Introduction

Many countries in sub-Saharan Africa have increasingly committed to tackling maternal illnesses and deaths through a mix of interventions. For instance, in the past 15 years, the Kenyan government has implemented structural reforms mainly focused on increasing access to and reducing the cost of care for women. These reforms include the 2006 care subsidy voucher programme, the 2013 free maternity care programme of care for women. These reforms include the 2006 care subsidy voucher programme,1 the 2013 free maternity care programme in public facilities,2 which significantly increased facility-based births,3 and the health insurance subsidy programme for poor people.4 Yet, preventable maternal deaths are still high in Kenya, where the maternal mortality ratio is estimated at 510 maternal deaths per 100 000 live births.5

The spectrum of maternal morbidity as described by the World Health Organization (WHO) ranges from mild to moderate, severe (potentially life-threatening conditions), maternal near miss or death. WHO defines maternal near miss as a woman who nearly died but survived a complication that occurred during pregnancy or within 42 days of delivery or termination.6 On the other hand, potentially life-threatening conditions are severe complications that may progress to near misses but may also resolve with clinical care, are not at the end of the spectrum of morbidity, and typically require less intensive care and resources to manage than maternal near miss.

Maternal mortality ratio is a popular indicator for assessing progress in maternal health, but it is not adequate to understand the full scale of maternal health-care provision and outcomes,7 because maternal deaths are infrequent events.8 Thus, maternal near-miss events, which occur 5–10 times more frequently than maternal deaths and often require intensive care, attendance by highly skilled staff and extended hospital stays,9–16 may be used as a proxy to explore the circumstances surrounding maternal deaths.

In low- and middle-income countries where health systems may be weak and there is little financial protection for vulnerable people, experiencing severe obstetric complications such as maternal near miss likely increases the risk of catastrophic expenditure for women and their households compared with less severe complications or an uncomplicated delivery. Catastrophic expenditure is any cost incurred in the process of seeking health care that threatens a household’s ability to meet its subsistence needs,17 and could push households into financial hardship and poverty.18 At the core of the universal health coverage (UHC) target of the sustainable development goals (SDGs) is guaranteeing financial protection for all people seeking health care and expanding services. Despite increased investment in UHC efforts in many low- and middle-income countries, recent data suggest that progress towards financial protection and service coverage has been limited.18

In Kenya, the elimination of user fees for maternity care should theoretically cover antenatal care, deliveries, postnatal care, referrals and family planning. In practice however, this only covers deliveries.19 Kenyan health-care financing is predominantly through social health insurance and non-contributory mechanisms (government tax and donors). The National Health Insurance Fund currently covers about 18% of

Objective To estimate the direct costs of treating women with maternal near misses and potentially life-threatening conditions in Kenya and the factors associated with catastrophic health expenditure for these women and their households.

Methods As part of a prospective, nationally representative study of all women with near misses during pregnancy and childbirth or within 42 days of delivery or termination of pregnancy, we compared the cost of treating maternal near-miss cases admitted to referral facilities with that of women with potentially life-threatening conditions. We used logistic regression analysis to assess clinical, demographic and household factors associated with catastrophic health expenditure.

Findings Of 3025 women, 1180 (39.0%) had maternal near misses and 1845 (61.0%) had potentially life-threatening conditions. The median cost of treating maternal near misses was 7135 Kenyan shillings (71 United States dollars, US$) compared with 2690 Kenyan shillings (US$ 27) for potentially life-threatening conditions. Of the women who made out-of-pocket payments, 26.4% (122/462) experienced catastrophic expenditure. The highest median costs for treatment of near misses were in Nairobi and Central region (22 220 Kenyan shillings; US$ 222). Women with ectopic pregnancy complications and pregnancy-related infections had the highest median costs of treatment, at 7800 Kenyan shillings (US$ 78) and 3000 Kenyan shillings (US$ 30), respectively. Pregnancy-related infections, abortion, ectopic pregnancy, and treatment in secondary and tertiary facilities were significantly associated with catastrophic expenditure.

