

## ORIGINAL RESEARCH ARTICLE

# Effects of Improved Access to Transportation on Emergency obstetric Care Outcomes in Uganda

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## Abstract

Reduction in maternal mortality has not been appreciable in most low-income countries. Improved access to transport for mothers is one way to improve maternal health. This study evaluated a free-of-charge 24-hour ambulance and communication services intervention in Oyam district using 'Caesarean section rate' (CSR) and compared with the neighbouring non-intervention district. Ecological data were collected retrospectively from maternity/theatre registers in October 2010 for 3 years pre and 3 years intervention period. The average CSR in the intervention district increased from 0.57% before the intervention to 1.21% ( $p=0.022$ ) during the intervention, while there was no change in the neighbouring district (0.51% to 0.58%,  $p=0.512$ ). Hospital deliveries increased by over 50% per year with a slight reduction in the average hospital stillbirths per 1000 hospital births in the intervention district (46.6 to 37.5,  $p=0.253$ ). Reliable communication and transport services increased access to and utilization of maternal health services, particularly caesarean delivery services. (*Afr J Reprod Health 2014; 18[3]: 87-94*)

**Keywords:** caesarean section, emergency obstetric care, ambulance services, accessibility, referral and communication system

## Résumé

La réduction de la mortalité maternelle n'a pas été appréciable dans la plupart des pays à faible revenu. L'amélioration de l'accès aux transports pour les mères est une façon d'améliorer la santé maternelle. Cette étude a évalué l'intervention des services gratuits d'ambulance et des communications assurés pour 24 heures dans le district d'Oyam à l'aide de «taux d'opération césarienne» (TOC) et nous l'avons comparé avec le quartier voisin de non-intervention. Les données écologiques ont été recueillies rétrospectivement à partir des dossiers de maternité / théâtre en octobre 2010 au cours de trois ans avant et pendant la période d'intervention de 3 ans. Le TOC moyen dans le district d'intervention a augmenté de 0,57% avant l'intervention à 1,21% ( $p = 0,022$ ) au cours de l'intervention, alors qu'il n'y avait pas de changement dans le district voisin (0,51% à 0,58%,  $p = 0,512$ ). L'accouchement à l'hôpital a augmenté de plus de 50% par an, avec une légère diminution dans les mortinaissances en milieu hospitalier pour 1000 naissances dans le district d'intervention (de 46,6 à 37,5,  $p = 0,253$ ). Les services de communication et de transport fiables ont augmenté l'accès aux, et à l'utilisation des services de santé maternelle, notamment les services d'accouchement par voie césarienne. (*Afr J Reprod Health 2014; 18[3]: 87-94*)

**Mots-clés:** césarienne, soins obstétricaux d'urgence, services ambulanciers, accessibilité, orientation et le système de communication

## Introduction

Globally, it is estimated that about 358,000 mothers died during pregnancy, child birth or within the first 42 days after giving birth in 2008; a reduction of 34% from 546,000 in 1990<sup>1,2</sup>. Sub-Saharan Africa contributes more than a half of the world's maternal mortality and has had the slowest annual reduction rate of maternal mortality from 1990<sup>1,3</sup>. In Uganda, the maternal mortality ratio

(MMR) for a seven year period preceding the surveys is estimated to only have reduced from 524 per 100 000 live births in 2001 to 418 in 2006 and increased to 435 in 2011<sup>4</sup>. This shows that there has been no significant change in maternal mortality ratio over the last ten years and Uganda's target for Millennium Development Goal (MDG) five may unfortunately not be met.

In a recent Lancet review, skilled care at birth and emergency obstetric care were highlighted as

having the greatest potential of reducing maternal and neonatal deaths as well as stillbirths of all the priority interventions proposed<sup>5</sup>. Effective and reliable emergency transport services and communication, which is a major component of emergency obstetric care, is therefore an important element if maternal deaths are to be averted in these countries.

