

Care seeking during pregnancy: testing the assumptions behind service delivery redesign for maternal and newborn health in rural Kenya

Kevin Croke^{1,*}, David Kapaon¹, Kennedy Opondo¹, Jan Cooper¹, Jacinta Nzinga^{2,3}, Easter Olwanda², Nicholas Rahim¹ and Margaret E. Kruk¹

¹Department of Global Health and Population, Harvard T.H. Chan School of Public Health, 677 Huntington Ave, Boston, MA 02115, United States

²Health Systems and Research Ethics Department, KEMRI-Wellcome Trust Research Programme, Nairobi P.O BOX 43640-00100, Kenya

³Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, UK

*Corresponding author. Department of Global Health and Population, Harvard T.H. Chan School of Public Health, 677 Huntington Ave, Boston, MA 02115, United States. E-mail: kcroke@hsph.harvard.edu

Accepted on 18 September 2024

Abstract

A health systems reform known as Service Delivery Redesign (SDR) for maternal and newborn health seeks to make high-quality delivery care universal in Kakamega County, in western Kenya, by strengthening hospital-level care and making hospital deliveries the default option for pregnant women. Using a large prospective survey of new mothers in Kakamega County, we examine several key assumptions that underpin the SDR policy's theory of change. We analyse data on place of delivery, travel time and distance, out-of-pocket spending, and self-reported quality of care for 19 127 women prospectively enrolled during antenatal care (ANC) and surveyed two times after their delivery. We analyze changes in womens' delivery location preferences in recent years in Kakamega, and over the course of their most recent pregnancy. We also evaluate travel time, out-of-pocket expenditures and patient satisfaction for women who deliver in public hospitals vs primary health centres. We find substantial changes in delivery location at the population level over time and for individual women over the course of pregnancy. Facility delivery has increased from 50.4% in 2010 to 89.5% in 2019; 70% of respondents deliver at a different facility than their reported intention at ANC. Out-of-pocket delivery expenditures are on average 1351 Kenyan shillings (Ksh) in hospitals compared to 964 Ksh in PHC (primary health care)s ($P < 0.01$). Transport expenditures are 337 Ksh for PHC level deliveries vs 422 Ksh for hospitals ($P < 0.01$). Self-reported average travel time is 51 min (PHC delivery) vs 47 min (hospital delivery) ($P = 0.78$). The average distance to a delivery location is 15.1 km for PHC deliveries vs 15.2 km for hospitals ($P = 0.99$). There were no differences in overall patient-reported quality scores, while some subcomponents of quality favoured hospitals. These findings support several key assumptions of the SDR theory of change in Kakamega County, while also highlighting important challenges that should be addressed to increase the likelihood of successful implementation.

Keywords: Service Delivery Redesign, health system evaluation, maternal and child health

Introduction

Kenya has committed to the Sustainable Development Goals (SDGs) for maternal and newborn mortality, seeking to reduce its maternal mortality to <70 per 100 000 and neonatal mortality to <12 per 1000 births. The 2014 Demographic and Health Survey measured maternal mortality in Kenya at 362 per 100 000 births, while more recent estimates from the World Health Organization are higher, at 530 per 100 000 births (World Health Organization, 2023). Neonatal mortality is 21 per 1000 births compared to the SDG target of 12 per 1000 births (KNBS, ICF, 2023). Kenya has implemented a number of policies relating to maternal and newborn health to reduce this burden, including policies to target malaria and HIV/AIDS, as well as to make delivery care free of charge. Since Kenya's health system decentralization in 2013, these policies have been largely implemented at the county level. We

study a key factor related to maternal and newborn survival—choice of delivery location—in Kakamega, a county of ~2 million people located in Western Kenya. Maternal mortality and neonatal mortality in Kakamega have been estimated at 316 per 100 000 births and 19 per 1000 births, close to Kenya's national averages (Nimako *et al.*, 2021).

The majority of maternal and newborn deaths can be prevented if women receive quality care during delivery and the first 24-h postpartum (Campbell and Graham, 2006). One of Kenya's main strategies has been to increase the percentage of women who are assisted by skilled birth attendants in health facilities at delivery. Recent Demographic and Health Surveys (DHS) indicate that the percentage of births taking place in a health facility has increased, from 43% in 2008–2009 to 61% in 2014, to 82% in 2022 (KNBS, ICF, 2023). However, while facility delivery is rising rapidly, high-quality delivery

Key messages

- Kakamega County, Kenya, is currently in the process of implementing a major change to maternal and newborn health services, known as Service Delivery Redesign (SDR) for maternal and newborn health.
- To explore the feasibility of SDR in advance of a full prospective evaluation, this paper seeks to test several key SDR assumptions.
- The findings largely support key SDR assumptions, while also highlighting challenges that should be addressed to ensure successful implementation.
- Travel time, travel cost and interpersonal quality of care are similar in Kakamega for women who deliver in subcounty-level hospitals compared to primary health centres. Out-of-pocket expenditures are slightly higher for women who deliver in hospitals, primarily driven by higher medicine and supply expenditures.
- This suggests that in this setting, the shift of deliveries equipped to provide definitive care in case of obstetric or newborn emergency (i.e. with specialized clinical staff, operating theatres and newborn units) could be achieved without significant deterioration in patient experience.

care is still not assured. There is wide variation in quality of delivery care across facility types, in Kenya and globally, with higher-level facilities (especially hospitals) and higher volume facilities typically providing higher quality care than lower-level clinics. In Kakamega, approximately one-third of births in 2018 took place in primary healthcare (PHC) centres, which are not equipped to address serious obstetric emergencies (Nimako *et al.*, 2021).

To address these gaps, an initiative known as Service Delivery Redesign (SDR) for maternal and newborn health is being piloted in Kakamega County. SDR for maternal and newborn health aims to first strengthen the quality of emergency obstetric and newborn care in subcounty-level hospitals (known as Level 4 hospitals or ‘delivery hubs’ in the SDR model), while bolstering emergency transport. Once delivery hub hospitals have been upgraded to an appropriate level, the goal is to make hospital delivery the default option in Kakamega County, such that life-threatening complications for mothers and babies can be definitively addressed when they occur (Nimako *et al.*, 2021). A feasibility assessment for the implementation of SDR in Kakamega was conducted in 2019. Based on the results of this assessment, County leadership decided to implement SDR, beginning with a preparatory phase of hospital and health system strengthening (Roder-DeWan *et al.*, 2020). Starting from March 2023, the programme began piloting in one of Kakamega’s 12 subcounties (Malava subcounty) (Praxides, 2023). In October 2023, the programme continued in a second location (Lugari subcounty). At the time of writing, the programme is scheduled to launch in a third location (Butere subcounty) in 2024.