Conclusion The cost of treating maternal near misses is high and leads to catastrophic spending through out-of-pocket payments. Universal health coverage needs to be expanded to guarantee financial protection for vulnerable women.
Kenyans, while private insurance covers only about 1% of the population. Most Kenyans depend on out-of-pocket payments. Whereas maternity care is free, patients must often make other advance or post-service payments in cases of emergency. Occasionally, patients who are unable to pay rely on social networks (e.g. churches and friends) for support, or, in extreme cases, health facilities may exempt or waive hospital bills. These out-of-pocket payments are a significant financial barrier to accessing emergency obstetric care and result in delays, which may lead to clinical deterioration and increase women’s risk of experiencing a maternal near miss and facing catastrophic expenditure. 20–23

Tackling direct and indirect financial expenditure in accessing health care for severe obstetric complications is thus essential to reducing the maternal mortality ratio. 24–27 Understanding the magnitude of the financial burden associated with maternal near miss and other levels of complications is a starting point for efforts to eliminate financial barriers and guarantee protections against catastrophic expenditure. 27–30 However, few studies have been done to understand the economic consequences of pregnancy complications, how costs increase with the severity of morbidity and the likely impact on women and their households. This information is important to better understand the financial implications of varying levels of severe obstetric complications on households in Kenya and to enable the government to adapt financing and payment mechanisms to provide adequate financial protection for all women. Therefore, we assessed the total financial costs to women and/or their families associated with maternal near-miss events in Kenya and compared these costs to the costs of potentially life-threatening conditions. We also examined the factors associated with incurring catastrophic expenditure among women making out-of-pocket payments for their care.

Methods

Study design and sample

This study is part of a larger prospective nationally representative study conducted from February to May 2018 in Kenya that estimated the incidence of maternal near miss and the quality of clinical management. 31 The larger study was interested in capturing all cases of maternal near miss; as such, our inclusion criteria captured all women admitted to referral-level facilities (i.e. level IV, V and VI facilities) in Kenya who developed or received an intervention for a potentially life-threatening condition resulting from pregnancy, childbirth or within 42 days of delivery or termination of pregnancy. We also included women who had presented in the facility as a maternal near miss or had died of pregnancy-related causes. Using the WHO definition of maternal near miss, 8 we then applied clinical algorithms to determine which women had experienced a maternal near-miss event out of all the eligible women in the study.

Sampling and recruitment

The Kenyan public health system has six levels of health care as defined in the 2014 Kenya Health Sector Strategic Investment Plan: level I community units; level II dispensaries; level III health centres; level IV primary referral facilities; level V secondary referral facilities; and level VI tertiary referral facilities. 25 Since maternal near-miss events are severe complications that may require surgery, we included all level V (16) and VI (two) facilities, which are designated to perform caesarean sections and are more likely to handle maternal near-miss cases. We then generated a random sample of 46 level IV facilities from a total of 426 (stratified by region), which are the primary treatment and referral facilities for severe pregnancy-related complications in areas where there are no immediate higher-level facilities. Within the study facilities, we recruited into the study all women admitted with potentially life-threatening conditions or those who developed these conditions during their hospital stay.

Data collection

Each facility had at least one trained clinician, who was a doctor, clinical officer or nurse. In bigger facilities with higher caseloads, two or three trained clinicians assessed patients admitted with obstetric emergencies for eligibility for the study. If a patient was eligible, and in a stable condition, the interviewer requested informed consent and administered the clinical study questionnaire. 31 We linked all women who consented to participate in the cost component of the study to trained fieldworkers at discharge who interviewed them or their caretakers. Data collected included both direct medical costs (e.g. medicines, consultations or surgeries and diagnostic procedures) and direct non-medical costs (e.g. transport, food and accommodation) incurred during the time of the maternal near-miss event. We did not measure indirect costs (e.g. lost earnings and waiting time) and intangible costs (e.g. pain, inconvenience and anxiety). Interviewers used a tablet-based questionnaire to record data on SurveyCTO and then uploaded the data to a central server based at the African Population and Health Research Center. Interviewers conducted the interviews in a private location within the health facilities, determined in consultation with facility management.

