How do Supply- and Demand-side Interventions Influence Equity in Healthcare Utilisation?

Evidence from Maternal Healthcare in Senegal

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Abstract

The launch of the Millennium Development Goals in 2000, followed by the Sustainable Development Goals in 2015, and the increasing focus on achieving universal health coverage has led to numerous interventions on both supply- and demand-sides of health systems in low- and middle-income countries. While tremendous progress has been achieved, inequities in access to healthcare persist, leading to calls for a closer examination of the equity implications of these interventions. This paper examines the equity implications of two such interventions in the context of maternal healthcare in Senegal. The first intervention on the supply-side focuses on improving the availability of maternal health services while the second intervention, on the demand-side, abolished user fees for facility deliveries. Using three rounds of Demographic Health Surveys covering the period 1992 to 2010 and employing three measures of socioeconomic status (SES) based on household wealth, mothers' education and rural/urban residence – we find that although both interventions increase utilisation of maternal health services, the rich benefit more from the supply-side intervention, thereby increasing inequity, while the poor benefit more from the demand-side intervention i.e. reducing inequity. Both interventions positively influence facility deliveries in rural areas although the increase in facility deliveries after the demand-side intervention is more than the increase after the supply-side intervention. There is no significant difference in utilisation based on mothers' education. Since people from different SES categories are likely to respond differently to interventions on the supply- and demand-side of the health system, policymakers involved in the design of health programmes should pay closer attention to concerns of inequity and elite capture that may unintentionally result from these interventions.

Keywords: Senegal; exemption; quality of care; equity; maternal health; access; emergency obstetric care; user fees.

Introduction

The launch of the Millennium Development Goals (MDG) in 2000, followed by the Sustainable Development Goals (SDG) in 2015, and the increasing focus on achieving Universal Health Coverage (UHC) – has led to numerous interventions on both the supply- and demand-side of health systems in low- and middle-income countries (LMIC). Supply-side interventions operate by improving the *supply* of healthcare and include interventions such as increasing the number, coverage, and training of health professionals. While, demand-side interventions operate by increasing the *demand* for healthcare such as reducing the cost of accessing healthcare and providing incentives for seeking care. A large body of evidence shows that while tremendous progress has been achieved as a result of both supply- and demand-side interventions – poor often tend to benefit less than the rich, leading to calls for a closer examination of the differential influence of supply- and demand-side interventions on equity (Ensor & Cooper, 2004; McPake et al., 2013; O'Donnell et al., 2007; Victora et al., 2018; Wagstaff et al., 2014).

Consider the case of West Africa where in 1980s and 90s, under international influence, user fees were introduced in the health system (See for example Akin et al., 1987; Ridde, 2015). It was envisaged the additional revenue from user fees will provide the impetus to improve the quality of services (supply). As a result, even though there is some evidence to suggest an improvement in quality of care, to a large extent these policies worsened demand-side barriers and adversely effected utilisation, especially amongst the poor (Lagarde & Palmer, 2011). One of the main reasons for inequity in healthcare utilisation was and still remains – that poorer households find it more difficult to overcome demand-side barriers (De Allegri et al., 2011; McPake, 1993). Even when households have health insurance, high out-of-pocket (OOP) expenses due to user fees, transport, and medicines can be a major hurdle in increasing utilisation amongst the poor, who may choose to seek alternate care from traditional healers or quacks (Shahrawat & Rao, 2012). Therefore, government interventions that primarily focus on the supply-side, such as

training more health professionals, can make healthcare utilisation more inequitable as the benefits of these supply-side improvements are more likely to go to richer households who have lower demand-side barriers (Demery, 2000).

To improve utilisation, since the early 2000s, West African countries have introduced policy interventions on the demand-side that have either abolished or subsidised user fees. For instance, in the context of maternal health, Ghana introduced free facility deliveries in 2003 (Bosu et al., 2007), Senegal in 2005 (Witter et al., 2010) and Burkina Faso subsidised user fees in 2007 (Ridde et al., 2015). Mali removed user fees for only caesarean deliveries in 2005, followed by Benin and Morocco in 2009 (Dossou et al., 2018; Ravit et al., 2018; Witter et al., 2016). Evidence from these schemes show that demand-side interventions that reduce barriers to access by reducing or eliminating user fees at health facilities make healthcare more equitable as poor households are now more likely to access healthcare (Peters et al., 2008; Ridde & Morestin, 2011); albeit the poorest are still often the least likely to utilise facility-based care (Ridde et al., 2015).

More recently, researchers have also pointed out some issues emanating from these policies that are often driven by political calculations and donor influence, without fully exploring the holistic influence on the balance of demand and supply (Ridde et al., 2015). For instance, national political attention is largely focused on the demand-side – perhaps because these interventions are more readily visible to voters; but as a result the supply-side is often neglected, putting excessive strain on the health system (McPake et al., 2013; Nabyonga-Orem et al., 2008). This can adversely impact quality of care (Hardeman et al., 2004; Noirhomme et al., 2007), and more significantly, it can also increase inequity due to *elite capture*: as more people compete for limited services, individuals who can exert disproportionate influence on the system tend to access more and better quality services (Wong, 2010). On the other hand, there is increasing donor influence on healthcare policies such as performance-based financing, which tend to prioritise the

supply-side; but these often receive inadequate buy-in from national governments (Gautier & Ridde, 2017) and researchers have raised concerns on the long-term effectiveness of such interventions (Paul et al., 2018).