The SDR for the newborn and maternal health model is based on a critical analysis of assumptions embedded in current policies. These five assumptions, listed in a recent paper by Roder-DeWan *et al.* (2020), are as follows:

- (a) information collected during antenatal care can reliably identify women at risk of serious complications;
- (b) primary care clinics can provide high-quality delivery care, including for life-threatening obstetric and newborn emergencies;
- (c) emergency referral can effectively address complications when primary clinics cannot;
- (d) pregnant women cannot easily access hospitals due to cost or distance; and
- (e) given the choice, most women prefer to deliver in local primary care facilities (Roder-DeWan *et al.*, 2020).

The SDR feasibility assessment casts several of these assumptions in doubt in Kakamega, showing, for example, that travel times to subcounty hospitals in Kakamega are under 1 h for almost all residents (assumption 4) and that providers in PHCs reported limited experience managing serious delivery complications compared to providers in hospitals (assumption 2) (Nimako *et al.*, 2021). The assumption that first-level facilities can reliably treat or effectively refer to serious obstetric complications has been similarly called into question in other settings (Kruk *et al.*, 2016; Gabrysch *et al.*, 2019). Similarly, the assumption that women at high risk of obstetric complications can be reliably identified through routine antenatal care (ANC) is inconsistent with recent findings from India, which show that 47% of newborn mortality occurs in pregnancies judged as ‘low risk’ (Tandon *et al.*, 2023). Similarly, the limited effectiveness of emergency referral systems in cases of life-threatening emergencies has been documented, including in recent trials seeking to improve quality maternal and newborn care (Semrau, 2018).

However, the logic of SDR also incorporates several strong assumptions (Table 1). A first assumption is that hospital delivery is feasible for all women in a given context. A second assumption is that choices about delivery location can be influenced and are changeable rather than being culturally embedded or subject to deeply held preferences. A third assumption is that care at hospitals will be comparably satisfactory to users, considering both technical and interpersonal aspects of quality, as care at PHCs (Roder-DeWan *et al.*, 2020). While technical quality of delivery care has been consistently shown to be higher in hospitals than in primary health centres (PHCs), interpersonal quality of care is less certain.

This first assumption of SDR would be invalidated if hospital delivery in Kakamega County were dramatically more expensive or if it involved much greater travel distances than PHC delivery. The second assumption would be called into question if women in Kakamega were clearly unwilling to change delivery location; for example, if patterns of facility or hospital delivery had remained largely unchanged over an extended period of time. The third assumption would be invalid if increases in hospital delivery led to overcrowding at hospitals, reductions in other aspects of interpersonal quality of care, or even increased disrespect and abuse (Abuya *et al.*, 2015).

We examine women’s choices about delivery care in a large prospective sample of pregnant women in Kakamega County, in light of these assumptions embedded in the SDR theory

Table 1. Assumptions embedded in current delivery care models and in SDR for maternal and newborn health**Assumptions embedded in current models of delivery care in low and middle income countries** (based on Roder-DeWan *et al.*, 2020)

Risk stratification in pregnancy can identify women at high risk of complications who need hospital-based delivery care
 Primary care-level health facilities provide high-quality delivery care
 Emergency referral is an effective response to life-threatening complications

Pregnant women cannot get to hospital for delivery
 Women prefer to give birth in primary care settings

Selected assumptions in the SDR model

Hospitals can deliver life-saving care for obstetric and newborn complications

Hospital delivery is financially and logistically feasible in settings like Kakamega County

Women's preferences about delivery location are not static; they can change in response to perceived improvements in quality of care

Interpersonal quality of care is similar in hospitals and PHCs

of change. We use data collected prior to the rollout of SDR reforms in the county. While we cannot directly test the validity of these assumptions by estimating the causal effects of the SDR reform at this early stage, we instead examine whether or not cross-sectional patterns in this baseline data are consistent with core SDR assumptions.

Materials and methods

Study setting

There are six health service delivery levels in Kenya, per Ministry of Health guidelines. In the community (Level 1), 10 community health volunteers are expected to serve a population of 5000 (~1000 households) and provide services directly to clients. Level 2 units (dispensaries) serve populations of 10 000. Level 3 units (health centres) serve ~30 000 persons. Level 4 units (primary subcounty/county hospitals) provide specialized/referral services to allow for a more comprehensive package of services. In some, but not all cases, these facilities have operating theatres and other comprehensive obstetric services. Level 5 units (secondary—county/regional hospitals) provide more highly specialized services, together with internship training services for medical staff, and also serve as training centres for paramedical staff. Level 6 units (tertiary national referral hospitals) provide highly specialized services, including specialist teaching and research. Kakamega County has 1 Level 5 hospital (Kakamega County General Hospital), 22 Level 4 facilities (15 public, 3 private and 4 faith-based) and 203 Level 2 and Level 3 primary health centres (180 public, 20 faith-based and 3 owned by non-governmental organizations). There are also a large number of lower-level private facilities; however, most antenatal, delivery and post-natal care is provided in either public or faith-based facilities.

Study participants were enrolled, from February 2022, in a sample of 72 facilities, which provide ANC across all 12 subcounties of Kakamega. Facilities were sampled with stratification by subcounty and randomly selected proportional to the volume of ANC visits, excluding facilities located within the town of Kakamega, private facilities and public facilities with fewer than six new ANC clients per month. **Figure 1** shows all public and faith-based facilities

in Kakamega County, including sampled, non-sampled and excluded facilities. Design weights were calculated as the inverse of the sampling probabilities.

