Linking Rural Communities with Health Services:
Assessing the Effectiveness of the Ambulance Services in Meeting the Needs of Rural Communities in West Africa

Final Report

Prepared for the Africa Community Access Programme (AFCAP)

By Transaid

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This project was funded by the Africa Community Access Programme (AFCAP) which promotes safe and sustainable access to markets, healthcare, education, employment and social and political networks for rural communities in Africa.

Launched in June 2008 and managed by Crown Agents, the five year-long, UK government (DFID) funded project, supports research and knowledge sharing between participating countries to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources.

The programme is currently active in Ethiopia, Kenya, Ghana, Malawi, Mozambique, Tanzania, Zambia, South Africa, Democratic Republic of Congo and South Sudan and is developing relationships with a number of other countries and regional organisations across Africa.

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Abstract:

It is increasingly accepted in our understanding of maternal healthcare in Africa that poor physical access is reducing the effectiveness of measures to reduce maternal mortality. This project developed an evaluation framework that combined transport measures with health condition assessment methods of the Vital Signs approach and the Glasgow Coma Score to assess differences in patient condition when being referred from local health centres to higher-level referral facilities. Surveys were undertaken of 704 women from 40 communities across Katsina State, Northern Nigeria. It was found that whilst the majority took 1-2 hours between being referred and arriving at the referral facility many took up to 7 hours. Whilst using the Glasgow Coma Score, the study found no statistical relationship between health condition and how a patient arrived at the referral facility or how long it took to arrive. However, using the Vital Signs approach, statistical associations were found between a number of vital signs and how women arrived at the referral facility and how long it took to be referred. As a result, improvements to how women travel to a referral facility and the time referral takes can have positive impacts on the severity of patients managed by referral facilities. Efforts by a range of countries across West Africa to establish widespread ambulance provision may be effective in contributing to reducing maternal mortality. This study shows they may have a positive impact on the skills, resources and equipment emergency obstetric care facilities needed to reduce maternal mortality.

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Executive Summary

It is clear from the limited, but growing, amount of academic literature that poor physical access is acknowledged as a significant factor in the limited number of women giving birth in health facilities in sub-Saharan Africa and in the significant number of rural women who die when giving birth through medical complications. In June 2011, the Africa Community Access Programme commissioned Transaid and its partners to undertake a study into the impact on maternal health of poor community access in West Africa. The study was commissioned to develop an evaluation framework to understand better the interaction between physical access and health outcomes. It was also designed to explore solutions that can be implemented to address physical access to maternal healthcare around National Ambulance Services and to develop knowledge tools to promote the sustainable management and scale-up of such solutions.

The study developed an evaluation framework that looked at the time taken in being referred from local health centres to higher level facilities and how women travelled when accessing the different levels of health care. It also looked at the health condition of women being referred along this 'chain' at the local health centre upon referral and at the referral facility upon arrival. It utilised two methods to assess patient condition, the Vital Signs approach and the Glasgow Coma Score. It also gathered information on the socio-economic background of the women surveyed and the previous medical and gynaecological experience.

The study undertook fieldwork in Katsina State in Northern Nigeria. Women from 10 rural communities in each of the 4 Local Government Areas who were referred with medical complications in childbirth were surveyed between February and March 2013. In total 704 women were surveyed.

The study found that amongst the women surveyed for this study, there was an average 1-2 hour gap between being referred by a health worker and reaching the appropriate referral facility. However, a significant number of women took between 4 and 7 hours to reach appropriate care. The majority of women reached their referral facility by motor vehicle or motorbike. Ambulance and the Emergency Transport Scheme contributed just over 10 per cent of referrals transferred. Travel on foot was a significant proportion of access to local health facilities but in accessing higher-level referral facilities it made up a small but, none the less, worrying level.

The health condition of the women surveyed depended largely on how they were assessed. If the assessment used the Glasgow Coma Score, the women surveyed in this study largely arrived at referral facilities in good condition regardless of how they travelled or how long it took to be referred. However, using another valid medical assessment method, Vital Signs approach, over 43 per cent were assessed not to have normal vital signs or vital signs that are associated with being in a medically weak condition. The lack of an association of the experience of being referred with the Glasgow Coma Score might be because the Glasgow Coma Score is an aggregate score and not the direct health measurements as seen by practitioners, more readily represented by the Vital Signs approach.