Although prior research provides evidence on the influence of single interventions, there is a paucity of evidence that provides insights on the differential influence of supply- and demand-side interventions on equity in utilisation in the same context. In this paper, we aim to address this gap by investigating these dynamics: how is equity in healthcare utilisation influenced by supply- and demand-side interventions? Using the case of Senegal, we examine inequities in utilisation of maternal health services in relation to two sequential interventions – the first intervention, on the supply-side, focuses on improving the availability of maternal health services, and the second intervention on the demand-side focuses on abolishing user fees for facility deliveries. Even though, due to limitations in the data and design of the study, we are unable to make causal claims, to the best of our knowledge, this is the first study examining the sequential and combined effects of supply- and demand-side interventions on improving utilisation of maternal health services. The sequential implementation is important as the quality of services is improved *before* increasing demand to ensure women who access health facilities receive good quality of care. By assessing how supply- and demand-side interventions influence equity in the same context (i.e. Senegal), this analysis allows us to identify the implications for policymakers, who often focus on one side more than the other.

Our research focus – maternal health services in Senegal – is particularly relevant as over the past two decades, there have been significant investments in improving maternal health in LMICs – especially in West Africa (Nyamtema et al., 2011; Wang et al., 2011). On the supply-side, there have been investments in antenatal care, availability of skilled birth attendants during deliveries, and improvements in the provision of emergency obstetric care (EmOC). While on the demand-side – early experience of user fees abolition in Uganda in 2001 that resulted in increased

utilisation (Deininger & Mpuga, 2005; Nabyonga et al., 2005), combined with the drive to achieve targets set out in the MDG, SDG, and UHC – has led many countries to focus on abolishing user fees altogether or for specific services and populations (Yates, 2009).

Unfortunately, despite significant efforts to promote and provide maternal healthcare, progress towards achieving the maternal health targets have been slow. The WHO (2016) reports that LMICs account for 99% of the global maternal deaths of which sub-Saharan Africa alone accounts for 66%. Furthermore, to achieve the SDG target of a global Maternal Mortality Ratio (MMR) below 70 – global MMR must reduce by 7.5% each year till 2030, at a rate three times the annual rate of reduction observed between 1990 and 2015. A primary concern towards meeting this goal is the slow increase in utilisation of healthcare. For instance, the WHO recommends a minimum of four antenatal contacts per pregnancy, which has recently been revised to eight contacts – but, in 2012 only 37% of pregnant women in LMIC had at least four antenatal contacts (UN, 2014), and the rate is estimated to be even lower in rural areas and amongst poorer households (UN, 2018). In this context, in line with the immense interest in a variety of supply- and demand-side interventions, the evidence is growing – but several reviews have also reiterated the need for better quality evidence, particularly with regards to the magnitude of effect in the long term, and deeper analysis to understand the uncertain impact on health and socioeconomic inequities (Dzakpasu et al., 2014; Hatt et al., 2013; Lagarde & Palmer, 2011; Ridde & Morestin, 2011).

Methodology

Senegal

Senegal, like several LMICs, continues to face a major challenge in providing equitable maternal healthcare. The WHO (2016) reports that while MMR in Senegal has improved from 540 in 1990 to 315 in 2015, it is significantly higher than the global target of under 70 by 2030. One in 61 women

in Senegal faces the lifetime risk of dying due to pregnancy or childbirth-related complications – in developed countries, it is one in 4900 women (WHO, 2016).

Over the last two decades, two large-scale interventions were implemented in Senegal to increase utilisation of maternal health services (UNFPA & Immpact, 2008). First on the supply-side, to address the acute shortage of surgeons and obstetricians-gynecologists, the Ministry of Health decided to delegate emergency obstetric care (EmOC) to non-physicians. This programme was conducted at two levels of the health systems. At the first level (health posts) nurses were trained to provide basic EmOC which included administration of antibiotics, oxytocics and anti-convulsants, manual delivery of placenta, curettage, and manual intra-uterine aspiration. Only assistance at delivery using a vacuum extractor, also considered basic EmOC, was not taught to this staff. The training programme included theoretical and practical training lasting 1-2 weeks in regional hospitals. At the second level (health centres and district hospitals), surgical teams including general practitioners, anaesthetists, and surgical assistants (including midwives) were trained in comprehensive EmOC - all functions of basic EmOC and in addition, caesarean sections, forceps, and intervention for ectopic pregnancy. The teams received both theoretical and practical training, lasting 6 months for general practitioners and 3 months for the other two staff, followed by 3 months of placement in their local regional hospitals. Eight such teams were to be trained between 1998-2002, followed by another eight in 2005-2008 (De Brouwere et al., 2009). Since the first set of teams became operational in 2001 (De Brouwere et al., 2009), we have considered 2001 as the starting point of this intervention.

The second major intervention was on the demand-side - Free Delivery and Caesarean Policy (FDCP), which provides free deliveries in public health facilities. The intervention was launched in 2005 and became fully operational in 2007. In the first year, it was introduced in five poor regions in Senegal before it was extended to other regions in 2006 and to Dakar in 2007. In 2006, FDCP was temporarily restricted to cover only deliveries by caesarean section in regional

hospitals but since then it covers all types of deliveries. As part of FDCP, to compensate for the lost income, the government provides subsidised kits to public facilities that include supplies for normal deliveries (Witter et al., 2008). The regional hospitals receive remuneration of 55,000 FCFA (USD 89) per caesareans delivery – with some paid in advance, as per an estimated caseload, and the rest is reimbursed based on actuals. The government spent USD 1.18 million on FDCP during mid-2005 to mid-2006, 10% of the total national health budget.

Data

We use data from three rounds of the Demographic Health Surveys (DHS) conducted between 1997 and 2010 in Senegal. DHS is a repeated cross-sectional, nationally representative household survey designed to collect comparable data on maternal and child health indicators over time. It provides individual, household and regional level information. The survey is designed using multi-stage stratified probability-based sampling method (For detailed information on the sampling method, refer to ANSD and ICF International (2012)).

The DHS collected information on the socioeconomic and demographic indicators of the household. All women (15-49 years) in the household reported on their use of maternal health services for children born in the last five years. Using the date of birth, we were able to identify child-level data, and therefore, have information on 30,364 children born in the period 1992 to 2010. See Figure 1 for the data collection and intervention timeline.