This study uses data that were collected as part of the baseline period of an evaluation of Kakamega County's SDR for maternal and newborn health reform. In each sampled facility, the goal was to enrol all pregnant women who presented for ANC from February 2022 until the planned study enrolment end date in February 2024. This study uses data from the first 13 months of enrolment, from February 2022 through 1 March 2023. We omit participants whose delivery date was after 1 March 2023 since the SDR policy was initiated in one location (Malava subcounty) starting in early March. Exclusion criteria were reported intention to give birth outside of Kakamega County, intention to deliver at a referral facility due to complications or previous caesarean sections, and age <15 years.

The main data collection tool used in this analysis is the 'pregnancy registry' (hereafter, PR) survey that includes both enrolment at ANC and post-delivery follow-up surveys. At enrolment, basic demographic information, anticipated delivery date, preferred and previous delivery locations, self-reported and formally diagnosed antenatal complications and detailed contact and tracking information were collected. Participants were contacted by phone starting from 7 days after their anticipated delivery date and again starting from 28 days after their expected delivery date. In these interviews, details regarding maternal health and child survival and mothers' delivery experience were collected, as well as mothers' receipt of post-natal care, satisfaction with delivery care and out-of-pocket expenditures (OOPEs) for delivery, including transportation spending. In-person follow-up visits were conducted when respondents could not be reached by phone. A subset of 2000 respondents from the PR were contacted for four interviews over the course of their pregnancy and immediate postpartum period. This subsample was drawn from enrollees in a subset of delivery facilities: 40 out of 72 facilities were randomly selected as subsample enrolment sites, and within these facilities, ~3% of enrollees were randomly selected for the longer questionnaire. This more intensive survey, known as the longitudinal subsample (LS), was conducted at enrolment; via phone surveys during month 8 of pregnancy and starting between 7 and 28 days after delivery; and again in person at home 2 months after delivery.

Outcome variables

A total of 19 127 women were enrolled and successfully contacted and surveyed after their delivery between the start of enrolment in February 2022 and 1 March 2023. Place of delivery was collected in the 7-day post-delivery follow-up survey and validated in the 28-day post-delivery follow-up survey. Place of delivery for all previous pregnancies was recorded during the enrolment survey. Information about OOPEs for women who delivered in facilities was collected in the 28-day survey by asking respondents about all expenditures related to their delivery, across multiple subcategories (costs for registration, consultation, drugs and supplies, labs, transportation, child care, food and other). Kenyan shilling (Ksh) values are converted to US dollar amounts using the 1 November 2023 exchange rate (1 Ksh = \$0.00665).

Travel time variables were calculated using both geographic information system (GIS) analysis and survey reports.

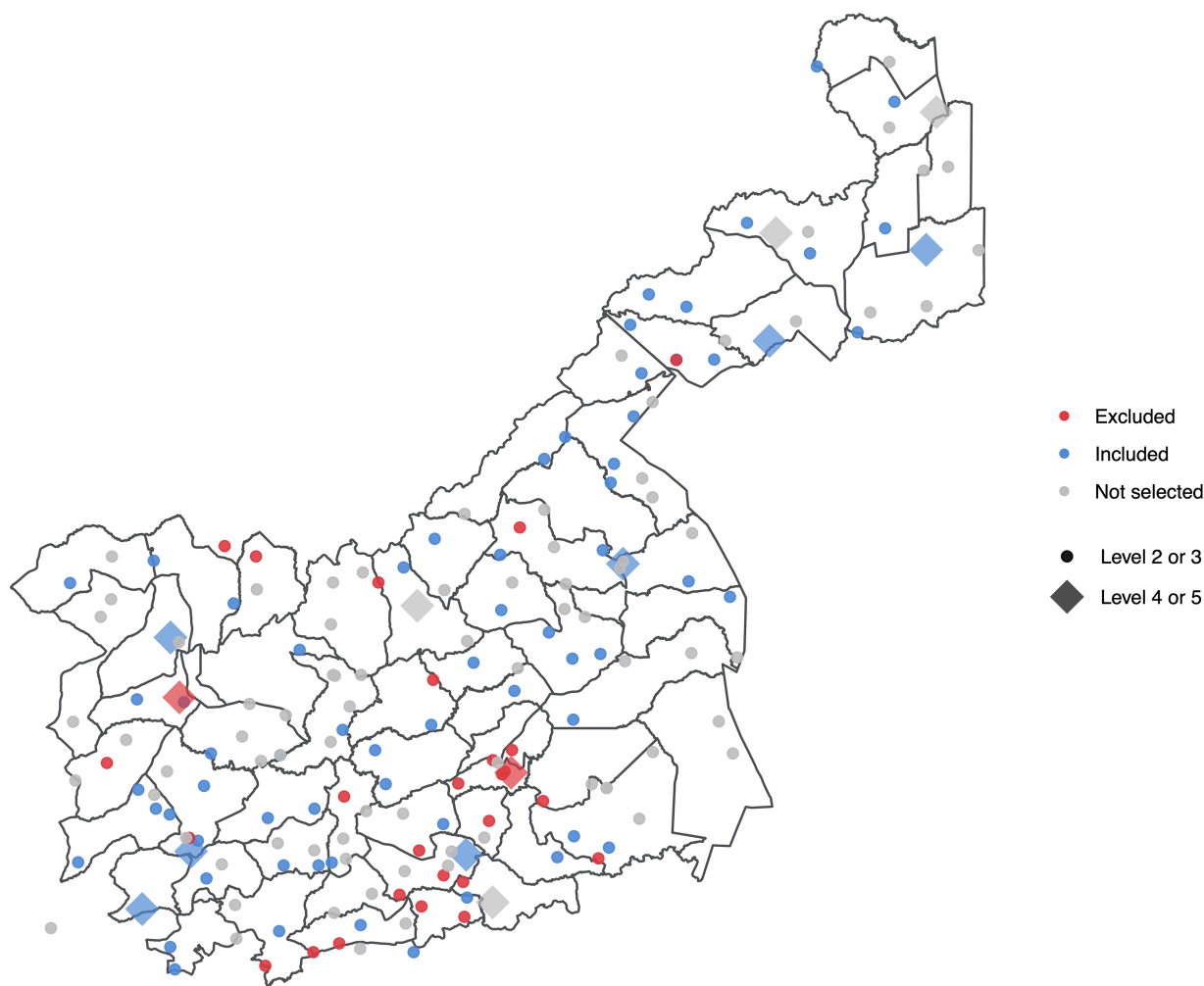


Figure 1. Sampled and excluded health facilities in Kakamega County

Self-reported travel time to delivery location is asked in the LS, but not in the larger PR. We use this variable for the first set of travel time analyses. Alternatively, we have obtained the latitude and longitude for respondents' villages of residence as well as the latitude and longitude of all health facilities that provide delivery care in Kakamega. These are either villages officially gazetted by Kakamega County (in which case official geocodes were available) or alternative markers reported to mark the respondent's community, which were geocoded by the research team, by locating the local landmarks in Google Maps. For the remaining respondents without either official village location or identifiable landmarks, we take the centroid of the respondent's ward of residence to approximate their village location. Using these locations, we calculate the travel distance to a delivery facility and use geospatial algorithms to estimate the travel time needed to cover this distance. Details of geocoding and estimated distance and travel time calculations are provided in the Online Appendix.