Data analysis

We used STATA, version 15 (StataCorp LLC, College Station, United States of America) for statistical analysis. We only included patients with both clinical and financial data in the analysis. We conducted exploratory analyses to describe the patient characteristics and estimated cost of treatment. Given the skewed distribution of the cost data, we estimated the direct cost of care using medians and interquartile ranges (IQR). In addition, we used the Mann–Whitney U test to compare the cost of treatment for maternal near-miss events and potentially life-threatening conditions. We summarized sociodemographic characteristics and underlying clinical complications of the participants as proportions.

Catastrophic expenditure

We categorized health spending as catastrophic when out-of-pocket health expenditure exceeded a certain proportion of total household consumption. Using just one threshold could result in misinterpretation of important factors. Therefore, we used two previously applied consumption thresholds (10% of total expenditure and 40% of non-food expenditure) 26–28 to women who made out-of-pocket payments (available in the data repository). 31 We applied both thresholds as a sensitivity check and to determine which threshold yielded stronger explanation for our regression model (available in the data repository). 33 The frequency of catastrophic spending was the pro-
portion of households that exceeded either of these two thresholds. To assess the clinical, demographic and household characteristics associated with catastrophic expenditures, we used multiple logistic regression analysis with the outcome dichotomized as: did or did not experience catastrophic expenditure. We included the following covariates in the final model: residence, expenditure. We included the following did or did not experience catastrophic expenditures, we used the clinical, demographic and household characteristics of women experiencing severe obstetric complications. We report odds ratios (OR) and corresponding 95% confidence intervals (CI).

### Results

#### Characteristics

A total of 3082 women (weighted for level of health facility and region) were eligible for inclusion in the study and 3025 participated in the cost component (response rate of 98.2%). The other 57 women either declined to participate, were discharged before interviews, were referred to other facilities with higher or same levels of care, or died. Of the 3025 women in the study, 1180 (39.0%) had had a maternal near miss and 1845 (61.0%) had had potentially life-threatening conditions. About half the respondents (51.1%; 1545/3025) were aged 20–29 years (Table 1). Most women had primary or secondary level education (74.5%; 2255/3025), were unemployed (63.0%; 1907/3025) and lived in rural areas (69.6%; 2105/3025). Of the women who had experienced a maternal near-miss event, 57.2% (675/1180) were between 20 and 29 years and 65.6% (774/1180) lived in rural areas.

