Introduction:

Tanzania has made significant strides towards reducing maternal and neonatal mortality through a sustained effort to increase the quality of health facilities and the availability of equipment and human resources(Government of Tanzania, 2011). However, facility delivery is far from universal and we have little understanding of the individual and community factors influencing place of delivery in the country. Research from other developing countries suggests that the community is particularly influential in promoting health seeking behavior and service utilization (Glei, Noreen Goldman, & Germán Rodríguez, 2003; Kruk, Rockers, Mbaruku, Paczkowski, & Galea, 2010; Magadi, Diamond, & Rodrigues, 2000; Pebley, N Goldman, & G Rodríguez, 1996; Simkhada, Porter, & van Teijlingen, 2010). This study investigates the hypothesis that in addition to observed individual and community factors, there are remaining unmeasured community indicators that influence a woman's decision to give birth in a facility.

In this study we describe the trends in facility delivery from 2001 to 2010 in the Rufiji Health and Demographic Surveillance Site (RHDSS). We investigate the large variation in village level rates of delivery and determine the role of individual and community characteristics in influencing facility delivery.

Background:

Facility delivery plays an important role in improving maternal and newborn health worldwide. Facility delivery with a skilled attendant reduces maternal mortality to ≤ 50 deaths/100,000 live births. Currently, the rate of facility delivery in Tanzania is 50% (National Bureau of Statistics, 2010). Tanzania has experienced a reduction in the maternal mortality rate, currently at 454/100,000 live births, decreased from 578/100,000 live births since 2005 (National Bureau of Statistics, 2010). Among other efforts to sustain this trend in declining maternal mortality and reach Millennium Development Goals 4 and 5, policy makers promote facility delivery for safe maternal and neonatal outcomes. Decreasing under five and maternal mortality by encouraging facility delivery is a top policy priority in Tanzania.

Policy makers hope that by improving the quality and efficiency of health facilities and personnel they will increase facility delivery. In Rufiji, the site for our study, two programs have been implemented to this aim: Tanzania Essential Health Intervention Project (TEHIP), an early effort organized by the government of Tanzania from 1998-2003, and Empower, an ongoing project by Ifakara Health Institute initiated in 2006.

The goal of TEHIP was to increase district capacity to provide for expectant mothers based on the belief that lack of and unequal access to basic obstetric and reproductive care has led to decreased utilization of facilities for complications and deliveries. The Empower project has upgraded clinic infrastructure and supplied equipment to increase access to comprehensive emergency obstetric care. They have also trained staff in an effort to improve their service provision and increase retention. Empower has found that the upgrades have increased facility delivery at the improved clinics.

Data and Methods:

The Health and Demographic Surveillance System (HDSS) is a set of field and computing operations aimed to handle the longitudinal follow-up of well-defined entities or primary subjects (individuals, households, and residential units) and related demographic and health outcomes within a clearly circumscribed geographic area. The Rufiji HDSS, implemented by the Ifakara Health Institute, is located in the coast region of Tanzania and covers an area of 1813 square kilometers with 33 communities (villages). The surveillance area extends between latitudes 7.47° and 8.03° South and longitudes 38.62° and 39.17° East, about 178 km south of Dar es Salaam. Dominant ethnic groups are Ndengereko, Makonde and Sukuma.

Rufiji HDSS was established in 1998 with an initial census conducted by enumerating the entire population in Demographic Surveillance Area (DSA). The initial census forms a dynamic cohort that enrolls individuals through birth and in-migration and who exit through death or out-migration. Every four months field teams make regular visits to each registered household in order to record births, deaths, in-out migration and marital status changes that have occurred since the previous visit and to update the status of all registered individuals and households. Birth registration includes detailed information about mother's place of delivery and assistance during delivery.

Our analysis includes 20,049 children born between 2001-2010. We use multilevel logistic regression to quantify the influence of individual and community factors on facility delivery. The primary outcome is a binary indicator for whether or not the birth took place in a health facility. Pregnancy specific characteristics include maternal age and marital status at birth, parity, multiple births, season of birth (rainy/dry), outcome and place of delivery of previous pregnancy, wealth quintile in year preceding birth, and distance from facility (in kilometers). Wealth measures are constructed using an asset index based on asset ownership (such as bicycle, radio, bed) by the household and house characteristics such as roofing and building material. Maternal characteristics include education and work (paid/other). Community level predictors include mean age, education and asset index of childbearing women. Maternal and community random effects were included.

Preliminary Results:

Overall there has been an increasing trend in facility delivery, from 63% in 2001 to 77% in 2010 based on 20,049 deliveries observed. Such high levels of facility delivery conceal considerable village level variation (Figure 1). Although overall there has been an increase in facility delivery, there are some villages that have consistently high rates, others that are increasing over time and some that remain with very low rates of facility delivery throughout the period (Figure 2). It is important to understand which factors contribute to these variations.

Model 1 in Table 1 presents results from a multivariate logistic model without random effects for mother and village. As maternal age increases, odds of facility delivery decrease by 6%. There is some evidence of nonlinearity of maternal age, with a point of inflection around age 38, but the evidence is barely significant. As parity increases, odds of facility delivery decrease by 13%. Consistent with these results, in a similar model, not shown, we investigated the effects of first birth and find that women giving birth to their first child are more likely to deliver in the facility. Education has a positive influence on facility delivery; while the influence of primary school as compared to no school is not significant, attending secondary school or higher as compared to no school increases the odds of facility delivery by 47%. Participating in paid labor, as opposed to farming, is associated with a 87% increase in the odds of delivering at a facility. Regarding wealth, each income quintile is associated with significantly higher odds of facility delivery.