For interpersonal quality of care, we examined measures in three domains. The first domain is overall quality ratings, comprised of quality of care ratings as reported by mothers after delivery as well as a 'net promoter score', i.e. how likely women would be to recommend the facility to

friends and family. These questions were asked of all women who reported facility delivery in Kakamega County in the PR. The second domain captures elements of patient-centred care (such as whether providers requested consent, whether they addressed patients by name, whether attention was paid when respondents requested help and whether patients were afforded privacy and treated with respect, as well as perceived health worker knowledge and competence, willingness to answer questions and clarity of explanations). The third domain relates to disrespect and/or abuse during delivery, including the incidence of physical abuse (slapping, hitting or pinching) during delivery. Questions relating to the second and third domains were only asked in the LS survey. See the Online Appendix for exact question wording. Quality of care variables were either binary yes/no questions or, in the case of continuous scales, have been dichotomized such that the highest category of rating (excellent) equals 1. The single exception is the net promoter score, which is a continuous 0–10 rating. Analyses of travel time, spending and interpersonal quality ratings are restricted to the sample of women who delivered in Kakamega County.

Comparisons for travel time, travel distance, OOPes and quality of care are made between deliveries at the primary care level (Level 2 or Level 3 facilities) and the public sector Level

4 subcounty-level hospitals that were designated as future ‘delivery hubs’ by Kakamega County officials at the start of the SDR planning process. A small number of Levels 2 and 3 are faith-based facilities; however, they are well integrated into the public delivery system in Kakamega and function effectively as public facilities from the point of view of system users. Therefore, we group them with public sector PHC facilities in this analysis. This comparison, between Level 2 and 3 facilities and future Level 4 delivery hub hospitals,

is the most relevant comparison to test the assumptions of SDR.

In Tables 2–4, we present means and standard deviations for all variables of interest, comparing births in delivery hub hospitals to births in primary health-level facilities. For travel time and distance, we also present median values. We present *P*-values from bivariate linear regressions with the outcome of interest regressed on a binary indicator for delivery location (delivery hub or PHC). Robust standard errors

Table 2. Travel time and distance by delivery facility

	PHC delivery			Hospital delivery			<i>P</i> -value
	Mean	Median	SD	Mean	Median	SD	
Longitudinal survey							
Travel time (min) to delivery facility: self-reported	51.0	30.0	51.4	47.1	30.0	40.0	0.78
Observations	61			58			119
PR							
Observations							
Travel time (min) from village to delivery facility: estimated	20.7	13.5	20.8	19.1	14.7	17.5	0.55
Distance (km) from village to delivery facility	15.1	7.1	20.0	15.2	9.4	18.3	0.99
Observations	5146			5472			10 618

Referrals, deliveries outside of Kakamega County and deliveries at the county referral hospital are excluded. PHC includes Level 2 and 3 facilities; the hospital category includes Level 4 facilities only.

Table 3. Out-of-pocket spending by delivery facility

	PHC delivery			Hospital delivery			<i>P</i> -value
	Mean	Median	SD	Mean	Median	SD	
Total cost	963.55	700.00	1073.03	1351.45	950.00	1680.98	<0.01
Transport	337.48	250.00	351.86	421.93	300.00	395.62	<0.01
Drugs	267.67	60.00	441.82	391.24	200.00	659.47	<0.01
Labs	30.50	0.00	152.85	73.76	0.00	236.04	<0.01
Registration	24.70	0.00	110.85	33.99	0.00	172.16	0.02
Consultation	28.40	0.00	186.30	15.61	0.00	143.44	0.14
Observations	5512			5418			11 049

PR data only. Referrals, deliveries outside of Kakamega County and deliveries at the county referral hospital are excluded. Sample size values correspond to observations for total cost variables in which all missing variables are imputed as zero. PHC includes Level 2 and 3 facilities; the hospital category includes Level 4 facilities only.

Table 4. Perceptions of patient-centred care in PHCs and delivery hubs

	PHC delivery		Hospital delivery		<i>P</i> -value
	Mean	SD	Mean	SD	
PR					
Quality of care—excellent	0.53	0.50	0.52	0.50	0.71
Net promoter score	9.04	1.47	8.93	1.64	0.10
Observations	5629		5911		11 540
Longitudinal survey					
Competence—excellent	0.41	0.50	0.55	0.50	0.18
Willingness—excellent	0.34	0.48	0.57	0.50	0.03
Explain—excellent	0.31	0.48	0.51	0.50	0.05
Respect—excellent	0.39	0.49	0.53	0.50	0.33
Privacy—excellent	0.30	0.46	0.42	0.50	0.55
Addressed by name	0.81	0.39	0.88	0.33	0.11
Asked consent	0.76	0.43	0.67	0.47	0.63
Gave help when asked	0.92	0.28	0.92	0.27	0.64
Disrespected	0.02	0.14	0.07	0.25	0.11
Slapped/hit/pinched	0.06	0.25	0.02	0.16	0.12
Observations	61		66		127

Deliveries outside of Kakamega County are excluded. PHC includes Level 2 and 3 facilities; the hospital category includes Level 4 facilities only.

for these regressions are clustered by the health facility where respondents were enrolled in the study.

