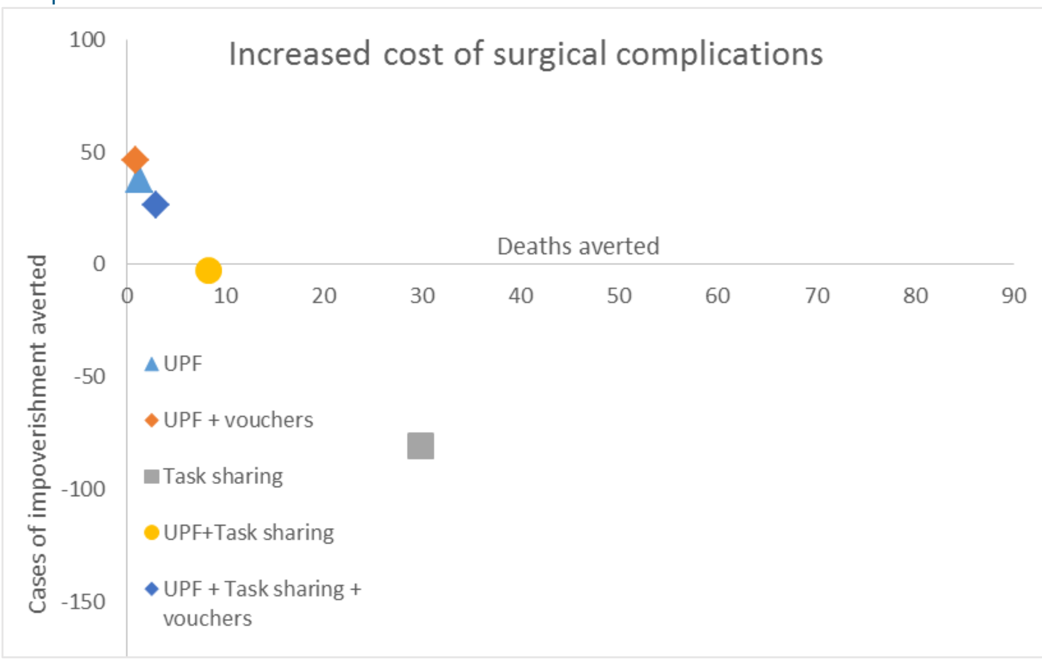



**Figure 19A.5** Health and Financial Risk Protection per $100,000 Spent under Assumptions of Increased Mortality from Untreated Disease