#### Table 1. Sociodemographic characteristics of women experiencing severe obstetric complications, Kenya, 2018

| Characteristic | Maternal near miss (n = 1180) | Potentially life-threatening conditions (n = 1845) | All cases (n = 3025) |
|----------------|-------------------------------|---------------------------------|---------------------|
| **Age group (years)** | | | |
| 15–19 | 92 (7.8) | 236 (12.8) | 328 (10.8) |
| 20–24 | 353 (29.9) | 423 (22.9) | 776 (25.7) |
| 25–29 | 322 (27.3) | 447 (24.2) | 769 (25.4) |
| 30–34 | 240 (20.3) | 441 (23.9) | 681 (22.5) |
| > 35 | 173 (14.7) | 298 (16.2) | 471 (15.6) |
| **Education level** | | | |
| Primary | 387 (32.8) | 721 (39.1) | 1108 (36.6) |
| Secondary | 467 (39.6) | 680 (36.9) | 1147 (37.9) |
| Tertiary | 181 (15.4) | 318 (17.2) | 499 (16.5) |
| No education | 144 (12.2) | 126 (6.8) | 270 (8.9) |
| **Occupation** | | | |
| Employed | 444 (37.6) | 674 (36.5) | 1118 (37.0) |
| Unemployed | 736 (62.4) | 1171 (63.5) | 1907 (63.0) |
| **Residence** | | | |
| Rural | 774 (65.6) | 1331 (72.1) | 2105 (69.6) |
| Urban | 406 (34.4) | 514 (27.9) | 920 (30.4) |
| **Religion** | | | |
| Catholic | 373 (31.6) | 382 (20.7) | 755 (25.0) |
| Protestant | 695 (58.9) | 1249 (67.7) | 1944 (64.3) |
| Muslim | 112 (9.5) | 214 (11.6) | 326 (10.8) |
| **Marital status** | | | |
| Married | 882 (74.7) | 1463 (79.3) | 2345 (77.5) |
| Divorced or widowed | 58 (4.9) | 88 (4.8) | 146 (4.8) |
| Never married | 240 (20.3) | 294 (15.9) | 534 (17.7) |
| **Region** | | | |
| Coast and North Eastern | 112 (9.5) | 196 (10.6) | 308 (10.2) |
| Eastern | 82 (6.9) | 114 (6.2) | 196 (6.5) |
| Nairobi and Central | 300 (25.4) | 168 (9.1) | 468 (15.5) |
| Nyanza and Western | 302 (25.6) | 1097 (59.5) | 1399 (46.2) |
| Rift Valley | 384 (32.5) | 270 (14.6) | 654 (21.6) |

Notes: All estimates are weighted from the 3-month study period and include only patients who consented to be interviewed for both the cost and clinical surveys. Inconsistencies arise in some values due to rounding.

#### Cost of severe obstetric complications, Kenya

The median total cost of treatment for a maternal near-miss event in Kenyan shillings (1 United States dollar = 100 Kenyan shillings in May 2018) was 7135 Kenyan shillings (IQR: 50–271 068) compared with 2690 Kenyan shillings (IQR: 50–68 293) for potentially life-threatening conditions. A significant share of the total cost of treating maternal near misses was attributed to direct medical costs (4000 Kenyan shillings; IQR: 100–161 434), e.g. for medicines, laboratory tests and X-rays, compared with non-medical costs (1600 Kenyan shillings; IQR: 50–40 900), e.g. for transport and food (Table 2). The difference between median costs of maternal near-miss cases and potentially life-threatening conditions was significant across all categories of medical (P < 0.001) and non-medical costs (P = 0.001).

#### Regional variations in cost

The median cost of treating near-miss episodes varied considerably by region, with the highest costs in Nairobi and Central region (22 220 Kenyan shillings; IQR: 570–135 613) and Rift Valley region (12 395 Kenyan shillings; IQR: 500–235 133), and the lowest in Nyanza and Western region (1400 Kenyan shillings; IQR: 50–38 890). Across all regions, the median costs of treatment for maternal near-miss patients were higher than for patients with potentially life-threatening conditions, except in the Eastern region (Fig. 1).

### Ethical approval

The Kenya Medical Research Institute Scientific Ethics Review Unit approved the study, as did the Guttmacher Institute institutional review board and the National Commission for Science, Technology and Innovation, Kenya.
Cost by underlying complication

Disaggregating costs by type of complication, the highest median costs were for women with ectopic pregnancy complications (7800 Kenyan shillings; IQR: 400–48932), pregnancy-related infections (3000 shillings; IQR: 400–167434) and medical, surgical or neurological complications (2600 Kenyan shillings; IQR: 200–17240). The lowest median costs were for women with hypertensive disorders (1400 Kenyan shillings; IQR: 50–194175) and obstetric haemorrhage (1500 Kenyan shillings; IQR: 50–120916; Table 3).

Source of financing

Just over half of maternal near-miss patients (56.4%; 665/1180) and 65.0% (1199/1845) of patients with potentially life-threatening conditions made out-of-pocket payments for treatment. Only 26.0% (307/1180) of near-miss patients had some form of insurance cover, including the National Hospital Insurance Fund, Community Health Insurance Scheme or private health insurance. One third of near-miss patients (30.0%; 354/1180) had their medical bills waived or they were exempted from paying, and 7.0% (83/1180) had other ways of paying for their medical bills (e.g. paid by friends, allowed to pay later).