Assessing maternal mortality is still a major obstacle for maternal mortality reduction programmes, owing to the fact that it is a rare event and poorly reported hence prone to misclassification. One would thus need unbearable large sample sizes to come up with reliable estimates. To circumvent this, the United Nations (UN) has come up with six process indicators that can be used to monitor maternal mortality progress in a health district, region/province or country<sup>6</sup>: availability of emergency obstetric care (EmOC) services; geographical distribution of EmOC facilities; proportion of births in EmOC facilities; met need for EmOC; Caesarean section as a proportion of all births (Caesarean Section Rate, CSR); facility direct obstetric case fatality rate.

In Uganda, although ambulance services are free in the Public Health Sector by policy, in most cases the ambulances are not available or are inaccessible to the mothers. This study evaluated a project with improved transport for emergency obstetric care in Northern Uganda by comparing caesarean section rates and hospital-based deliveries between an intervention district and a neighbouring non-intervention district for six years, three pre-project years and three project years.

## Methods

### Study area

The study was conducted in neighbouring districts of Oyam and Apac, in Lango sub-region, Northern Uganda. The region is located approximately 350 km north of Kampala. Oyam District was carved out of Apac district in 2006. The two districts are predominantly inhabited by the Luo-speaking Langi ethnic group who are largely subsistence farmers.

The two districts are in Northern Uganda the region that was affected by the Lords' Resistance

Army (LRA) war which ended in 2005. The people who were living in Internally Displaced Persons (IDP) camps were now resettled back to their villages. This meant increased distances to the health facilities which had been constructed around the camps.

Apac district was selected for comparison because of its similarity to Oyam district in many aspects including the demographics, culture, history and economic activities.

### The intervention

In 2007, 'Collegio Universitario Aspiranti e Medici Misionari' (CUAMM), an Italian founded non-governmental organisation, started implementing a three-year programme providing free-of charge ambulance service and communication between health facilities in the post conflict Oyam district. A 4x4 wheel Landcruiser ambulance was made available 24-hours and seven days a week. Each health facility was provided with a mobile phone and airtime to communicate with the ambulance team and the referral facility in case of an obstetric emergency. The ambulance was stationed at the referral facility (Hospital) and would be called to pick mothers from the different health centres within Oyam district. The referral facility was not centrally located in the district and reported to-and-fro travel time to different peripheral facilities ranged from 30 minutes for those nearby to two to three hours for the furthest.

### Data collection

Information about the number of caesarean sections and the number of deliveries in health facilities as well as still births was collected retrospectively in October 2010 covering a period of six years (three pre-intervention and three intervention years). Secondary data from maternity registers and or theatre operating log books was used. Additional data on annual health unit deliveries were obtained from the respective district health management information systems annual reports. Registers were photographed digitally page-by-page using a Sony DSC-W220, 4x Zoom x 12.1 Megapixels. The data on hospital deliveries and caesarean sections was first entered

using EpiData version 3.1 and transferred into SPSS version 17 for analysis.

For Oyam district we were able to disaggregate the data according to whether the patient had an address in or outside the district, yielding two categories called ‘Oyam strict’ (only patients with an address inside the district) and ‘Oyam all’ (all patients included irrespective of address or missing address). For Apac District this disaggregation was not possible and only one category was created, called ‘Apac all’ including all patients. Student’s t-test was used to compare the mean caesarean section rates and deliveries at the two hospitals for the pre-intervention and intervention periods.

We further calculated the caesarean section rates using actual number of caesarean sections as numerator and as denominator we used 5% of the total population which is the number of expected annual deliveries in the district based on projections from the census 2002<sup>7,8</sup>.