Results

Sample characteristics

Women were enrolled in the study on average in their sixth month of pregnancy. Participants had an average age of 25 years. In total, 32% completed secondary school, and 97% resided in Kakamega County. Two-thirds of respondents had previous pregnancies with 1.5 prior births on average (Table 5).

Place of delivery and previous births

Using retrospective birth histories, we examine how delivery location choices have changed across recent birth cohorts, using the birth history section of the questionnaire. The percentage of births that took place in health facilities (rather than at home) in Kakamega County among mothers in this sample increased from 50.4% in 2010 to 89.5% in 2019 (Figure 2).

Next, we examine womens' self-reported delivery intentions over the course of pregnancy (Figure 3). In total, 30% of women delivered at the location they had reported (at enrolment) as their intended delivery site, while 70% did not deliver where they had originally planned. At study enrolment, 60% reported intention to deliver in a PHC clinic vs 27% in a sub-county hospital, while 6% planned to deliver in private or faith-based hospitals, and 4% at Kakamega County General Hospital (Level 5). Just 0.3% reported intending to deliver at home. Actual delivery locations are as follows: 31% of respondents delivered at a subcounty-level hospital (Level 4), 31% delivered at a public primary care centre (Level 2 or Level 3), and 13% delivered in a private or faith-based hospital. Seven percentage of respondents delivered at home, and 5% delivered at Kakamega County General Hospital (Level 5).

Next, we provide estimates of bypassing the nearest facilities for delivery. In order to calculate the form of bypassing most relevant to the SDR theory of change, we define this as delivering at a facility of a level that is different than the level of the nearest facility to the respondent's community. In other words, respondents are defined as having bypassed if they live closest to a Level 2 facility, but deliver at Level 3 or 4 facility (or vice versa). Figure 4 shows, for the population who eventually deliver in public sector facilities, the share of the population living closest to each level facility, as well as the level at which these populations deliver. 64% live closest to a Level 2 facility, 25% live closest to a level 3 facility and 11% live closest to a Level 4 facility. While delivery hub (Level 4) delivery is the highest among the few respondents who live closest to Level 4 hospitals, Figure 4 demonstrates that substantial proportions of those living nearest to Level 2 and 3 facilities also deliver in delivery hubs. Proximity alone does not determine delivery location choice for many women in this setting.

Travel time and distance

We report average travel times using both self-reported and GIS-calculated travel times. Here, we restrict the sample to women who gave birth in either delivery hub hospitals (Level 4) or primary health care facilities (Level 2 or 3),

Table 5. Sample characteristics

Observations	N = 19 127
Respondent age	25.2 (6.0)
Secondary or higher education	6532 (32.4%)
Number of previous births	1.5 (1.5)
Lives in Kakamega county	18 604 (96.7%)
Months of pregnancy at time of enrolment	6.1 (1.8)

Continuous variables: mean (SD).

Binary variables: *n* (%).

in Kakamega County, excluding those who were referred to multiple facilities during their delivery period.

As Figure 4 shows, respondents are more likely to live closest to a PHC facility (Level 2 or 3) than to a hospital. However, greater geographic proximity to PHC facilities is not reflected in shorter travel time and distance for those who deliver in PHCs. Using GIS coordinates from village of residence to delivery facility location, the mean travel distance from a respondent's village to delivery facility for the full sample is 15.2 km (median 8.7 km). Comparing PHC and hospital/delivery hub deliveries, the mean distance to a delivery hub where the respondent delivered her child is 15.2 km (median 9.4 km) with a modelled travel time of 19.1 min (median 14.7). The mean travel distance to a delivery location for those who deliver at PHC level is 15.1 km (median 7.1 km) with an estimated travel time of 20.7 min (median 13.5).

Using self-reported travel time (collected in the longitudinal survey only), the average travel time to a delivery facility is 51 min for PHC deliveries (median 30 min; *n* = 61), compared to 47.1 min for delivery hubs (median 30 min; *n* = 58).

Out-of-pocket expenditures

Next, we analyse out-of-pocket spending for delivery across multiple categories of spending associated with delivery (e.g. transportation to and from the facility, registration, consultation, labs, drugs and supplies). Total costs for deliveries at public clinics or subcounty hospitals average 1154 Ksh (\$7.67). To put this in context, monthly wages in the agriculture sector in Kenya average 33 231 Ksh (Kenya National Bureau of Statistics, 2023). In the Kenya DHS 2022, survey respondents reported an average annual inpatient care spending of 37 362 Ksh (24 731 in rural areas), while the average monthly outpatient spending was 1735 Ksh (KNBS, ICF, 2023).

Expenditures are compared between those who deliver in subcounty Level 4 hospitals (delivery hubs) vs public PHCs (Levels 2 and 3), using the PR sample. The total expenditure variable sums across all measured expenditure categories, treating missing or 'not applicable' responses for spending subcategories as equal to zero expenditures for that category when calculating the cross-category sum. The average total spending is significantly higher in hospitals than in PHCs (mean 1351 vs 964 Ksh; *P* < 0.01); this reflects both higher clinical costs (notably drug/supplies and labs costs) and non-clinical costs (e.g. transport). The difference is 387 Ksh, between \$2 and \$3 at November 2023 exchange rates. The mean transport cost for PHC deliveries is 337 Ksh vs 422 Ksh for hub deliveries (85 Ksh; approximately \$0.50). Differences between categories are statistically significant for total cost, transport, drugs, labs and registration (all *P* < 0.05).