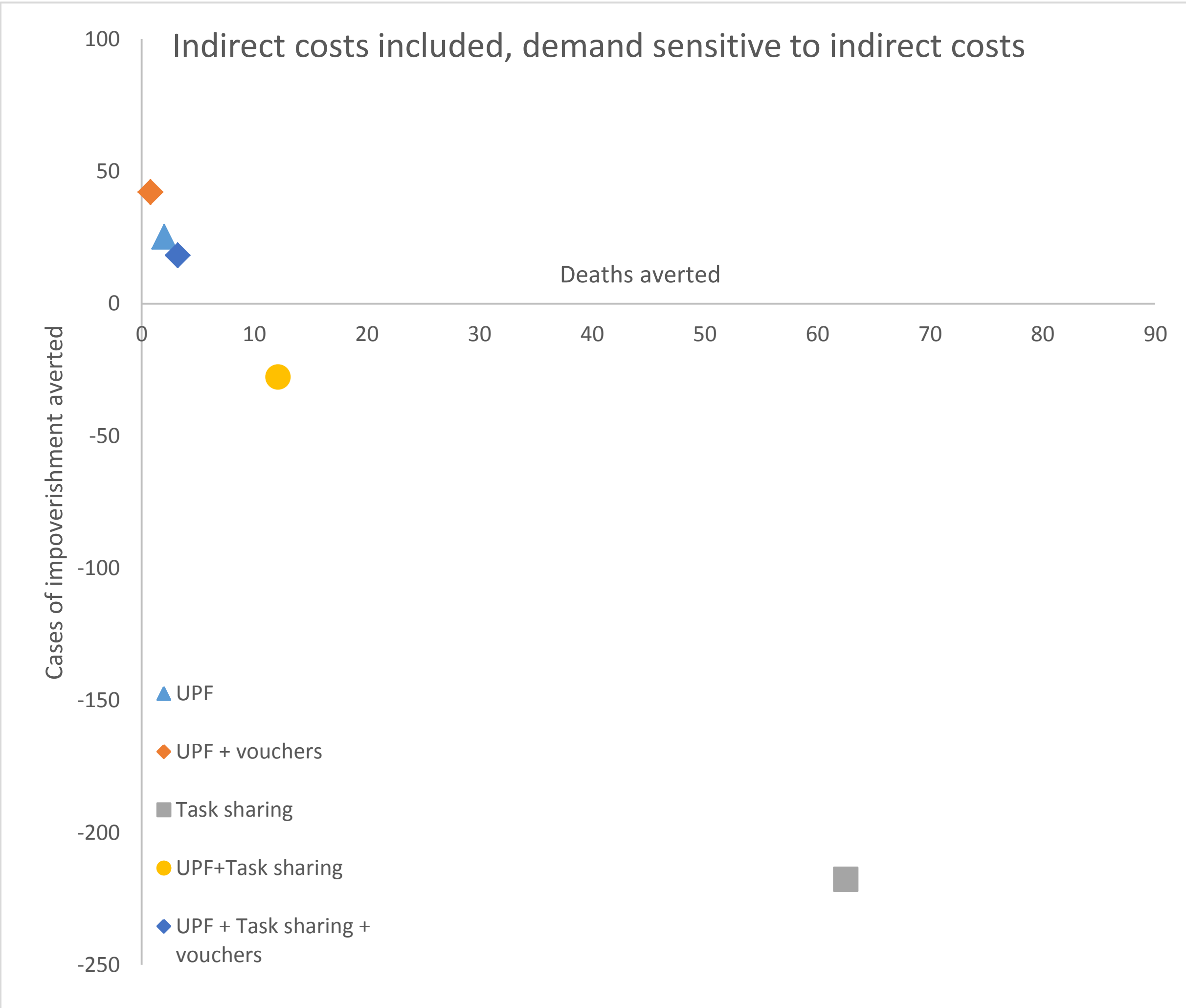

*Note:* UPF = universal public financing.

**Figure 19A.6** Health and Financial Risk Protection per $100,000 Spent under Assumptions of Increased Costs for Complications



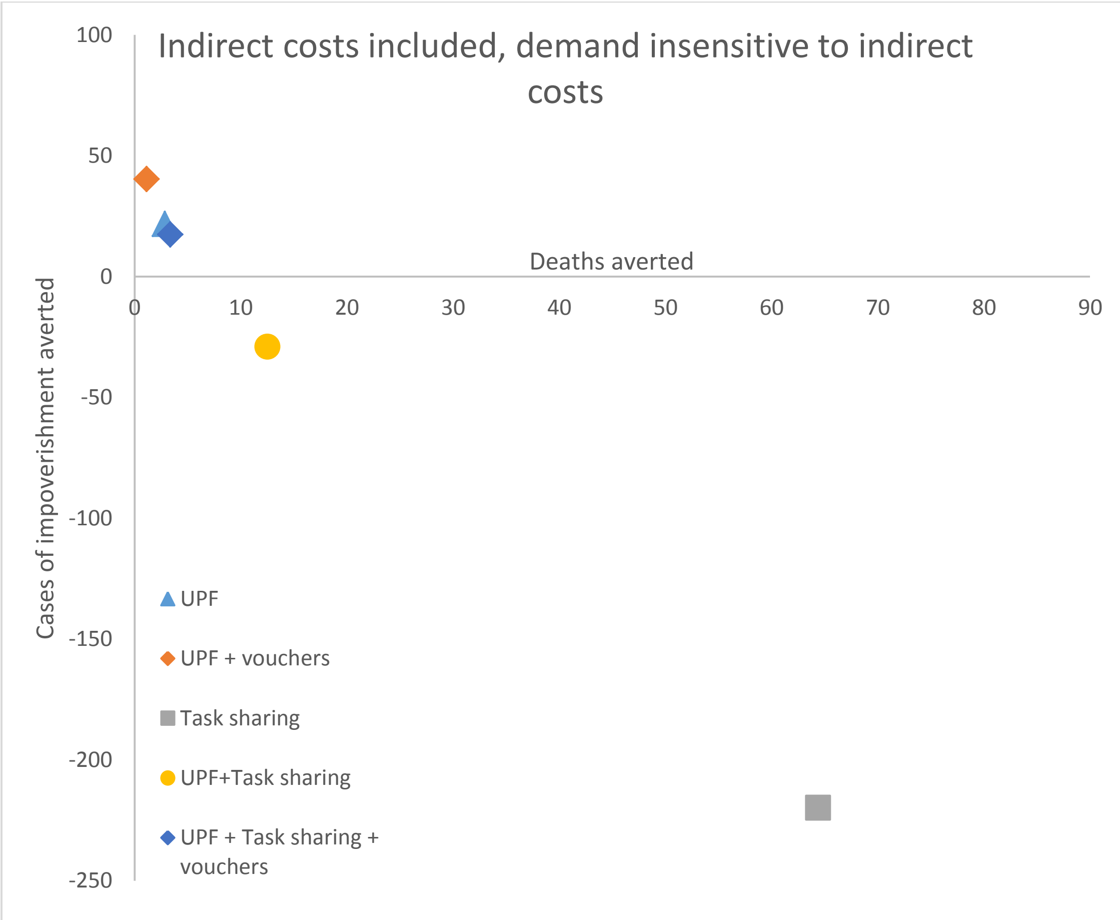

*Note:* UPF = universal public financing.