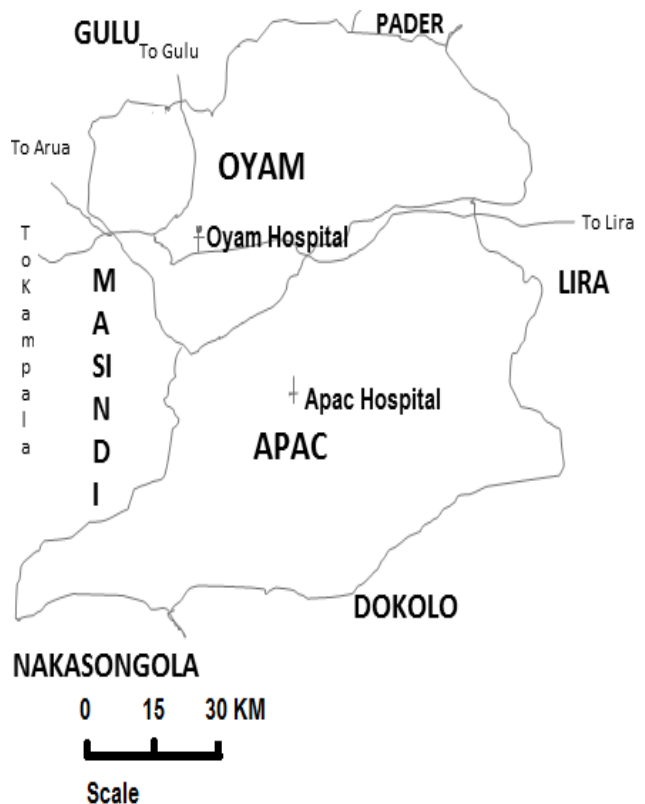
In Oyam district, hospital stillbirths were collected and disaggregated into ‘all stillbirths’ and ‘fresh stillbirths’. Student’s t-test was used to compare the mean stillbirths for the pre-intervention and intervention periods. We were able to collect stillbirth data in the neighbouring Apac district due to missing data and inconsistencies in documentation of stillbirths (It was difficult to tease out fresh stillbirths from macerated stillbirths as these were all recorded as ‘stillbirths’). Delivery data was missing at the non-intervention Apac hospital for the first two pre-intervention years (one log book missing) and counting was started one year before the intervention. In addition, data for the 6 months October 2007 to March 2008 were missing and were replaced using an average of the previous three quarters before them.

**Ethical considerations**

The permission to carry out the research was sought from the Uganda National Council of Science and Technology (Reference Number: HS 830). Further permission was sought from the Oyam district and Apac district Administrative Offices and from Doctors with Africa CUAMM – Uganda Office.

**Results**

At the time of data collection, Oyam district had one Hospital (Private not for profit) with 112 total bed capacity and was the only centre for Comprehensive EmOC (Figure 1), one Health Centre (HC) IV (the next lower level after the hospital which should provide Comprehensive EmOC, five HCIIIs (the next lower level after HCIV which should provide Basic EmOC) and 11 HCIs (lowest level HC which should provide antenatal care, outpatient and immunisation services) whereas Apac district had one Hospital (Public) with 100 total bed capacity also the only Comprehensive EmOC centre (figure 1), two HCIVs, 14 HCIIIs and 22 HCIs. In both districts, HCIVs and HCIIIs had maternity units although, Oyam district had 100% coverage of midwives in all health centres in Oyam and some level II health centres had maternity units and were able to conduct deliveries (Table 1).



**Figure 1:** Map of Oyam and Apac districts showing the location of Apac and Oyam Hospitals

**Table 1:** Demographic and health service indicators for the intervention Oyam District and the non-intervention Apac District<sup>16-19</sup>

| Item                                       | Oyam District<br>Intervention district         | Apac District<br>Neighbouring district |
|--|--|--|
| Projected population for mid-year 2010     | 354,000  | 543,000                                |
| Population growth rate                     | 3.6%   | 3.5%                                   |
| Crude birth rate per 1000 population       | 49.6%  | 49.6%                                  |
| Fertility rate (no. of children per woman) | 7.6  | 7.6                                    |
| Rural population                           | 98%  | 98%                                    |
| Female literacy rate                       | 58%  | 58%                                    |
| Male literacy rate                         | 83%  | 83%                                    |
| Number of                                  |  |  |
| Level IV health centres                    | 01   | 02                                     |
| Level III health centres                   | 05   | 14                                     |
| Level II health centres                    | 11   | 22                                     |
| Total                                      | 17   | 38                                     |
| Centres with emergency obstetric care      | 1 missionary hospital                          | 1 public hospital                      |
| Comprehensive EmOC centres and ownership   | Private not for profit (Aber Mission Hospital) | (Apac Hospital)                        |
| Hospital total bed capacity                | 112  | 100                                    |