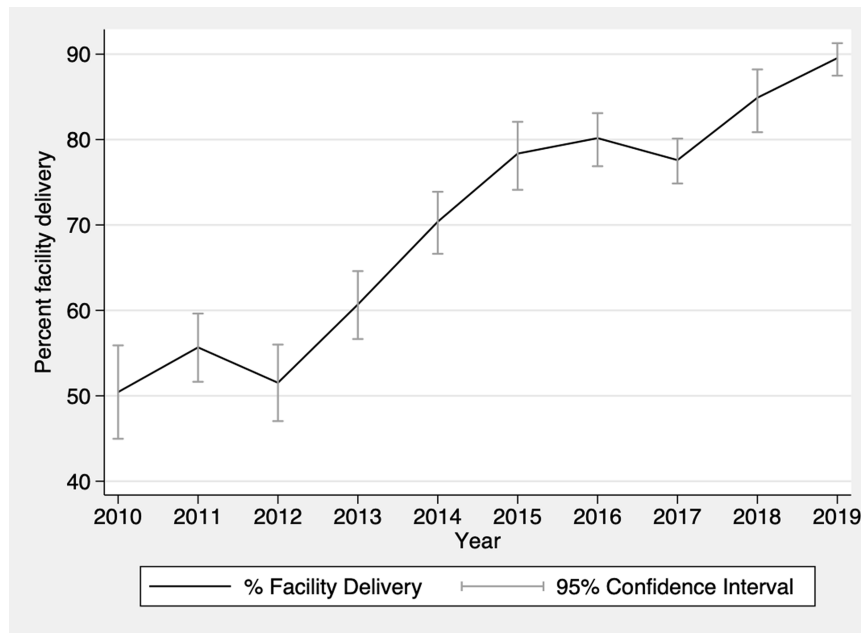


Figure 2. Delivery location by birth cohort

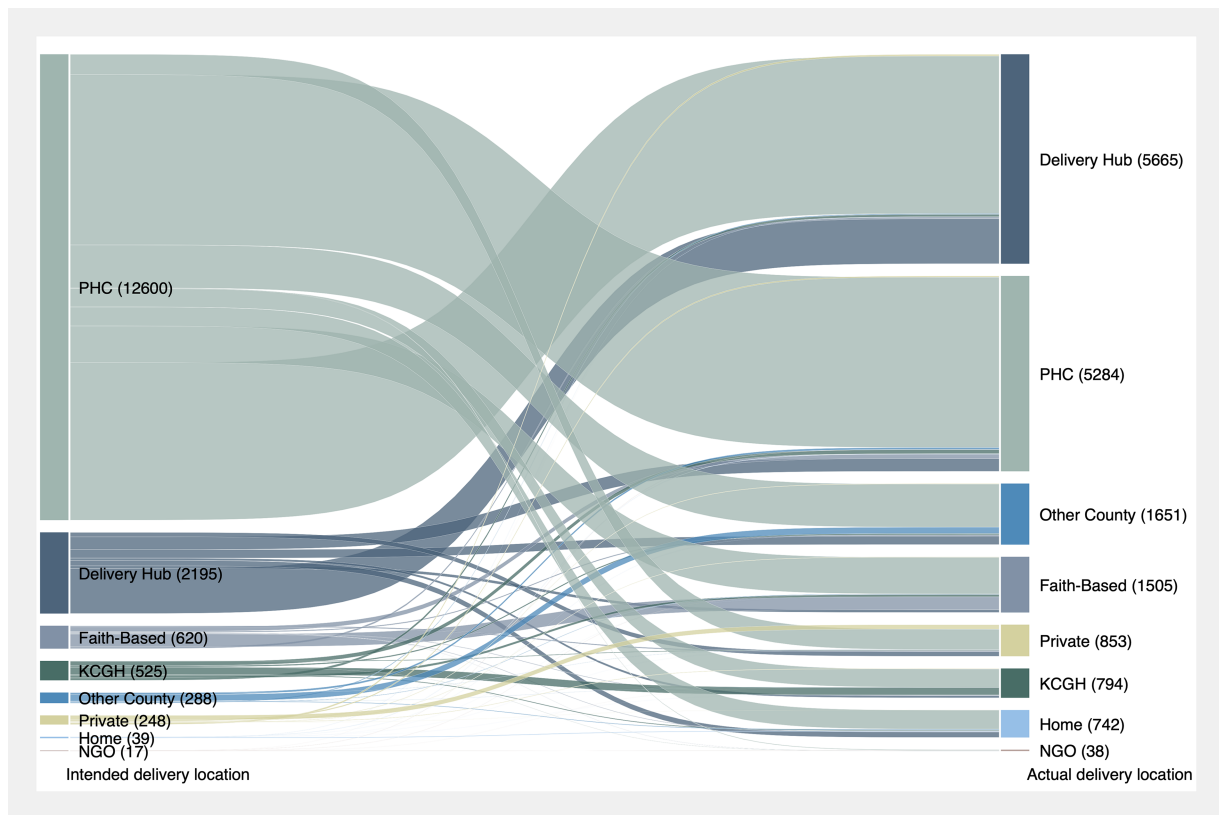


Figure 3. Delivery locations (intended and actual)

The largest category of difference is for drugs and supplies, accounting for one-third of the total expenditure difference between delivery hubs and PHCs.

Satisfaction and perceived quality of care

In this section, we analyse patient-reported measures of perceived quality and satisfaction with care received. We do

not find statistically significant differences among respondents' perceptions of overall quality, most subindicators of perceived quality, or incidence of disrespect and abuse in PHCs vs hospitals. However, there are two significant differences ($P < 0.05$) in responses to questions focused on specific interpersonal quality indicators: 57% said that hospital-based health workers were very willing to hear and answer their

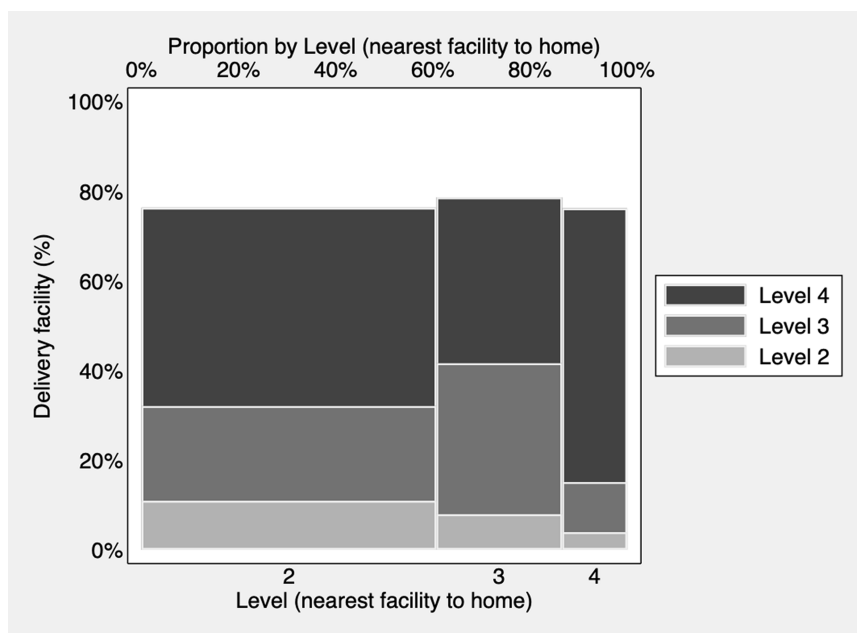


Figure 4. Place of delivery by nearest health facility to home

questions, compared to 34% in PHCs; 51% rated the clarity of health workers' explanations in hospitals as excellent, compared to 31% in PHCs. Differences in other patient-reported quality metrics were not statistically significant, including prevalence of feelings of humiliation or disrespect (2% in PHCs vs 7% in delivery hubs) and incidents of physical abuse such as being slapped, hit, or pinched during delivery (6% in PHCs vs 2% in delivery hubs) (Table 5).