However, there was a significant relationship found between how long women took to arrive at the referral facility and their respiration, blood pressure and urine vital signs. There was also a significant relationship between the means of transport to the referral facility and their vital signs for respiration, neurological state, pulse, urine and temperature. Finally, there was a significant relationship between the means of transport to the initial health centre and their vital signs for neurological condition, blood pressure, pulse, urine and temperature.

The project has shown that improving the means of access to referral facilities may have a positive impact on the health condition of women in childbirth. The project draws upon the increasing experience being gathered across Africa in developing and managing national systems of Ambulance provision. To promote this transport solutions and its sustainable management, the project has developed a good-practice guide for the sustainable management of National Ambulance Services. The project has also set in place dissemination practices in order to translate this best–practice knowledge into use within professionals across West Africa and the region.

The project has shown that poor physical access does contribute towards the poor health condition of women when they arrive at the appropriate level of care to be treated in case of a maternal medical emergency. This worsened condition will require greater skill, more equipment and drugs and increased capability of the health system than would otherwise be the case when access is good. How women get to referral facilities does make a difference and so investment in ambulance provision, communications systems and community-based emergency response will make a difference to health outcomes for women giving birth and their new-born and the health systems that seek to deliver that outcome.

1. Introduction

1.1. Problem description

Meeting the Millennium Development Goal of reducing maternal mortality by 2015 is a significant challenge in Africa. The headline level of maternal mortality is significantly worse in Africa than elsewhere in the world and the indicator is getting worse not better. Inadequate transport services and infrastructure in rural areas currently represent a major contributor to maternal mortality. It is estimated that 35% of all maternal mortality can be directly attributed to lack of transport (Gil-González et al, 2006) and that in 75% of maternal mortality cases transport is an influential factor (Babinard and Roberts,2006). Timely access to health facilities is a key element in maternal and newborn health and the lack of adequate and appropriate transport services has a complex impact on the ability of a country's health care providers to provide adequate maternal and neonatal care to those in need. However, there is very limited evidence-based guidance for practitioners and policy-makers in either the health or transport sectors on how best to reduce the negative impact that transport has on the substantial efforts being made to reduce Africa's maternal mortality burden.

Work already undertaken by AFCAP in its review of the interaction between transport and maternal health (Lema, 2010) found that travelling and transport services contribute to health outcomes in pregnancy and childbirth in the following ways:

- Poor access, particularly in rural areas of Africa, plays a key role in the death of women and new-borns in child birth.
- Poor rural access delays decisions in seeking healthcare due to considerations of extra cost and time it places on households seeking healthcare.
- Poor rural access delays women in getting to healthcare in emergency situations.
- Poor access and ineffective transport management capacity delays women and new-borns in being referred from health facility to appropriate healthcare professionals when medical complications arise.
- Poor access and lack of transport management capacity reduces the ability of community health workers to undertake outreach activities to enhance maternal health access, particularly in pregnancy and post-natal care.
- Poor access of rural communities reduces the morale of health workers and limits the ability to retain skilled health workers.
- Poor access and low logistics capacity restricts the ability to deliver medical supplies and drugs in a timely manner for effective maternal healthcare and facility management.
- Poor access impacts on health seeking behaviour in the antenatal period and management of other diseases in pregnancy such as HIV/AIDS and malaria.
- Poor access impacts on households' survival if mothers and new-borns require post natal care.
- Poor access impacts on the capacity of mothers or households to attend postnatal care for newborns.
- Poor access contributes to the delay in seeking medical attention in the case of sick newborns.

Different sectors need to develop pro-active responses to the worsening of the maternal and neonatal health MDGs. Integrated interventions across the transport and health sectors require robust investigation and evaluation to assess their impact as they address both socio-economic and medical factors contributing to mortality during childbirth. A number of innovative strategies to surmount cost, distance, and time barriers to accessing care have been previously implemented at the community level and many appear to offer solutions. However, few studies have either reported or evaluated the possible health impact of the wide-scale implementation of these strategies nor offered a route to their scaling up.