As expected, distance to facility is negatively associated with facility delivery; a one kilometer increase in distance is associated with an 8% decrease in the odds of delivering at a facility. Similarly related to access, mothers who deliver in the rainy season are 12% less likely to deliver in the facility as compared to mothers in the dry season.

In Model 2 we add community level variables and random effects for mother and community of residence. The relationships from Model 1 hardly change. Living in villages with an older mean age of women in reproductive years is positively associated with facility delivery, in opposition to the individual level findings. One year increase in the mean age of the childbearing population is associated with a 6% increase in the odds of delivering at a facility.

Discussion

Over the past decade, we noted an increasing trend of facility delivery overall. However, this obscures community level variation, with some villages' consistently increasing facility delivery and in some a constant trend of high or low uptake. Individual characteristics identified in this study are similar to what was observed in previous studies. Distance to the facility has a particularly strong influence. Communities surrounding health facilities (IKS, IKN, IKC, MGC, MGN, UMS, UMN, KIB, KIA, BUA and BUB) have higher proportion of facility deliveries than those far from health facilities (MKU, MNG, NGU, MAN, MAC, JAM etc.). Communities along the main road have higher facility deliveries as compared to those far remote from the road. These observable characteristics of villages however, do not completely account for the variation in delivery rates, and unobserved characteristics of the mother and villages remain influential. We plan to investigate the potential role of ethnicity and religion in explaining some of the remaining unobserved village level influence.

Figure 1:

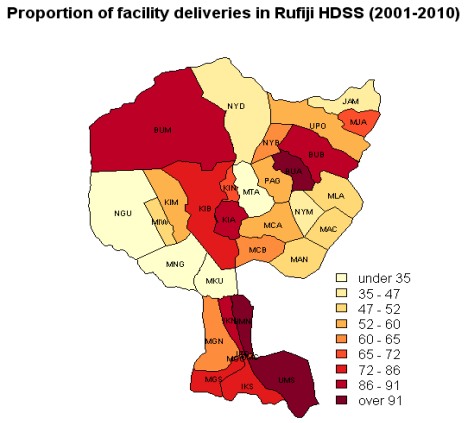

Figure 2:

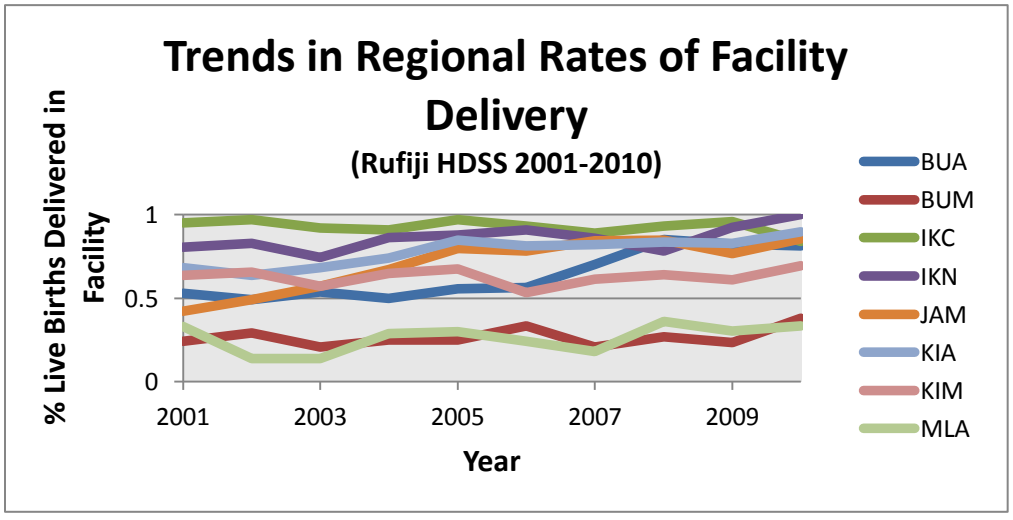

Table 1 – Logistic Regression Results, Determinants of Facility Delivery

	Model 1	**Model 2**
Exposure variable	**Odds Ratio**	**Odds Ratio**
Maternal age	0.94(0.92-0.97)	0.90(0.87-0.94)
Maternal age squared	1.00(1.00-1.00)	1.00(1.00-1.00)
Parity	0.87(0.85-0.89)	0.86(0.84-0.90)
Primary school	1.02(0.95-1.09)	1.21(1.11-1.33)
Secondary school and beyond	1.47(1.16-1.86)	2.00(1.45-2.74)
Paid work	1.87(1.69-2.07)	1.78(1.54-2.05)
Other work	1.65(1.44-1.89)	1.74(1.44-2.09)
Distance from closest facility	0.92(0.92-0.93)	0.98(0.97-0.99)
Giving birth to multiples	1.58(1.32-1.90)	1.57(1.22-2.01)
Married	0.97(0.91-1.04)	1.03(0.93-1.13)
Rainy season	0.88(0.83-0.94)	0.86(0.79-0.94)
Quintile 2	1.25(1.14-1.38)	1.16(1.02-1.32)
Quintile 3	1.53(1.39-1.68)	1.37(1.21-1.55)
Quintile 4	2.14(1.94-2.36)	1.76(1.53-2.01)
Quintile 5	4.03(3.56-4.58)	3.22(2.71-3.81)
Composite age		1.06(1.04-1.09)
Maternal and Village Random Effects	No	Yes
N	20049	19586

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