<< Figure 1 >>

Analytical approach

The main objective of both interventions is to reduce maternal and infant mortality by increasing deliveries in health facilities. Therefore, our focus is on the intermediary objective of increasing

facility deliveries. To understand changes in facility delivery, our analytical approach observes changes in utilisation before and after supply- and demand-side interventions. Note that this approach reveals an association, but not a causal relationship. We do not differentiate between public and private facilities as the latter is negligible in Senegal. Only 2.7% of all births were in the private facilities including NGO-operated facilities in the period 1992-2010. We also examine deliveries at home, as an increase in facility deliveries should consequently reduce deliveries at home. And finally, we examine whether the birth was assisted by a health professional (doctor, nurse or midwife), as delivery by a skilled attendant is one of the main reasons for encouraging deliveries at a health facility.

The EmOC training was aimed at improving emergency care and therefore not directly aimed at increasing normal physiological births. However, there is evidence from African and other settings that multi-professional EmOC training can improve teamworking, communication and respect between different cadres of health workers (Ameh et al., 2012; Bergh et al., 2015; Cornthwaite et al., 2015; Grady et al., 2011); it can increase the respect towards midwives and enable them to practice more autonomously(Cornthwaite et al., 2015). A Cochrane review of midwifery-led continuity of carer has shown that this model of care increases physiological (normal vaginal) birth (Sandall et al., 2016).

To examine the equity effects of the two interventions, we consider three measures of socioeconomic status (SES) – household wealth, mothers' education, and location (urban or rural). Household wealth uses the asset-based wealth index provided in the DHS. It is based on household ownership of durable assets (e.g. bicycle, radio, telephone) and housing conditions (e.g. water source and toilet facilities) and is calculated for each survey using principal component analysis (ANSD, 2015). We use this index to create wealth quartiles separately for each survey. Due to the low level of education in Senegal, mothers' education is coded as no education vs some education. Finally, the location of the household is categorised as urban or rural. Although SES data is from

the time of data collection and not from the time of delivery, we expect these indicators to be stable over time especially mothers' education and location. Since household wealth is a relative measure as compared to other households in the region, we expect it to be stable in the short-term. See Table 1 for variable descriptions.

<< Table 1 >>

Our model uses the following equation:

$$y_{it} = \alpha + \beta_1(SES_i * Time_t) + \beta_2(SES_i) + \beta_3(Time_t) + \delta_r + \gamma_t + \mathbf{X_{it}} + \epsilon_{it} \quad (1)$$

y_{it} refers to the outcome variable for a child i born in time t. The binary variable SES_i denotes the socioeconomic status of the household, comparing poor to rich household (wealth quartile 1 vs quartile 4), uneducated to educated mothers, or rural to urban households. The variable $Time_t$ takes the value of 1 for the post-intervention period and 0 for the pre-intervention period. Therefore, when assessing Intervention 1 (EmOC), the pre-EmOC is represented by Period 1 and post-EmOC by Period 2 as shown in Figure 1. Similarly, when assessing Intervention 2 (FDCP), the pre-FDCP is represented by Period 2 and post-FDCP by Period 3. Period 3 does not include years 2005 and 2006 as FDCP was not fully operational in these two years. The main coefficients of interest are β_1, β_2 and β_3, which are used to estimate the differential effect of the interventions by socioeconomic status in different time periods.

Any unobservable effects common to all children born in a year are controlled for by the year fixed effects γ_t. Similarly, region fixed effects, unobservable effects common to all children born in a region, are controlled for by δ_r. The administrative boundaries of regions were changed during our analysis period. To facilitate comparison across the entire period (1992-2010), we use the ten regions as defined in DHS-3. Therefore, Matam is clubbed with St. Louis, Kaffrine with Kaolack, Kedougou with Tambacounda, and Sedhiou with Kolda. Lastly, matrix $\mathbf{X_{it}}$ is the set of

control variables which includes ethnicity and sex of household head and ϵ_{it} denotes the random error term.

We use a linear probability model as the interpretation of interaction terms is controversial in non-linear probit or logit models (Ai & Norton, 2003; Greene, 2003). In all models, standard errors are clustered at the region and household levels to account for serial correlation, and weights are used to adjust for survey sampling.

Results

The descriptive from Table 1 show that in our sample of 30,364 children born during 1992-2010, 58% were born in health facilities and little over 50% had delivery assisted by a health professional. Almost 76% of the mothers in the sample have never attended school and 70% of the households were from rural areas.

The regression results (Tables 2-4) and marginal effect graphs (Figure 2) show the differences in deliveries by SES. The time periods refer to the pre- and post-intervention periods as shown in Figure 1 and the equity effects of the two interventions are captured by the coefficients, interpreted as per equation (1). Therefore, the estimated utilisation for Poor (1) and Time (1) i.e. poor households after an intervention is $\beta_1(1 * 1) + \beta_2(1) + \beta_3(1) = \beta_1 + \beta_2 + \beta_3$; and Poor (0) and Time (1) i.e. for rich households after an intervention is $\beta_1(0 * 1) + \beta_2(0) + \beta_3(1) = \beta_3$; and similarly for other combinations of SES and time.