Catastrophic expenditure

Based on the threshold of health expenditure of over 40% of non-food expenditures, more than one in three (33.3%; 154/462) households paying entirely through out-of-pocket payments experienced catastrophic expenditure. Similarly, more than a quarter of such households (26.4%; 122/462) incurred catastrophic expenditures using the threshold of over 10% of total household expenditure (Fig. 2). Proportions of patients who experienced catastrophic expenditures increased across the two thresholds when we included those who made payments both out of pocket and through insurance cover.

Table 2. Cost of severe obstetric complications by type of cost, Kenya, 2018

| Type of cost                        | Women, no. | Range of costs, Kenyan shillings | Median cost, Kenyan shillings (IQR) | P       |
|------------------------------------|------------|----------------------------------|-------------------------------------|---------|
| **Direct medical**                 |            |                                  |                                     |         |
| Maternal near miss                 | 246        | 20–322 295                       | 4000 (100–161 434)                  | <0.001  |
| Potentially life-threatening       | 191        | 10–127 734                       | 2700 (50–49 500)                    |         |
| conditions                         |            |                                  |                                     |         |
| All cases                          | 437        | 10–322 959                       | 3367 (50–161 434)                   |         |
| **Non-medical**                    |            |                                  |                                     | 0.001   |
| Maternal near miss                 | 311        | 30–177 250                       | 1600 (50–40900)                     |         |
| Potentially life-threatening       | 270        | 20–41 200                        | 800 (50–18 350)                     |         |
| conditions                         |            |                                  |                                     |         |
| All cases                          | 581        | 20–177 250                       | 1000 (30–41 200)                    |         |
| **Total**                          | 328        | 30–521 800                       | 7135 (50–271 068)                   | <0.001  |
| Maternal near miss                 | 281        | 50–136 284                       | 2690 (50–68 293)                    |         |
| Potentially life-threatening       |            |                                  |                                     |         |
| conditions                         | 609        | 30–521 800                       | 5200 (50–271 068)                   |         |

IQR: interquartile range.

* The Mann–Whitney U test was used to compare the costs for the maternal near-miss cases and cases with potentially life-threatening conditions under the null hypothesis that no difference exists in the distribution.

Notes: All estimates are weighted from the 3-month study period and include only patients who consented to be interviewed for both the cost and clinical surveys. 1 United States dollar = 100 Kenyan shillings in May 2018.
Factors associated with catastrophic expenditure

In a logistic regression analysis to examine the socioeconomic and clinical factors associated with catastrophic expenditure at the two thresholds, both models significantly explained the observed variances in catastrophic expenditure. The 40% threshold gave a better explanation of the variances: with the 10% threshold, the model summary was $\chi^2 = 91.539$, $P < 0.0005$ and Nagelkerke $R^2 = 26.2\%$; and with the 40% threshold, the model summary was $\chi^2 = 117.388$, $P < 0.0005$ and Nagelkerke $R^2 = 31.2\%$. Using the over 10% of total expenditure threshold, the likelihood of catastrophic spending for women with pregnancy-related infections was 3.1 times greater than for women without infections, 3.7 times greater for women with abortion complications and 2.2 times greater for women with ectopic pregnancy complications (Table 4). Furthermore, the likelihood of catastrophic spending was 6.5 times greater for women in level VI than level IV hospitals and 1.9 times greater for women in level V than level IV hospitals. Rural residence was also associated with catastrophic expenditure (OR: 1.94; 95% CI: 1.25–2.99).

Using the over 40% of non-food expenditure threshold, having pregnancy-related infections was associated with 3.1 times higher odds of making catastrophic payments, while the odds for women with abortion complications were 4.2 times higher, and the odds for women with ectopic pregnancy complications were 2.3 times higher. In addition, the odds of catastrophic expenditure was 6.3 times higher for women in level VI hospitals and 2.5 times higher for women in level V hospitals compared with women in level IV facilities (Table 4).