AFCAP had already supported the development of a scoping study on maternal health and emergency transport. The study clearly highlighted the need for robust independent evaluation of a variety of community based emergency transport solutions for poor rural communities in Africa. As a result, the main focus of this study will be to develop robust evidence of the health impacts of poor physical access to health services due to inappropriate transport services in rural Africa; to explore the health impact of transport solutions, such as ambulance services, which have scope for scaling-up and to develop guidance for practitioners on the sustainable operation of this possible solution to health access in rural Africa.

1.2. Study Background

AFCAP commissioned Transaid and its partners, in June 2011, to undertake an 18-month research project in a West African setting where investments had been made in ambulance provision. The project was supported with a view to establishing an evidence base to understand the contribution that transport measures such as ambulances could make in addressing the MDG related to maternal mortality. The project was also commissioned to develop the knowledge and capacity across the region in the sustainable management of ambulance provision and develop appropriate guidelines to support that.

1.3. Objectives

The objectives of this project were to:

- develop a robust evaluation framework to understand the interaction between physical access and maternal mortality
- understand the impact that a well-managed nationally available ambulance service can have on the level of maternal mortality in rural Africa caused by poor physical access
- inform the management and development of national ambulance services in Africa

1.4. Differences from initial proposal

The project has undergone significant changes since first conceived. It was initially developed as a partnership with Ghanaian government and academic stakeholders. However, changes in the approach of our partners in Ghana meant that several changes had to be made to the project. As a result, it was not possible to provide an in-depth evaluation of the operation of a National

Ambulance Service. It also became clear that it was not going to be possible to successfully deliver the fieldwork in our chosen case study areas of Ghana. It was therefore decided to seek a different case study area that would still be able to provide some representative understanding of the role of poor physical access on maternal health outcomes in a resource-poor remote rural environment in West Africa. The state of Katsina in Northern Nigeria provided a suitable alternative as it was resource-poor with issues of poor access for rural communities. It also presented an environment where initiatives were being put in place by the State Government and donors around investment in ambulances and support of community initiatives on Emergency Transport. Links and interactions with our Ghanaian academic and practitioner partners have been maintained. As a result one of the dissemination activities for the project was an international workshop in Accra, Ghana, that allowed the findings of this study to be shared with the Ghanaian policy environment.

The timeline for changes in the project has been as follows:

June 2011	AFCAP Project approved
July 2012	Partnership agreement reached with Ghana partners
January 2012	1st Survey design workshop in Ghana
September 2012	Decision reached to transfer field work to Katsina, Nigeria
October 2012	Scoping mission undertaken to develop partnership with Katsina Ministry of Health, Nigeria.
January 2013	Ethical clearance received from Katsina Ministry of Health
February-March 2013	Fieldwork in Katsina, Nigeria, undertaken.
April 2013	Analysis undertaken and final report submitted.

2. Literature Review

The project was initially informed by the undertaking of a systematic literature review. The literature search was undertaken using a number of electronic library resources and databases. A search was undertaken of MEDLINE, Maternity and Nursing Care, HMIC, EMBASE academic databases for English language articles over the last 10 years to 2011 with the following search terms:

- access
- distance
- transport
- travel time
- ambulance
- road
- emergency referral

Always in combination with at least one of the following search terms:

- maternal health
- maternal mortality
- neonatal mortality

Additional references were also identified from citations in articles retrieved in the initial and second round of searching. The articles retrieved were then selected for their relevance to the understanding of access and the impact of access on maternal and neonatal health in SSA countries as well as their contribution to the understanding of the access solutions that could be implemented and their evaluation. A total of 37 articles were reviewed.

This literature review found that there has been a developing literature on the framework for understanding maternal mortality. This work has included the constraints of physical access to varying degrees. The development of the 'Three delays' model offers one of the clearest frameworks for understanding the interaction between gender, mobility and health (Thaddeus and Maine, 1994). The 'three delays' model sets out that maternal mortality occurs because of delay in action in 3 areas; decision to seek care, getting to care and receiving the appropriate care.