<< Tables 2, 3, and 4 >>

<< Figure 2 >>

Household wealth

By comparing the influence of the intervention on facility deliveries by household wealth (Figure 2, left panel), we observe that overall – there has been an increase in facility deliveries amongst both the rich and poor households and correspondingly, there has been a fall in home deliveries for both SES categories. We also observe that overall the rich are more likely to seek facility delivery and they are more sensitive to changes to the supply-side intervention (EmOC) as indicated by the steeper increase in utilisation for richer households between Periods 1 and 2; and the poor are more sensitive to the demand-side intervention (FDCP) as indicated in the steeper increase in utilisation for poorer households between Periods 2 and 3. Similar results are observed for all four wealth quartiles (See appendix). The corresponding regression results are shown in Table 2, column 1. Before the implementation of EmOC in Period 1, children from poor households are 33% points less likely to be born in health facilities as compared to rich households. Although facility deliveries increased for both groups after EmOC, by +7% points for poor and +13% points for rich, the increase is much larger for the rich, thereby worsening inequities. After EmOC, children from poor households are 40% points less likely to be born in health facilities as compared to rich households. However, inequity improved after the second intervention, FDCP. The difference between poor and rich is 52% points before FDCP and this reduced to 44% points after FDCP. Facility deliveries increased by +12% points among poor households and by +4% points among rich households after FDCP.

This trend is reflected in the falling number of home deliveries. While home deliveries are higher among the poor, they are reducing over time (Figure 2). The reduction in home deliveries is more among the rich compared to the poor, after EmOC (-13% points vs -7% points) while the reduction is more among the poor compared to the rich, after the second intervention, FDCP (-12% points vs -4% points) as estimated from Table 2, column 2.

Similarly, for assisted deliveries, although they are increasing over time, they are lower for poor households (Figure 2). The increase in assisted deliveries is more for rich compared to poor

households after EmOC (+7% points vs +2% points), indicating worsening inequity, while the improvement is more for poor compared to rich households after FDCP (+9% points vs +5% points), thereby reducing inequity as seen from Table 2, column 3. As shown in Table 1, overall, only half of all deliveries were assisted by health staff – of which only 4% of the home deliveries were assisted by a health professional. In the case of health facilities, we find that 16% of the deliveries were not assisted by health staff of which, 27% of poor households and 8% of rich households had unassisted deliveries at a facility.

Mother's education

Regarding mother's education, similar overall trends are observed with increasing facility and assisted deliveries and reducing home deliveries over time (Figure 2, middle panel). Further, as seen from the regression results in Table 3, facility deliveries increased for uneducated mothers after both interventions: +16% points after EmOC and +13% points after FDCP and this increase was more than the increase in utilisation amongst educated mothers (+12% points after EmOC and +7% points after FDCP), consequently reducing inequity between these two SES categories. This trend is also reflected in reducing home deliveries for both educated and uneducated mothers: -16% points and -12% points after EmOC and -13% points and -7% points after FDCP. Assisted deliveries also show corresponding trends i.e. increasing over time. The increase in assisted deliveries after EmOC by mother's education is more for uneducated vs educated mothers (+7% points vs +5% points) but this difference is not significant. The increase in assisted deliveries after FDCP is +13% points for uneducated mothers and +8% points for educated mothers. The results indicate uneducated mothers benefitted more compared to educated mothers, from both interventions.

Location

The overall trends of increasing facility and assisted deliveries and reducing home deliveries over time are also observed in both rural and urban areas (Figure 2, right panel). For rural households, facility deliveries increased substantially after both interventions: +18% points after EmOC and +14% points after FDCP, while the increase was relatively less for urban households: +13% points and +8% points respectively– indicating an overall reduction in inequities between the two SES categories. This was also reflected in reducing home deliveries and increasing assisted deliveries. Home deliveries fell by -18% points after EmOC and -14% points after FDCP for rural households and by -13% points and -8% points for urban households respectively. Assisted deliveries increased by +7% points after EmOC and +15% points after FDCP for rural households and by +6% points and +7% points for urban households respectively. The results indicate the rural households increased utilisation at a faster rate after both interventions as compared to urban households.

Discussion

WHO (2013, 6) defines health inequities as "unjust differences in health between persons of different social groups and can be linked to forms of disadvantage such as poverty, discrimination and lack of access to services or goods". They propose, since health inequity is a normative concept, "observable differences between subgroups within a population [that] can be measured and monitored … serves as an indirect means of evaluating health inequity". Hence, inequity can be said to exist when we can show a difference in healthcare utilisation between population subgroups that have the same healthcare need (Starfield, 2011). While an absolute measure of inequity is useful – policymakers are also concerned with the *changes* in inequity over time especially after introducing new interventions. We draw upon this view and analyse changes in inequity in the utilisation of facility deliveries by three measures of SES and over two major health system interventions in Senegal.

We find that although facility and assisted deliveries are increasing, better-off i.e. households that are richer, more educated and in urban areas, continue to have higher utilisation than households that are poorer, less educated and in rural areas. Analysis of the changes in utilisation show that the rich are more sensitive to interventions on the supply-side while poor are more sensitive to interventions on the demand-side. Therefore, inequity in utilisation increased after the supply-side intervention and it reduced after the demand-side intervention. Examining changes in inequity by mother's education and household location (rural/ urban) reveal that in both instances inequities reduced after both the supply- and demand-side interventions. These findings have implications for research which we discuss in this section.

Influence of supply- vs demand-side interventions on equity

In line with prior research on the topic that has delved into equity analyses by sub-groups of wealth, geography, and education (Matthews et al., 2010; Tey & Lai, 2013) – our research also sheds light on the changing levels of equity in the context of facility delivery in Senegal. However, departing from prior research on the topic, our research provides a more nuanced understanding of equity by studying the influence of two sequential interventions: first on the supply-side followed by an intervention on the demand-side. We propose that an understanding of the differential influence of supply- and demand-side interventions on equity in healthcare utilisation is needed for several reasons.

While healthcare systems seek to balance both supply- and demand-side needs as a whole – interventions often target issues on one side more than another. For instance, as Kyei-Nimakoh et al. (2017) point out in their review, access to obstetric care faces several supply- and demand-side barriers, which often focuses policymakers' attention on designing interventions to target specific issues. Supply-side interventions may target issues of coverage of health services, long waiting times at health facilities, or inadequate knowledge and skills. Similarly, interventions on

the demand-side may focus on out-of-pocket payments, health education, or cultural beliefs. Therefore, in practical terms, policymakers will benefit from analyses that provide a distinction based on supply- and demand-sides.