**Figure 19A.7** Health and Financial Risk Protection per $100,000 Spent when Indirect Costs Are Included and Patients Consider These Costs in Their Decisions to Seek Care



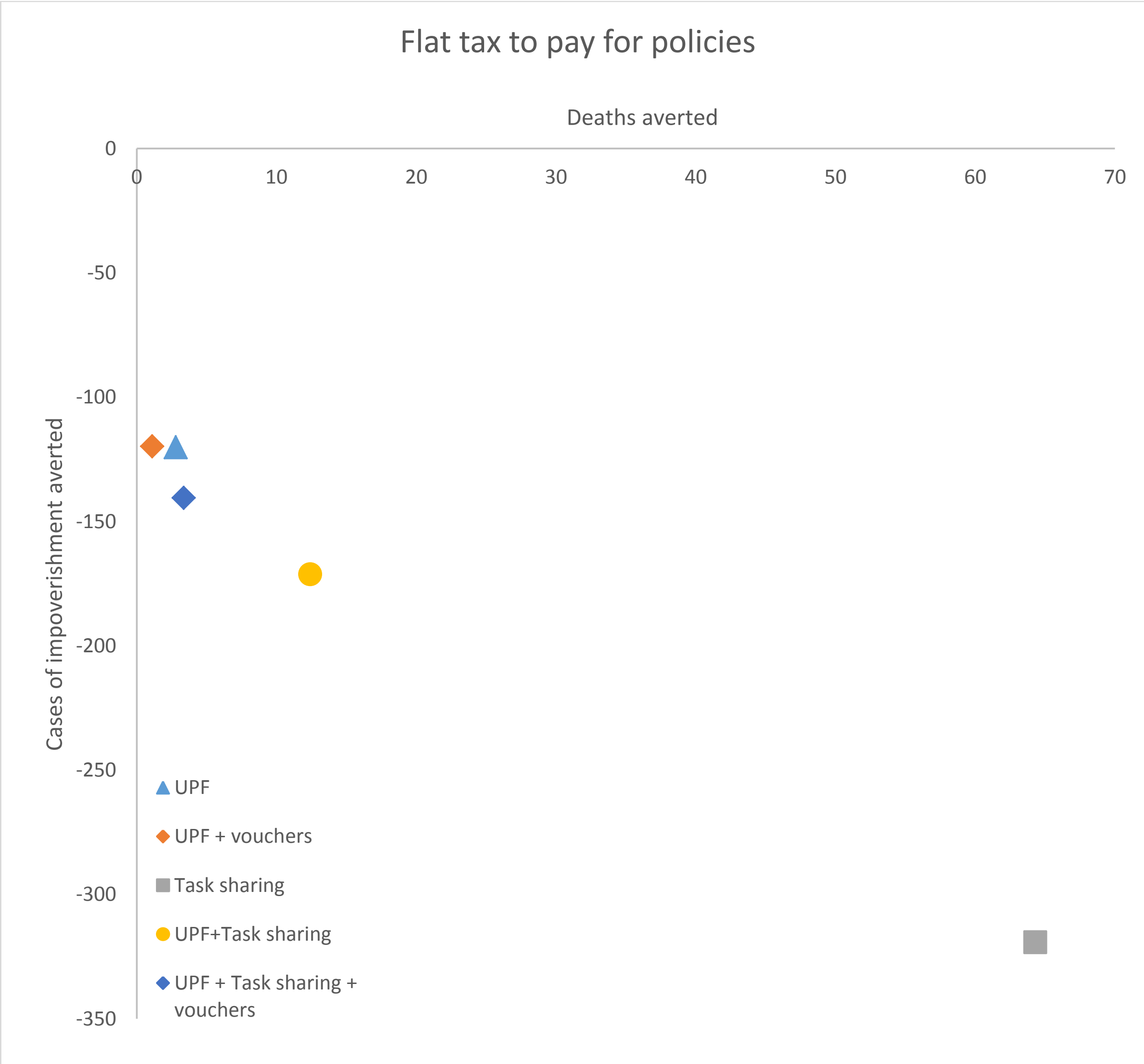

*Note:* UPF = universal public financing.

**Figure 19A.8** Health and Financial Risk Protection per $100,000 Spent when Indirect Costs Are Included and Patients Do Not Consider These Costs in Their Decisions to Seek Care




*Note:* UPF = universal public financing.

**Figure 19A.9** The Effect of Paying for Each Policy Using a Flat Tax across the Population




## Notes

1. To simplify the expression of this and following equations, all of the probabilities implied in figure 19.1 in the main text are not explicitly represented in the equations. Instead, $d_{a,j,k}$ and $d_{n,j,k}$ represent the expected probability of dying, conditional on having reached the respective chance nodes. That is, $d_{n,j,k} = P(\text{Die of untreated disease}) \times 1 + P(\text{Survive or resolve}) \times 0$. Similarly for $d_{a,j,k}$.
2. A proxy for an income distribution for Ethiopia *f(y)* can be approximated using a gamma distribution derived from Ethiopia's gross domestic product (GDP) per capita ($1,366 in international dollars) and Ethiopia's Gini index.

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