Discussion

Generally, the direct medical cost (i.e. for consultation, medicines and laboratory procedures) was higher for treating maternal near misses than treating potentially life-threatening conditions. Our findings illustrate wide variability in the cost of treating maternal near misses in the different regions of Kenya, with Nairobi and Central regions recording the highest median cost, while Nyanza

| Cause of complication | Women, no. | Range of costs, Kenyan shillings | Median cost, Kenyan shillings (IQR) |
|-----------------------|------------|----------------------------------|-----------------------------------|
| Hypertensive disorders | 643        | 50–521 800                       | 1400 (50–194 175)                 |
| Obstetric haemorrhage  | 1709       | 30–167 434                       | 1500 (50–120 916)                 |
| Pregnancy-related infections | 179 | 50–306 829 | 3000 (400–167 434) |
| Other obstetric complications* | 658 | 50–136 284 | 1500 (50–76 000) |
| Severe anaemia         | 426        | 60–306 829                       | 2000 (100–120 916)                |
| Pregnancy with abortive outcome | 370 | 50–235 133 | 2240 (660–78 045) |
| Ectopic pregnancy      | 434        | 200–99 365                       | 7800 (400–48 932)                 |
| Medical, surgical or neurological disease or complicationsb | 20 | 200–193 762 | 2600 (200–17 240) |

IQR: interquartile range.

* Other obstetric disease: obstructed labour complications, placenta complications, uterus complications, stillbirth complications, preterm complications.

b Cardiovascular complications, cerebrovascular accident, ascites complications, pulmonary complications, renal and blood complications.

Notes: All estimates are weighted from the 3-month study period and include only patients who consented to be interviewed for both the cost and clinical surveys. 1 United States dollar = 100 Kenyan shillings in May 2018.

Fig. 2. Proportion of households with catastrophic expenditure after making out-of-pocket payments for severe obstetric complications, Kenya, 2018

- Out-of-pocket payment only ($n = 462$)
- Out-of-pocket payment and insurance ($n = 551$)
and Western regions reported the lowest median cost. Our findings suggest that the financial burden arising from maternal near-miss events in Kenya is high. The median cost of treating an episode of maternal near miss was 7135 Kenyan shillings, which is expensive given that the average monthly wage in Kenya was 5162 Kenyan shillings, which is expensive given that the average monthly wage in Kenya was 5162 Kenyan shillings in 2018. \( ^{28} \)

Most of the maternal near-miss patients made out-of-pocket payments for their medical care, and more than a quarter of patients with severe obstetric complications who made out-of-pocket payments suffered catastrophic expenditure. Households that experience catastrophic expenditure have been found unable to meet subsistence needs such as rent and food and may be forced to turn to loans and sometimes liquidation of household assets. \( ^{22,23} \)

Furthermore, catastrophic expenditure was associated with certain severe obstetric complications, rural residence and attending level V and VI hospitals. These findings reflect the treatment needs for such complications, for example, treating infections that may require costly drug therapies, specialized staff and longer admissions. \( ^{39} \)

The estimated cost of treating maternal near misses in our study was considerably higher than reported in Ghana for treatment of all pregnancy-related complications, where the median expenditure by households per complication was US$ 32.03. \( ^{39} \) These differences may be due to the fact that our study focused on more severe maternal complications (maternal near-miss events), which may require longer hospital stays, sophisticated treatment procedures and attendance by highly specialized health staff, and hence result in higher costs of care. On the other hand, the Ghana study focused on all pregnancy-related complications, a significant proportion of which may not have been severe. However, in the context of resource-constrained settings, economically vulnerable women who experience near-miss events risk potential catastrophic expenditure with severe disruptions to household finances in the short and long term. Our findings also highlight the important role played by individuals and households in financing maternal health services in Kenya. Previous studies have indicated that household spending on pregnancy-related complications not only drains household budgets and resources, \( ^{17,24} \) but could disrupt their ability to fund subsistence needs, thus driving more vulnerable households to poverty. \( ^{39,45} \)