In our study, since the supply-side intervention was introduced before the demand-side intervention, the results are useful in understanding the sensitivity of poor vs rich households to only supply-side interventions. Our analysis suggests that supply-side interventions are likely to increase inequity, as poorer households, who have lower utilisation to begin with, are also less sensitive to supply-side interventions, even though overall utilisation in the population increases because of the intervention. However, our analysis also suggests, supply-side interventions do not influence equity across other SES sub-groups based on mother's education and location (urban/rural) – indicating that financial barriers (partly from OOP expenses) on the demand-side could be a significant hurdle in accessing facility deliveries.

On the demand-side, while our analysis suggests that poorer households do benefit more – and therefore demand-side interventions reduces inequity – evidence from prior literature is mixed. Dzakpasu et al. (2014) report in their review that the evidence for the impact of the abolition of user fees (a common demand-side intervention) on equity is limited and where available, the overall direction of effect is inconsistent. At the same time, we find there is also evidence to suggest that demand-side interventions improve utilisation. In a programme evaluation study in Senegal, Witter et al. (2010) show that there is a significant increase in utilisation in normal deliveries in areas that launched the FDCP in 2004–2005, compared to non-FDCP regions. Similarly, positive results are reported by McKinnon et al. (2015) who show that the removal of user fees led to an increase in utilisation of facility deliveries across all sub-groups of household wealth and mother's education. However, they also find that more educated mothers benefitted more, suggesting that there could be an increase in inequity even from demand-side interventions. This is in line with the 'inverse equity hypothesis', which proposes that higher SES sub-groups,

such as more educated mothers, are more likely to benefit from health interventions first – thereby increasing inequity, at least in the short-term (Victora et al., 2018).

Possibilities of elite capture

Elite capture is understood as a phenomenon in which a small group of *elites*, who can draw upon their social, political, economic and cultural status, to appropriate for themselves disproportionate amount of resources available in the community. The risk of elite capture tends to be higher in contexts of decentralised, local, participatory decision making, where resources are constrained leading to implicit rationing – especially in the short-term (Lund & Saito-Jensen, 2013; Platteau, 2004).

Our analysis suggests that interventions in the healthcare system could be open to risks of elite capture, especially by richer households. We find that amongst poorer households, utilisation continues to remain low, even with both supply- and demand-side interventions. While this could be due to several demand-side barriers such as high OOP expenses, our data suggest that even within health facilities, the treatment received by poor households is not of the same quality compared to that received by richer households. For instance, at a health facility, 27% of poor households had unassisted deliveries even though the number is 8% for rich households – indicating possible preferences given to richer households within a facility, or that the rich have access to health facilities that are better staffed.

To begin with, extant research suggests that constraints in resource supply can lead to lower quality of care or even absence of care at health facilities. It can also encourage implicit rationing where priority is given to richer households. For instance, in a review of care by skilled birth attendants (SBA) at facilities, Munabi-Babigumira et al. (2017) find that lack of an adequate number of SBAs and training leads to poor quality of care, which in turn leads to women's negative perception of facilities. Further, evidence suggests that poorer households are more likely

to be negatively affected by such supply constraints. Joseph et al. (2016) report that non-SBA births at a facility are more common in rural areas and among poorer people. They find that in Senegal, while non-SBA deliveries at a facility are common in both urban and rural areas (15% and 23 % respectively) – facility births by a non-SBA is more common for the three poorest quintiles. In a study on the relationship between national coverage of schemes and changes in equity, Victora et al. (2018) report that when coverage of an intervention is low, rich are significantly ahead of other groups in utilisation; poor catch up, albeit not to the same level as the rich, and only when the scheme reaches full coverage. Our analysis captures the early years of the two interventions, and therefore it is likely we observe the presence of elite capture in the early years.

Implication for policy in Senegal and West Africa

We would like to highlight three main implications for policymakers from our analyses. First, national averages of metrics, which are often the focus of key performance assessments in reports and official government documents including those used for monitoring SDG and UHC targets, can hide glaring inequities across sub-groups (Barros & Victora, 2013; Gwatkin, 2000; Ravallion, 2001). Our analysis shows this to be the case for maternal healthcare utilisation in Senegal. We find that while the average utilisation of maternal healthcare has improved – after the supply-side intervention, the difference in utilisation between the richest and poorest had in fact increased. Although this trend was reversed to some extent after the demand-side intervention, a central learning would be to track the impact of interventions by several SES sub-groups, most notably wealth. Specifically, in the context of Senegal, we find that there has been a significant political focus on UHC. For instance, in 2012, President Sall's successful election campaign had promised to increase healthcare coverage from 20% to 75% by 2017; and after the election numerous interventions on the demand-side were initiated that increased average utilisation (Fonteneau et

al., 2017). However, as our analysis shows, policymakers would benefit from a more critical assessment of whether the benefits were equitable.

Second, our central argument has been to show that rich and poor respond differently to supply- and demand-side interventions. Therefore, excessive focus on one side over another does not effectively meet the equity objectives. On the demand-side, abolishing user fees may increase utilisation, but without a comparable increase in supply, this risks quality of care, provider motivation, and may promote elite capture that could ultimately keep the poorest from utilising healthcare (Hatt et al., 2013). For instance, in Senegal, even after reducing user fees, poorer households are still less likely to use healthcare, despite having the healthcare need and information (Mladovsky & Ba, 2017). While, Zombré et al. (2017) find that in Burkina Faso the impact of user fees exemptions on healthcare utilisation was strongest in facilities with higher workforce density i.e. when demand-side intervention is adequately supported by supply.