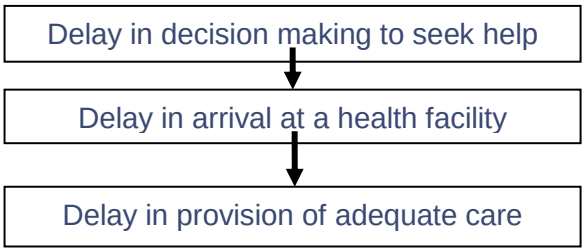


Figure 1 The Three Delays Model (Source: Thaddeus and Maine, 1994)

2.1. Causes of maternal mortality

From a review of literature focusing on understanding the causes of maternal mortality, it was found that inadequate transport services and infrastructure currently represents a major contributor to maternal mortality in sub-Saharan Africa. In a developing context, it is estimated that 35% of all maternal mortality can be directly attributed to lack of transport (Gil-González et al 2006) and that in 75% of maternal mortality cases transport is an influential factor (Babinard and Roberts, 2006). However, the amount of research is still very limited in this area. Of 2225 papers on maternal mortality reviewed by Gil-Gonzalez et al (2006), distance and transport constraints were analysed in only 11.

Other research was found to highlight different aspects of the interaction between physical access and maternal mortality. Work by Baiden et al (2006), highlighted that 71% of maternal deaths in a Ghanaian hospital occurred in women who lived within 15km of the hospital. The authors reported that, either women who live further from the hospital are purposefully not using the emergency services of the hospital, or were dying before even reached the hospital. Van den Broek et al (2003) reported that average distance to a health centre for the households surveyed in their study in Malawi was 4.85km. The distance of a household from a health centre was found to be important by the authors for health outcomes. They found that for households situated within 1km of the health centre, 79.1% of pregnancies resulted in a currently living child, whereas they found that, for households living 7km or more away, this had reduced to 73.3% ($p<0.0001$). A Nigerian study found that 72.9% of deaths occurred in women who had been in labour at home without attendance of a skilled health worker. Almost half of the maternal deaths occurred in women who lived more than 10km away from the hospital. (Okonta et al.,2002). A Gambian study found that transport played a part in between 5.6-16.7 per cent of mortality cases (Walraven et al., 2000).

A study in Senegal found that women who were referred late, often as a result of delays in seeking care or delays in travelling to hospital, had an increased risk of mortality. The study also found that women referred from further away were more likely to have severe complications on arrival and to arrive late in the medical episode (Garenne et al., 1997). Furthermore, 83% of the near-miss cases in a Cote d'Ivoire referral hospital were said to be in a critical condition on arrival at the hospital and 69% of them had been referred from another health facility. Those referred were statistically more likely to be a near miss case on arrival (Filipi et al., 2005).

Several studies from Southern Africa also point to significant impacts of poor access on maternal mortality. The lack of transportation in delaying or preventing access to health facilities in the rural area of Zimbabwe, was found to be a major problem in 28 percent of the maternal mortality cases studied. (Fawcus et al., 1996) and 5.8% of all cases reviewed in South Africa (Mhlanga et al., 2000). In a Ugandan study (Okong, 2006) 22 or 53% of cases reported, in an Ugandan audit of 'near misses', had had delays in accessing health care due to lack of transport, long distances or inappropriate means of travel. 34% also reported a lack of blood or lack of transport to the blood bank. Kadowa (2010) also found that, in Uganda, 64.4% of the women admitted witha ruptured uterus lived over 10km from the hospital. However, the picture from this limited range of work is not always clear as, by contrast, work on fistula in Ethiopia (Muleta et al., 2010) found that walking distance to the

nearest health facility did not appear to influence longer duration of labour, stillbirth, urethral damage and vaginal scarring.

2.2. Causes of neonatal mortality

The literature review found that there was even less research with respect to the interaction between neo-natal and child mortality and poor rural physical access. Work by Anyamele (2009) highlights that in many countries the level of access afforded by urban living reduces the likelihood of mortality for children. In Benin, it falls by 11.61%, Cameroon, 15.45%, Ethiopia, 25.42%, Niger, 39.16%, Nigeria, 16.89%. Research done in Burkina Faso found that being born in the rainy season was associated with significantly higher risk of mortality during the 1st year of life compared with being born in the dry season. Furthermore, it found that there was a 33% greater chance of mortality for those infants living more than 10km from their nearest health centre (Becher et al 2004). A Ghanaian study (Enweronu-Laryea et al., 2008) reported a high rate of mortality of new born babies from asphyxiation. It suggested that this may have been due to the mode of transportation (usually transported by a taxi organised and accompanied by their relatives) to the referral hospital. Wort et al., (2008) found that, in Tanzania, the prevalence of low birth weight in *primigravidae* (i.e. first born babies) increased with distance of the dispensary from the district hospital.