While the Kenyan government has made efforts to address the cost of obstetric care (such as elimination of delivery fees), \( ^{2} \) our study shows that women with near-miss events pay considerable amounts of money for maternal health care, even in public facilities. Such costs may deter women from using emergency obstetric services altogether \( ^{20} \) or result in delays in accessing services, which can increase the severity of complications. \( ^{36,37} \) In addition, most women who experienced a maternal near miss in referral hospitals did not have insurance to cover the costs of their treatment, and had to pay out of pocket. Fee exemption policies may exist to help mitigate costs, but they tend to neglect some critical components of clinical care such as laboratory and ultrasound services that are typically required to diagnose and manage severe conditions. \( ^{39} \) Our findings suggest that policies aimed at realizing UHC and reaching SDG targets in Kenya should go beyond funding basic maternity care fees to include treatment for women with severe pregnancy-related complications. One attempt to do this in 2018 in Kenya was the piloting of a free maternity scheme called the Linda Mama, which covered antenatal care, postnatal care, delivery and mother and baby complications in both public and private facilities. The Linda Mama initiative has now been scaled up around the country and has resulted in improved accountability to and expanded benefits for women in informal urban settlements and rural areas who are more vulnerable to catastrophic expenditure. \( ^{39} \) The coronavirus disease 2019 pandemic has adversely affected maternal health services and exposed vulnerable people to economic adversity, \( ^{40,41} \) thus, scaling up UHC is important for these disadvantaged populations.

Apart from the limitations reported in our clinical paper, \( ^{19} \) this study had

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**Table 4. Factors associated with catastrophic expenditure among women who made out-of-pocket payments for severe obstetric complications, Kenya, 2018**

| Characteristic                          | aOR (95% CI) Over 10% of total expenditure | aOR (95% CI) Over 40% of non-food expenditure |
|----------------------------------------|--------------------------------------------|---------------------------------------------|
| Area of residence                      |                                            |                                             |
| Urban                                  | Ref.                                       | Ref.                                        |
| Rural                                  | 1.935 (1.25–2.99)                          | 2.670 (1.75–4.09)                           |
| Education level                        |                                            |                                             |
| No education                           | Ref.                                       | Ref.                                        |
| Primary                                | 0.37 (0.18–0.78)                           | 0.39 (0.19–0.81)                            |
| Secondary                              | 0.36 (0.17–0.76)                           | 0.26 (0.12–0.54)                            |
| Tertiary                               | 0.64 (0.28–1.50)                           | 0.42 (0.19–0.97)                            |
| Underlying cause of severe obstetric complication* |                                            |                                             |
| Pregnancy-related infections           | 3.06 (1.52–6.20)                           | 3.15 (1.55–6.41)                            |
| Pregnancy with abortive outcome        | 3.73 (2.00–6.94)                           | 4.21 (2.27–7.79)                            |
| Ectopic pregnancy complications       | 2.21 (1.24–3.93)                           | 2.35 (1.35–4.08)                            |
| Inpatient days                         | 1.04 (1.02–1.06)                           | 1.03 (1.01–1.05)                            |
| Hospital level                         |                                            |                                             |
| IV                                     | Ref.                                       | Ref.                                        |
| V                                      | 1.85 (1.03–3.32)                           | 2.51 (1.46–4.33)                            |
| VI                                     | 6.53 (3.54–12.04)                          | 6.30 (3.48–11.43)                           |
| Constantb                              | 0.14                                       | 0.17                                        |

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*aOR: adjusted odds ratio; CI: confidence interval; Ref.: reference category.

* Reference categories are women who did not have the complications.

b Constant/intercept coefficient: this is the expected value of the log-odds of the outcome variable (in this case catastrophic expenditure) when all of the predictor variables equal zero.