Third, even though poor are more sensitive to demand-side interventions – we had still expected to see greater utilisation of the maternal healthcare amongst poorer households after the demand-side intervention. This suggests that in Senegal, while abolition of user fees has removed some of the demand-side barriers there are other barriers that hold back utilisation amongst poorer households. Prior literature suggests that these could be due to the remaining OOP expenses, lack of awareness, cultural practices, and the opportunity cost associated with family members travelling to the health facility (Mladovsky & Ba, 2017).

Limitation and future research

Our analysis has some limitations. First, our analysis does not show or claim to show causal relations between the interventions and inequity – instead, by comparing the changes in utilisation before and after supply- and demand-side interventions, we show an association between the interventions and utilisation by SES groups. While this association provides a strong foundation to

study the impact of interventions on inequity, future research is needed to examine the causal effects.

Second, we shed light on the dynamics of horizontal inequity: when subgroups have the same need but differences in utilisation. As researchers have pointed out – often the 'hidden inequity' in health is vertical inequity: when people with more complex needs are unable to seek care adequate to their need (Starfield, 2011). Our empirical context limits our scope to investigate vertical inequity, but future research may want to pursue this question with other data.

Lastly, as we are interested in studying two sequential interventions, our study period stretches from 1992 to 2010. Given the long period and limitations in data, we have not been able to capture all developmental interventions that may influence the two health interventions. To some extent, the inclusion of region and year fixed effects in our model controls for these unobserved interventions.

Conclusion

In LMICs, there has been an increased focus on reducing maternal and infant mortality by alleviating barriers to accessing health facilities. One of the main reasons for recommending facility delivery is that it is more likely to provide delivery by a skilled attendant, which is central in reducing maternal mortality and newborn mortality (Bhutta et al., 2014; WHO, 2004). In a study of equity across maternal and child health interventions across 54 countries, Barros et al. (2012) report that skilled birth attendant coverage was the least equitable intervention across wealth sub-groups. Our study is also useful in understating these dynamics. While demand-side intervention in maternal healthcare encourages people to seek facility deliveries – inadequate supply-side resourcing might nullify the underlying reasoning for this recommendation. Instead, policymakers may want to pay heed to the call to consider increasing investment in supply-side

intervention and also consider a range of delivery options appropriate to the need and resourcing constraints (WHO, 2015).

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Figure 1. Data Collection and Intervention Timeline