**Table 2:** Number of Caesarean sections per 3-month periods in the intervention district Oyam and the non-intervention district Apac before and during (grey) the intervention

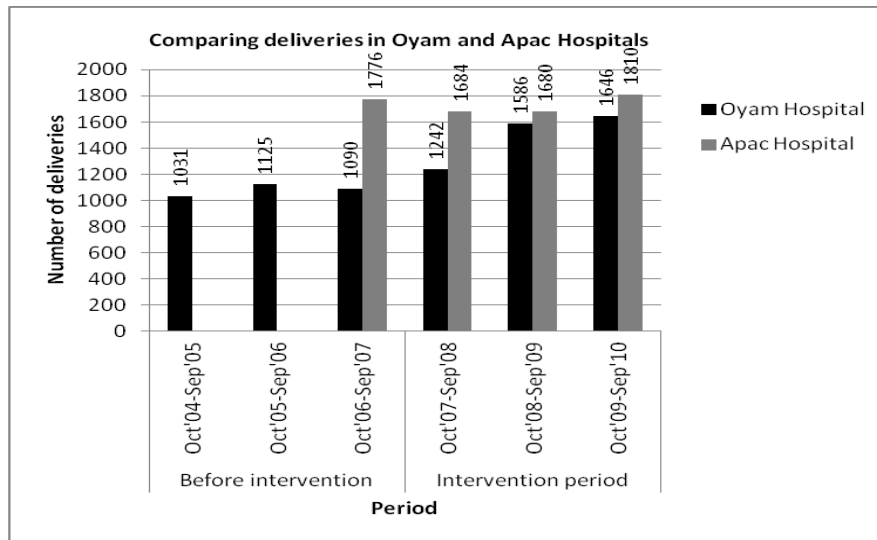
|            | Caesarean sections from within the intervention Oyam District |          |                       | All Caesarean sections in the intervention Oyam District |          |                       | All Caesarean sections in the neighbouring Apac District |          |                       |
|------------|---|----------|-----------------------|--|----------|-----------------------|--|----------|-----------------------|
|            | Quarterly   | Annually | 3-year quarterly mean | Quarterly  | Annually | 3-year quarterly mean | Quarterly  | Annually | 3-year quarterly mean |
| Oct-Dec'04 | 22  | 96       | 21                    | 34   | 154      | 32                    | 20   | 77       | 29                    |
| Jan-Mar'05 | 23  |          |                       | 33   |          |                       | 21   |          |                       |
| Apr-Jun'05 | 25  |          |                       | 47   |          |                       | 16   |          |                       |
| Jul-Sep'05 | 26  |          |                       | 40   |          |                       | 20   |          |                       |
| Oct-Dec'05 | 22  | 78       |                       | 37   | 120      |                       | 32   | 115      |                       |
| Jan-Mar'06 | 25  |          |                       | 42   |          |                       | 22   |          |                       |
| Apr-Jun'06 | 20  |          |                       | 25   |          |                       | 27   |          |                       |
| Jul-Sep'06 | 11  |          |                       | 16   |          |                       | 34   |          |                       |
| Oct-Dec'06 | 22  | 73       |                       | 43   | 113      |                       | 45   | 148      |                       |
| Jan-Mar'07 | 22  |          |                       | 32   |          |                       | 35   |          |                       |
| Apr-Jun'07 | 17  |          |                       | 22   |          |                       | 35   |          |                       |
| Jul-Sep'07 | 12  |          |                       | 16   |          |                       | 33   |          |                       |
| Oct-Dec'07 | 42  | 156      | 50                    | 66   | 221      | 70                    | 39   | 140      | 35                    |
| Jan-Mar'08 | 46  |          |                       | 56   |          |                       | 32   |          |                       |
| Apr-Jun'08 | 36  |          |                       | 53   |          |                       | 40   |          |                       |
| Jul-Sep'08 | 44  |          |                       | 61   |          |                       | 29   |          |                       |
| Oct-Dec'08 | 51  | 190      |                       | 69   | 257      |                       | 32   | 144      |                       |
| Jan-Mar'09 | 34  |          |                       | 49   |          |                       | 38   |          |                       |
| Apr-Jun'09 | 44  |          |                       | 59   |          |                       | 27   |          |                       |
| Jul-Sep'09 | 61  |          |                       | 80   |          |                       | 47   |          |                       |
| Oct-Dec'09 | 63  | 236      |                       | 86   | 347      |                       | 45   | 142      |                       |
| Jan-Mar'10 | 54  |          |                       | 77   |          |                       | 30   |          |                       |
| Apr-Jun'10 | 61  |          |                       | 93   |          |                       | 30   |          |                       |
| Jul-Sep'10 | 58  |          |                       | 91   |          |                       | 37   |          |                       |