Note: We only included patients who only made out-of-pocket payments in this analysis. We excluded patients who paid through insurance or those who combined out-of-pocket and insurance payments.
Our findings confirm that women in Kenya who experience maternal near-miss events incur high out-of-pocket costs. The costs of care that are beyond the reach of individuals limit access to emergency obstetric care and could be catastrophic to individuals and households. Efforts are needed to implement UHC and guarantee financial protection to vulnerable people and access to good-quality maternal health care.

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Competing interests: None declared.

Other limitations. We did not collect indirect costs incurred during treatment, which include loss in productivity during care and the sequelae following a maternal near-miss event. In capturing costs, we focused on costs paid by patients, rather than total costs of care (some paid by insurance firms). We did not ask women when they made the payments (on admittance, during the hospital stay or at discharge). Even so, our study provides best estimates of the direct cost of care for maternal near misses by capturing direct costs of care before arrival at the health facility, during treatment and during referral.

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Our findings confirm that women in Kenya who experience maternal near-miss events incur high out-of-pocket costs. The costs of care that are beyond the reach of individuals limit access to emergency obstetric care and could be catastrophic to individuals and households. Efforts are needed to implement UHC and guarantee financial protection to vulnerable people and access to good-quality maternal health care.

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Coste de la morbilidad materna extrema y de las enfermedades potencialmente mortales en Kenia

Objetivo Estimar los costes directos de tratamiento de las mujeres con morbilidad materna extrema y con enfermedades potencialmente mortales en Kenia, así como los factores asociados a los servicios sanitarios para estas mujeres y sus hogares.

Métodos Como parte de un estudio de cohortes y representativo a nivel nacional de todas las mujeres con morbilidad extrema durante el embarazo y el parto o dentro de los 42 días posteriores al parto o a la interrupción del embarazo, se comparó el coste del tratamiento de los casos de morbilidad extrema ingresados en centros de referencia con el de las mujeres con enfermedades potencialmente mortales. Se utilizó un análisis de regresión logística para evaluar los factores clínicos, demográficos y domésticos asociados a los servicios sanitarios.

Resultados De 3025 mujeres, 1180 (39,0%) tuvieron morbilidad materna extrema y 1845 (61,0%) tuvieron una enfermedad potencialmente mortal. Los costes medios de los casos con morbilidad extrema fueron a 2690 shillings kényans (27 dólares americanos), mientras que los casos con enfermedades potencialmente mortales fueron a 7135 shillings kényans (71 dólares americanos). Parece que las mujeres con enfermedades potencialmente mortales tuvieron un costo de tratamiento más alto que las mujeres con morbilidad extrema.

Conclusión El costo del tratamiento de las mujeres con morbilidad extrema y enfermedades potencialmente mortales es considerable y puede tener un impacto significativo en la economía y la salud de las mujeres en Kenia. Es importante garantizar la protección financiera y la protección legal para estas mujeres.
(27 USD) de las enfermedades potencialmente mortales. De las mujeres que pagaron de su bolsillo, el 26,4 % (122/462) tuvo gastos catastróficos. La mediana de los costos más elevados para el tratamiento de la morbilidad materna extrema se registró en Nairobi y en la región central (22 220 chelines kenianos; 222 USD). Las mujeres con problemas de embarazo ectópico y con infecciones causadas por el embarazo tuvieron los costos medios de tratamiento más elevados, 7800 chelines kenianos (78 USD) y 3000 chelines kenianos (30 USD), respectivamente. Las infecciones causadas por el embarazo, el aborto, el embarazo ectópico y el tratamiento en centros de atención secundaria y terciaria se asociaron de manera significativa con los gastos catastróficos.

**Conclusión** El coste del tratamiento de la morbilidad materna extrema es alto y genera un gasto catastrófico mediante los pagos de bolsillo. Se debe ampliar la cobertura sanitaria universal para garantizar la protección financiera de las mujeres vulnerables.

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