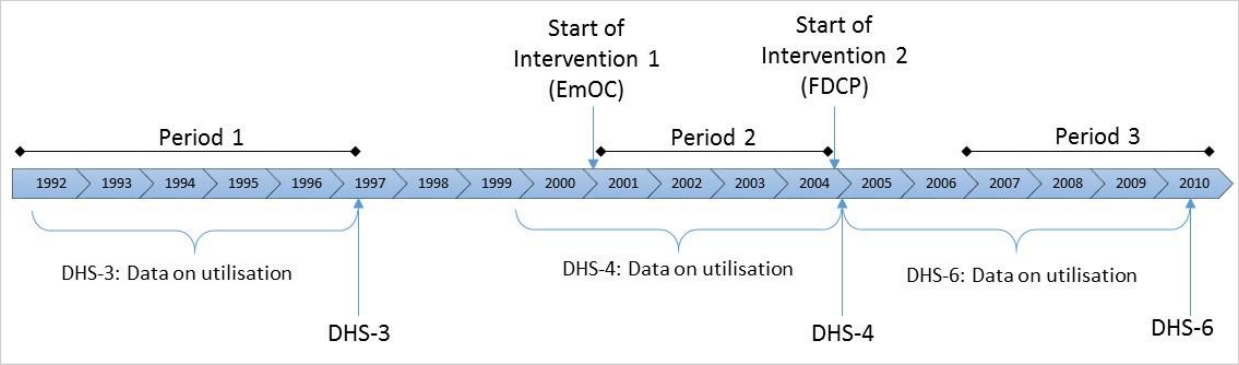

Figure 2. Marginal Effects by SES categories

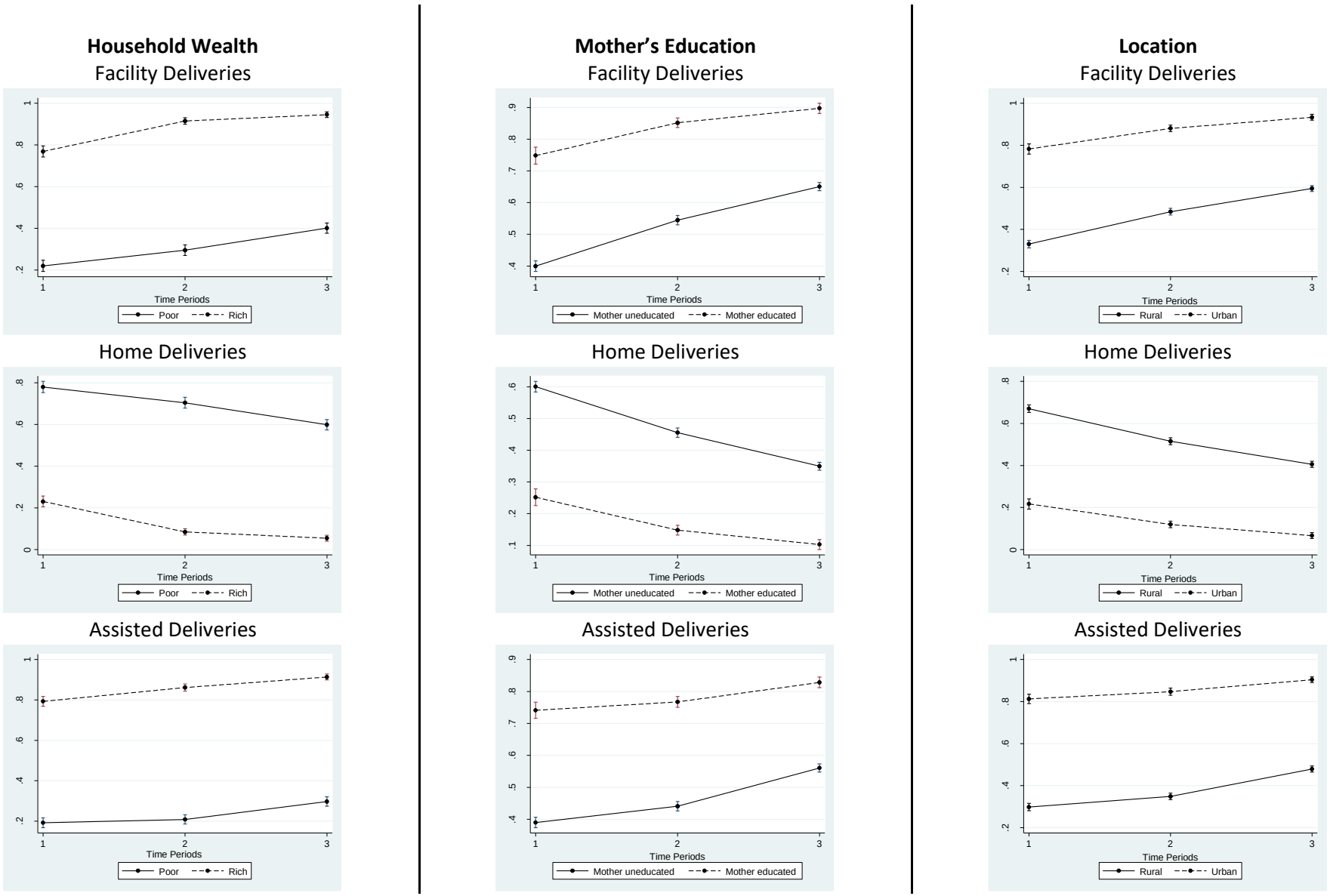

Table 1. Variable Definitions and Descriptive Statistics

(1) Description of variables		(2) Percentage N=30,364
Panel A: Outcome variables		
Facility	Delivery in a health facility (public or private) =1; 0 otherwise	58.09
Home	Delivery at home=1; 0 otherwise	41.91
Assisted	Delivery assisted by a health professional*=1; 0 if assisted by relatives, neighbours or traditional birth attendants.	50.11
Panel B: Socioeconomic variables		
SES	Wealth quartiles, with Q1 referring to the poorest 25% households and Q4 to the richest 25% households.	
	Q1	25.03
	Q2	25.00
	Q3	24.99
	Q4	24.99
Poor	Household in wealth quartile 1=1; 0 if household in wealth quartile 4	25.03
Unedu	Mother has never attended school=1; 0 otherwise	75.90
Rural	Household in a rural area=1; 0 if urban	70.08

* refers to a doctor, nurse/midwife or auxiliary nurse/midwife.

Table 2. Utilisation of Maternal Health Services by Household Wealth

Coef.		(1) Facility	(2) Home	(3) Assisted
		Intervention 1 (EmOC)		
Poor*Time	β_1	-0.062**	0.062**	-0.048**
	SE	(0.024)	(0.024)	0.022
	95% CI	[-0.110, -0.015]	[0.015, 0.110]	[-0.092, -0.004]
Poor	β_2	-0.334***	0.334***	-0.300***
	SE	(0.028)	(0.028)	0.029
	95% CI	[-0.390, -0.279]	[0.279, 0.390]	[-0.356, -0.244]
Time	β_3	0.135***	-0.135***	0.070***
	SE	(0.025)	(0.025)	0.024
	95% CI	[0.086, 0.183]	[-0.183, -0.086]	[0.022, 0.117]
Observations		8,082	8,082	8,082
R-squared		0.407	0.407	0.448
		Intervention 2 (FDCP)		
Poor*Time	β_1	0.081***	-0.081***	0.040**
	SE	(0.021)	(0.021)	(0.020)
	95% CI	[0.040, 0.122]	[-0.122, -0.040]	[0.000, 0.080]
Poor	β_2	-0.521***	0.521***	-0.446***
	SE	(0.023)	(0.023)	(0.025)
	95% CI	[-0.566, -0.476]	[0.476, 0.566]	[-0.496, -0.396]
Time	β_3	0.041**	-0.041**	0.048**
	SE	(0.020)	(0.020)	(0.020)
	95% CI	[0.003, 0.080]	[-0.080, -0.003]	[0.009, 0.088]
Observations		9,396	9,396	9,396
R-squared		0.432	0.432	0.468

Notes: Controls include: sex and ethnicity of household head, mother's education, whether household is in an urban or rural region. All models include region and year fixed effects.
*** p<0.01, ** p<0.05, * p<0.1

Table 3. Utilisation of Maternal Health Services by Mother's Education

	Coef.	(1) Facility	(2) Home	(3) Assisted
		Intervention 1 (EmOC)		
Unedu*Time	β_1	0.041**	-0.041**	0.021
	SE	(0.019)	(0.019)	(0.019)
	95%CI	[0.004, 0.078]	[-0.078, -0.004]	[-0.016, 0.058]
Unedu	β_2	-0.132***	0.132***	-0.102***
	SE	(0.017)	(0.017)	(0.017)
	95%CI	[-0.165, -0.098]	[0.098, 0.165]	[-0.135, -0.069]
Time	β_3	0.121***	-0.121***	0.046**
	SE	(0.022)	(0.022)	(0.021)
	95%CI	[0.079, 0.163]	[-0.163, -0.079]	[0.004, 0.088]
Observations		16,141	16,141	16,141
R-squared		0.297	0.297	0.326
		Intervention 2 (FDCP)		
Unedu*Time	β_1	0.057***	-0.057***	0.056***
	SE	(0.015)	(0.015)	(0.015)
	95%CI	[0.028, 0.086]	[-0.086, -0.028]	[0.025, 0.086]
Unedu	β_2	-0.109***	0.109***	-0.094***
	SE	(0.012)	(0.012)	(0.013)
	95%CI	[-0.132, -0.086]	[0.086, 0.132]	[-0.119, -0.070]
Time	β_3	0.072***	-0.072***	0.077***
	SE	(0.017)	(0.017)	(0.017)
	95%CI	[0.040, 0.105]	[-0.105, -0.040]	[0.043, 0.111]
Observations		18,826	18,826	18,826
R-squared		0.297	0.297	0.331