Discussion

SDR for maternal and newborn health is underway in Kakamega County, but causal impacts of the programme will not be measurable until the programme activities have been fully implemented across the county. However, the presence of a large-scale evaluation with detailed baseline data allows us to examine the key assumptions underlying this reform at a relatively early stage of this multiyear implementation process. In this paper, we seek to shed light on the SDR programme by using pre-programme data to test the validity of certain assumptions of SDR, such as the assumption that women are open to choosing new delivery locations, do not face prohibitive additional costs or travel burdens for hospital delivery, and receive comparable interpersonal quality of care in hospitals and PHCs in Kakamega County.

With respect to the first assumption, regarding place of delivery, we find a rapidly changing landscape. Change in place of delivery over the past decade has been dramatic, with rates of facility delivery increasing by almost 40 percentage points for women in the sample. This increase in Kakamega is consistent with similarly large increases recorded at the national level (KNBS, ICF, 2023). These increases appear to coincide with the introduction of free maternity care in Kenya (in 2013), highlighting the importance of reducing financial barriers to quality delivery care.

Moreover, during this pre-SDR period, although most women live closest to Level 2 facilities, most travel farther than their nearest facility to deliver at high-level facilities. Although most respondents start out planning a PHC delivery, they frequently change their plans as pregnancy progresses. The assumption that women in Kakamega are unwilling to change their practices regarding delivery location is not supported in these data.

However, even if they are willing to deliver in higher quality facilities, they may face financial barriers. We do find that total costs and transport costs are higher for Level 4 hospital (delivery hub) deliveries. The total cost difference is under 400 Ksh, just over \$2 at 2023 exchange rates. This difference is driven by higher expenditures for drugs and supplies as well as higher transport costs. We find limited differences in travel times. Differences in interpersonal quality of care are limited, and where they exist, all favour hospital delivery.

It is important to note that differences between the experiences of women who had clinic vs hospital deliveries in this cross-sectional data, prior to SDR programme implementation, cannot be interpreted as causal relationships. Those who live farther from delivery hubs may intentionally choose to deliver at PHCs (or at home) specifically because of this distance. These (untaken) longer trips do not show up as realized values of the travel time variable. Patient (self)-selection effects with respect to delivery location may explain some of the observed outcomes for cost, distance, and travel time.

Our paper also highlights the persistence of cost barriers to facility delivery even in the public sector, which persist despite several recent reforms in Kenya, including the Free Maternity policy and the 'Linda Mama' policy, which are designed to reduce out-of-pocket payments for delivery. Our findings demonstrate that in addition to non-facility charges (e.g. transport), women delivering in public sector facilities often face out-of-pocket costs, in contradiction to policy. Two explanations for this were offered in the course of fieldwork.

First, health facilities often faced drug and commodity stock outs due to delayed disbursement of funding from the central government to county governments, and policies that prevented facilities from retaining internally generated funds. As a result, women seeking delivery care were often directed to purchase cotton, gauze and other materials prior to their arrival at hospitals. Second, the mechanism by which maternity care costs were covered at the hospital level at the time of data collection was the Linda Mama programme. However, for this coverage to take effect, women needed to register for it, which required a national identity card or, for those <18 years, a birth certificate. While some facilities had put in place policies to assist women with registration, in some cases, women did not have these documents and could not register for Linda Mama, and therefore they faced OOPes for delivery care.

These results are consistent with a number of previous findings from Kenya. Our findings on dynamic decision-making regarding delivery location are consistent, for example, with the finding that 41% of women in urban Nairobi deliver in a facility which they had not even considered in the eighth month of their pregnancy (Cohen *et al.*, 2017). Our findings about cost of delivery in Kenya are consistent with the finding that despite the free maternity care policy, Kenyan women still face out-of-pocket costs for delivery of approximately \$9.50 per normal delivery in Kiambu County, with minimal differences between lower-level and referral hospitals (Oyugi *et al.*, 2023). Our findings about frequent bypassing are consistent with findings from elsewhere in rural East Africa (Kruk *et al.*, 2009; Kruk *et al.*, 2014).

Our paper has several limitations. First, the choice of facility level for delivery may be confounded by individual characteristics. Second, our results are generalizable only to our sample, which excludes the lowest volume ANC clinics in Kakamega County, where we did not enrol study participants. As a result, these results are not generalizable to populations that utilize low-volume ANC clinics, which may include relatively remote communities. In addition, while we present patient-reported measures of quality and user experience, we do not have direct information about the clinical quality of care that these patients received. We hope to examine the technical quality of care in Level 4 hospitals in Kakamega in future work.

Our results may also have limited generalizability to some other settings outside of Kakamega due to specific features of the setting in Kakamega County and in Kenya more broadly. First, despite the OOPes recorded in this survey, user fees for deliveries per se may not be the main driver of delivery choice in this setting, since Kenya in 2013 eliminated delivery fees in public facilities (Calhoun *et al.*, 2018). This is not the case in other settings where official delivery fees remain a major financial barrier to care. Second, unlike other settings where transport time and cost can be a prohibitive barrier for many women, Kakamega has a broad distribution of health facilities, including subcounty-level hospitals, and a relatively good road network: previous modelling has estimated that 98% of women live within 30-min travel time of a hospital (Nimako *et al.*, 2021). Furthermore, access to ANC services is close to universal: in the last DHS, 98% of women in Kenya made at least ANC visits (this was estimated at 100% in Kakamega) (KNBS, ICF, 2023).