The monthly costs for running this 24-hour free ambulance services was USD 1,875 including

paying the drivers and airtime for mobile telephone communication. The absolute numbers

of caesarean sections in the intervention district increased from 113 per year before the intervention to 347 per year at the end of the intervention, while there was no clear increase in the neighbouring district, Table 2. For hospital births, there was a similar increase in absolute numbers from just over 1000 per year to over 1500 at the end of the intervention while the numbers in

the neighbouring district remained stable, Figure 2. Both the ‘Oyam strict’ and ‘Oyam all’ had a more than a twofold increase from a mean per quarter of 20.5 to 49.5 ( $p < 0.001$ ) and 32.1 to 70.0 ( $p < 0.001$ ) for ‘Oyam strict’ and ‘Oyam all’, respectively; while there was only a slight change for the neighbouring ‘Apac all’ from 29.1 to 35.5 ( $p = 0.06$ ), Table 2.



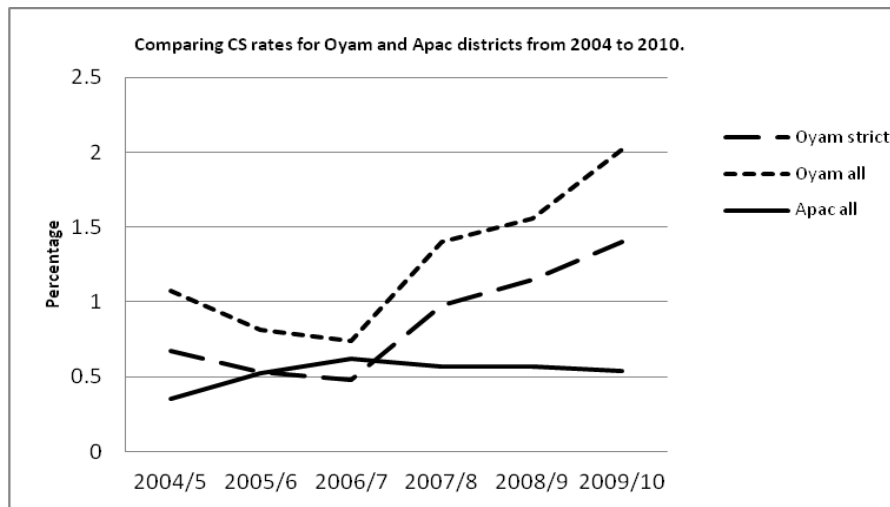
**Figure 2:** Comparing annual deliveries from the Hospital in Oyam and Apac districts

Similarly, the mean annual CSR calculated with the expected number of births as denominator increased from 0.56% to 1.18% ( $p = 0.022$ ) for ‘Oyam strict’ and 0.87% to 1.66% ( $p = 0.034$ ) for

‘Oyam all’ for the pre-intervention and intervention periods, respectively; while CSR for ‘Apac all’ only increased from 0.50% to 0.56% ( $p = 0.512$ ), Table 3 and Figure 3.