Notes: Controls include: sex and ethnicity of household head, household wealth quartiles, whether household is in an urban or rural region. All models include region and year fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Table 4. Utilisation of Maternal Health Services by Location

Coef.		(1) Facility	(2) Home	(3) Assisted
		Intervention 1 (EmOC)		
Rural*Time	β_1	0.057***	-0.057***	0.011
	SE	(0.019)	(0.019)	(0.019)
	95%CI	[0.019, 0.094]	[-0.094, -0.019]	[-0.026, 0.047]
Rural	β_2	-0.187***	0.187***	-0.250***
	SE	(0.020)	(0.020)	(0.020)
	95%CI	[-0.225, -0.149]	[0.149, 0.225]	[-0.288, -0.211]
Time	β_3	0.125***	-0.125***	0.063***
	SE	(0.021)	(0.021)	(0.020)
	95%CI	[0.084, 0.166]	[-0.166, -0.084]	[0.023, 0.102]
Observations		16,141	16,141	16,141
R-squared		0.291	0.291	0.321
		Intervention 2 (FDCP)		
Rural*Time	β_1	0.058***	-0.058***	0.075***
	SE	(0.015)	(0.015)	(0.016)
	95%CI	[0.028, 0.088]	[-0.088, -0.028]	[0.044, 0.105]
Rural	β_2	-0.136***	0.136***	-0.231***
	SE	(0.014)	(0.014)	(0.016)
	95%CI	[-0.163, -0.109]	[0.109, 0.163]	[-0.263, -0.199]
Time	β_3	0.078***	-0.078***	0.071***
	SE	(0.016)	(0.016)	(0.017)
	95%CI	[0.046, 0.110]	[-0.110, -0.046]	[0.038, 0.103]
Observations		18,826	18,826	18,826
R-squared		0.293	0.293	0.329

Notes: Controls include: sex and ethnicity of household head, household wealth quartiles, and mother's education. All models include region and year fixed effects.
*** p<0.01, ** p<0.05, * p<0.1

Appendix

Table A1. Utilisation of maternal health services by household wealth, including all four wealth categories

(SES1 indicates poorest quartile and SES4 indicates richest quartile; reference category is SES4)

	Intervention 1 (EmOC)			Intervention 2 (FDCP)		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Facility	Home	Assisted	Facility	Home	Assisted
SES1*Time	-0.056**	0.056**	-0.044*	0.071***	-0.071***	0.031
	(0.024)	(0.024)	(0.023)	(0.021)	(0.021)	(0.020)
	[-0.104, -0.008]	[0.008, 0.104]	[-0.089, 0.001]	[0.029, 0.112]	[-0.112, -0.029]	[-0.009, 0.071]
SES2*Time	-0.004	0.004	-0.013	0.110***	-0.110***	0.085***
	(0.026)	(0.026)	(0.024)	(0.023)	(0.023)	(0.022)
	[-0.055, 0.046]	[-0.046, 0.055]	[-0.060, 0.034]	[0.066, 0.155]	[-0.155, -0.066]	[0.042, 0.128]
SES3*Time	0.051*	-0.051*	-0.019	0.073***	-0.073***	0.103***
	(0.027)	(0.027)	(0.028)	(0.021)	(0.021)	(0.024)
	[-0.002, 0.104]	[-0.104, 0.002]	[-0.075, 0.036]	[0.033, 0.113]	[-0.113, -0.033]	[0.057, 0.149]
SES1	-0.314***	0.314***	-0.290***	-0.440***	0.440***	-0.383***
	(0.024)	(0.024)	(0.024)	(0.020)	(0.020)	(0.021)
	[-0.361, -0.267]	[0.267, 0.361]	[-0.336, -0.243]	[-0.479, -0.402]	[0.402, 0.479]	[-0.424, -0.342]
SES2	-0.262***	0.262***	-0.256***	-0.329***	0.329***	-0.314***
	(0.024)	(0.024)	(0.024)	(0.020)	(0.020)	(0.020)
	[-0.309, -0.215]	[0.215, 0.309]	[-0.302, -0.209]	[-0.368, -0.291]	[0.291, 0.368]	[-0.354, -0.274]
SES3	-0.135***	0.135***	-0.113***	-0.126***	0.126***	-0.165***
	(0.024)	(0.024)	(0.024)	(0.017)	(0.017)	(0.020)
	[-0.183, -0.088]	[0.088, 0.183]	[-0.160, -0.066]	[-0.159, -0.093]	[0.093, 0.159]	[-0.204, -0.125]
Time	0.154***	-0.154***	0.079***	0.058***	-0.058***	0.070***
	(0.021)	(0.021)	(0.021)	(0.017)	(0.017)	(0.017)
	[0.112, 0.196]	[-0.196, -0.112]	[0.037, 0.120]	[0.025, 0.090]	[-0.090, -0.025]	[0.036, 0.103]
Observations	16,141	16,141	16,141	18,826	18,826	18,826
R-squared	0.298	0.298	0.326	0.299	0.299	0.332

Notes: Controls include: sex and ethnicity of household head, mother's education, and whether household is in an urban or rural region. All models include region and year fixed effects. Standard Errors shown in round brackets and Confidence Intervals in square brackets

*** p<0.01, ** p<0.05, * p<0.1

Figure A1. Marginal plots by household wealth, including all four wealth quartiles

(SES = 1 indicates poorest quartile and SES = 4 indicates richest quartile)