These results largely support Kakamega County's decision to pilot SDR, while also highlighting implementation challenges that should be addressed for the reform to be successful. For example, although travel costs are only modestly higher for hospital delivery, remaining financial barriers to hospital delivery are driven by broader health system challenges, notably facility financing challenges that require additional expenditures by patients on medicines and supplies. Recent reforms in Kakamega, notably the Facility Improvement Fund policy, seek to address this problem. However, if counties continue to receive unpredictable and late budget transfers from the central government, resulting in imposition of continued financial barriers to delivery care, SDR implementation may be at risk. Other key assumptions for SDR are that hospitals can be meaningfully improved through infrastructure investments and deployment of better trained, higher cadre clinicians to deliver higher quality maternal and newborn care. Future research should document quality gaps across levels of care and the ability of focused programmes such as SDR to improve quality of care over relatively short periods of time.

Supplementary data

Supplementary data is available at *HEAPOL* online.

Data availability

Data will be made available after the SDR evaluation study is complete.

Funding

This work was funded by the Bill & Melinda Gates Foundation [INV-028724]. The funders had no role in the design of the study or writing the manuscript.

Acknowledgements

We would like to acknowledge the work of Ipsos Kenya, especially Caroline Mackenzie and Rodgers Kegode.

Author contributions

K.C. assisted with conception or design of the work. K.C. and K.O. assisted with data collection. K.C., D.K., N.R., and M.E.K. assisted with data analysis and interpretation. K.C. assisted with drafting the article. K.C., J.N., J.C., E.O., K.O., and M.E.K. assisted with critical revision of the article. K.C., D.K., J.C., J.N., E.O., K.O., N.R., and M.E.K. assisted with final approval of the version to be submitted.

Reflexivity statement

The paper is the product of a collaborative research effort. Five authors are US-based and three authors are Kenya-based. The authors include PhD candidates and junior and senior researchers. The authors also have diverse methodological backgrounds, including social science and medical/clinical training. The authors have made a conscious effort to consider how their differing backgrounds may have shaped

their approach to the research question and to critically reflect on the findings in this light.

Ethical approval. This study was approved by the Harvard University IRB (IRB21-0624), Amref Health Africa in Kenya IRB (ESRC P1083-2021) and the Kakamega County Government. All study participants sign an informed consent form before enrolment into the study.

Conflict of interest: None declared.

References

- Abuya T, Warren CE, Miller N *et al.* 2015. Exploring the prevalence of disrespect and abuse during childbirth in Kenya. *PLoS One* 10: e0123606.
- Calhoun LM, Speizer IS, Guilkey D, Bukusi E. 2018. The effect of the removal of user fees for delivery at public health facilities on institutional delivery in Urban Kenya. *Maternal and Child Health Journal* 22: 409–18.
- Campbell OMR, Graham WJ; Lancet Maternal Survival Series steering group. 2006. Strategies for reducing maternal mortality: getting on with what works. *The Lancet* 368: 1284–99.
- Cohen J, Lofgren K, McConnell M. 2017. Precommitment, cash transfers, and timely arrival for birth: evidence from a randomized controlled trial in Nairobi Kenya. *American Economic Review* 107: 501–5.
- Gabrysch S, Nesbitt RC, Schoeps A *et al.* 2019. Does facility birth reduce maternal and perinatal mortality in Brong Ahafo, Ghana? A secondary analysis using data on 119 244 pregnancies from two cluster-randomised controlled trials. *The Lancet Global Health* 7: e1074–87.
- Kenya National Bureau of Statistics. 2023. *Kenya Economic Survey 2023*. <https://www.knbs.or.ke/reports/2023-economic-survey/>, accessed 19 September 2024.
- KNBS, ICF. 2023. *Kenya Demographic and Health Survey 2022: Volume 1*. <https://dhsprogram.com/pubs/pdf/PR143/PR143.pdf>, accessed 19 September 2024.
- Kruk ME, Hermosilla S, Larson E, Mbaruku GM. 2014. Bypassing primary care clinics for childbirth: a cross-sectional study in the Pwani region, United Republic of Tanzania. *Bulletin of the World Health Organization* 92: 246–53.
- Kruk ME, Leslie HH, Verguet S *et al.* 2016. Quality of basic maternal care functions in health facilities of five African countries: an analysis of national health system surveys. *The Lancet Global Health* 4: e845–55.
- Kruk ME, Mbaruku G, McCord CW *et al.* 2009. Bypassing primary care facilities for childbirth: a population-based study in rural Tanzania. *Health Policy & Planning* 24: 279–88.
- Nimako K, Gage A, Benski C *et al.* 2021. Health system redesign to shift to hospital delivery for maternal and newborn survival: feasibility assessment in Kakamega County, Kenya. *Global Health: Science and Practice* 9: 1000–10.
- Oyugi B, Nizalova O, Kendall S, Peckham S. 2023. Does a free maternity policy in Kenya work? Impact and cost-benefit consideration based on demographic health survey data. *The European Journal of Health Economics* 25: 77–89.
- Praxides C. 2023. Kakamega to redesign maternal and newborn service delivery. *The Star*.
- Roder-DeWan S, Nimako K, Twum-Danso NAY *et al.* 2020. Health system redesign for maternal and newborn survival: rethinking care models to close the global equity gap. *BMJ Global Health* 5: e002539.
- Semrau K. 2018. *10 Lessons From The BetterBirth Study*. *Maternal Health Task Force*. <https://www.mhtf.org/2018/04/23/10-lessons-from-the-betterbirth-study/>, accessed 4 December 2024.
- Tandon A, Roder-DeWan S, Chopra M *et al.* 2023. Adverse birth outcomes among women with ‘low-risk’ pregnancies in India: findings from the Fifth National Family Health Survey, 2019–21. *The Lancet Regional Health—Southeast Asia* 15: 100253.
- World Health Organization. 2023. *Trends in Maternal Mortality 2000 to 2020: Estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division*. <https://iris.who.int/bitstream/handle/10665/366225/9789240068759-eng.pdf?sequence=1>, accessed 19 September 2024.