**Table 3:** Expected number of deliveries, actual number of deliveries within health facilities, Caesarean section rates in Oyam District and the neighbouring Apac District over a 6-year period

|  |               | 2004/5  | 2005/6  | 2006/7  | 2007/8  | 2008/9  | 2009/10 |
|--|---------------|---------|---------|---------|---------|---------|---------|
| Total population                                     | Oyam          | 287,690 | 295,420 | 307,590 | 318,280 | 329,580 | 343,520 |
|  | Apac          | 444,620 | 459,170 | 474,300 | 490,360 | 507,240 | 528,130 |
| Expected deliveries                                  | Oyam          | 14,385  | 14,771  | 15,380  | 15,914  | 16,479  | 17,176  |
|  | Apac          | 22,231  | 22,959  | 23,715  | 24,518  | 25,362  | 26,407  |
| Deliveries in all health facilities (actual numbers) | Oyam          | No data | No data | 1,658   | 3,225   | 4,189   | 5,455   |
|  | Apac          | No data | No data | 5,987   | 3,918   | 6,684   | 6,926   |
| Deliveries in health unit (%)                        | Oyam          | No data | No data | 11.1%   | 20.9%   | 26.2%   | 32.7%   |
|  | Apac          | No data | No data | 26.0%   | 16.5%   | 27.2%   | 27.0%   |
| Caesarean sections (actual numbers)                  | ‘Oyam strict’ | 96      | 78      | 73      | 156     | 190     | 236     |
|  | ‘Oyam all’    | 154     | 120     | 113     | 221     | 257     | 347     |
|  | ‘Apac all’    | 77      | 115     | 148     | 140     | 144     | 142     |
| Caesarean section rates (% of expected deliveries)   | ‘Oyam strict’ | 0.67%   | 0.53%   | 0.48%   | 0.98%   | 1.15%   | 1.40%   |
|  | ‘Oyam all’    | 1.07%   | 0.81%   | 0.74%   | 1.40%   | 1.56%   | 2.02%   |
|  | ‘Apac all’    | 0.35%   | 0.52%   | 0.62%   | 0.57%   | 0.57%   | 0.54%   |



**Figure 3:** Caesarean section rates in ‘Oyam strict’, ‘Oyam all’ and ‘Apac all’ from 2004/05 to 2009/10 in relation to expected number of deliveries based on population data

In Oyam district, the mean hospital stillbirths per 1000 births disaggregated ‘all stillbirths’ and ‘fresh stillbirths’ decreased from 46.6 to 37.5,  $p=0.253$ ) and 27.8 to 24.0,  $p=0.412$ ) for pre-intervention and intervention periods respectively.

## Discussion

The free ambulance services and the communication system between health facilities in Oyam district increased accessibility to emergency obstetric care as shown by a doubling of the CSR and motivated more mothers to deliver in health facilities as shown by an increase in hospital-based deliveries in Oyam. Our interpretation is that this has saved lives of both mothers and babies, even if the numbers could not be easily quantified.

A similar intervention in Mali showed that reducing transport time and elimination of financial barriers doubled utilisation of major obstetric interventions mainly caesarean sections and was also correlated to increased utilisation of health centres for deliveries<sup>9</sup>.

The intervention had not targeted quality improvement in the management of deliveries at Oyam hospital (the ‘third delay’) but availability of transport per se led to a slight decrease in the proportion of stillbirths per 1000 births in Oyam hospital. This shows that availing transport could probably have been more significant if improved access to means of transport was coupled other

interventions that enhance access like quality improvement initiatives.

It should be noted that free ambulance services is not a magic bullet and indeed it needs to be delivered in a supportive environment that enhances accessibility to and quality of emergency obstetric care. The presence of mobile telephone network, the road network, equipped health facilities and health workers as well as political support must have contributed to this achievement in Oyam district for instance there is 100% coverage of midwives in all health centres in Oyam. Recent studies including a study in western Uganda established that the distance and availability of quality transport were more important factors in the choice of place of delivery compared to cost and quality of health services in the health facility<sup>10,11</sup>. Additionally, one of the limitations of this vehicle ambulance was the inability to pick mothers from their homes. This probably can be improved by using it in combination with motorcycle ambulances such as one described in Malawi<sup>12</sup>. The motorcycle ambulance can be stationed in the community or nearby health facility so that they can pick mothers from their homes where the vehicle may not reach to nearby health centres.

In Uganda, many district hospitals have ambulances. However, it is not routine for ambulances to pick patients from the lower level units, in most cases probably due to fear of costs.

Our study results and the cost-effectiveness study by Somigliana and colleagues have illustrated that a free ambulance service is an effective intervention with reasonable and affordable costs<sup>13</sup>. Therefore, efforts should be harnessed to improve funding and management of referral for emergency obstetric care so that ambulances stationed at higher level health facilities are able to pick mothers from the poorly equipped lower level health facilities for life saving interventions like caesarean sections and blood transfusion.

Although one ambulance may not have been adequate for a district with a population of 353,000 people, especially taking into account that the referral facility was not located centrally in the district with a response time ranging from half an hour to three hours, far longer than the recommended time for emergency teams' response in medical related emergencies of four to six minutes and an emergency team for every 50,000 people<sup>14</sup>. However, the optimal number of ambulances required by a given population in low-income countries will depend on the local context.

Although user fees were abolished in Uganda in order to remove financial barriers for maternal health and other healthcare services, costs of transport were not considered as well as costs of delivery services in private non-for-profit hospitals. Mothers may therefore still incur high costs in addition to non-official payments in public hospitals. The exponential increase in utilization of preventive services like immunization and curative services like out-patient attendance for infectious diseases has therefore not been paralleled by a corresponding increase in maternity services<sup>15</sup>.

### ***Methodological issues***

Although there may be concerns about the power of this study when comparing only one district with a neighbouring district, there are not so many alternative strategies given the size of the intervention. Of course, it would have been preferable to have a large intervention with say 20 intervention districts and another 20 comparative districts. But for ethical and political reasons it would be difficult to have a control group in such an intervention. The only defensible strategy would be a step-wise introduction of the intervention in all the study districts and then

compare the intervention time to the non-intervention time.

Taking the design constraints into account, comparing retrospectively available secondary data from registers for the pre-intervention and intervention periods was useful. A larger number of comparative districts without the intervention around Oyam would have been preferable to better factor in any secular changes in Caesarean section rate. The quality of the data would have been improved if the data had been collected prospectively during the project implementation; recording ambulance travel distances, cases brought to hospital and their outcomes. Assessing hospital deliveries in the two districts corroborated our findings since the two parameters behaved in a similar way in the respective districts. In addition, there was a slight reduction in hospital stillbirths per 1000 births in Oyam district although the overall picture for the entire district for this outcome could not be established since this data was only collected for one hospital.

The selection of the neighbouring Apac district for comparison could also be discussed but as earlier alluded to, alternative strategies were not available. Although structural, administrative, political and economic differences may exist between Oyam and Apac, comparing data for the 3-year pre-intervention and 3-year intervention periods minimized the chances that the changes in caesarean section rates could have been greatly influenced by other factors other than the intervention unless the factors followed similar trends as the intervention. However, we agree that in the intervention district, the caesarean section rates could have been influenced by other program elements like advocacy for the utilization of maternity services, training of health workers as well as adequate medical supplies from the project, although we feel these would not have caused a significant increase without the free ambulance service and mobile phone communication between facilities.

### **Conclusion**

Providing reliable communication and 24-hour transport services for picking mothers with complications during pregnancy, delivery and/or post-partum from primary health care facilities to

the hospital increased access to and utilization of emergency obstetric care services and improved the process indicator CSR towards reducing maternal mortality in Uganda. There is need for more studies designed to assess the effect of improved communication and transport services of stillbirths at population level. In addition, there is need for more investment geared towards improving documentation and record keeping for improved maternal and neonatal health outcomes.

### Competing interests

None

### Acknowledgments

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### Authors' contributions

SM and TT participated in the conception and data analysis. SM, PL and TT participated in design and implementation. SM drafted the manuscript. HW, PL and TT reviewed the manuscript. All the authors approved the final manuscript.

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### Transportation for Emergency Obstetric Care

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