2.3. Causes of maternal morbidity, especially fistula

The literature review also explored whether a focus on morbidity would be more useful in the understanding of the role of transport, as morbidity is more frequent an outcome than mortality in the case of maternal complications. The significance of the role of transport may particularly be the case in more extreme morbidity and disability outcomes, such as in the condition called fistula. However, a limited amount of previous research may hinder progress. The work of Kadowa (2010) in Uganda found that 64.4% of the women admitted with ruptured uterus lived over 10km from the hospital. It found that women who lived over 10km from the hospital had an odds ratio (OR) of 3.62 of attending with a ruptured uterus. Ramphal, Kalane, Fourie & Moodley (2008) found that 40 of the 41 women with obstetric fistula in South Africa sampled had cited lack of transport as a major factor of delay in seeking emergency medical care. Muleta, Rasmussen and Kiserud (2010) found, in a study in Ethiopia, that primiparity (i.e. a woman's first pregnancy) had the strongest and most consistent association with longer duration of labour, stillbirth, urethral damage and vaginal scarring. Height of <145cm and walking distance to the nearest health facility, it was found, did not statically influence the likelihood of longer duration of labour, stillbirth, urethral damage and vaginal scarring.

2.4. Effectiveness of referral interventions

The literature review also looked at academic articles focusing on assessments of interventions to improve emergency referral and poor physical access. As Gill-Gonzalez (2006) identifies, there have been few studies that have deliberately set out to measure and influence through targeted interventions the socio-economic and spatial factors around maternal health outcomes. The review,

however, found a certain amount of work on trying to improve take-up and process of emergency referral. This consisted both of understanding the impact of being physically nearer service delivery as well improving the referral process. Hounton et al., (2008) found that in Burkina Faso, distance to health centre was a major determinant of institutional delivery – ¾ of births within 1km of a health centre took place in a facility. By contrast, less than $^{1}/_{5}$ of deliveries took place in a facility if the women lived more than 10km away. The distance to health centre and socio-economic characteristics of the mother were found to be important determinants of institutional birth up to 7km away (with OR 0.77/km), levelling off beyond that (OR 0.97/km). The work by Meda et al., (2008), again in Burkina Faso, recommended that from a number of rural Burkina Faso studies, utilisation of maternal health services fell off sharply with distance from health facility. It claims that outreach services are, at best, only an interim solution to this problem; countries need to embark on policies leading to 24-hr universal coverage of basic emergency obstetric care to which women need to travel no more than 5km to reach and that these facilities must have adequate logistics for upward referral. In a study in Mali, Fournier et al., (2008) found, 2 years after the implementation of a maternity referral system in selected rural districts that included basic and comprehensive emergency obstetric care, transportation to obstetric health services and community cost-sharing schemes had started, the risk of death was half the risk recorded before the intervention (OR 0.48 95% CI 0.30-0.76). Nearly half (47.5%) of the reduction was attributable to fewer deaths from haemorrhage.

2.5. Effectiveness of transport solutions

The literature review also explored the few studies that had explicitly evaluated transport interventions. A study by Hofman et al., (2008) in Malawi found that, on average, 16 patients per month were referred by motorcycle ambulance, of which 5.7 per month were obstetric complications. The study found that because of their better off-road access and reliability, the motorbike ambulance reduced delay in accessing healthcare vis-a-vis the 4-wheel ambulance by between 2-4.5 hours or 35-76 per cent.

A study by Samai and Sengeh (1997) in Nigeria deliberately focused on measuring transport interventions in health terms, with a focus on a patient's condition on arrival at the referral facility and on the case fatality rate. In a 16 month period 31 calls for the referral vehicle were made. Of the 21 women who were carried, 38% were assessed as arriving in *good* condition compared with only 30% for women not arriving by project vehicle and 38% of women arriving by project vehicle were assessed as in *fair* condition compared to 45% for those not arriving by project vehicle. The case fatality rate for women in the project area decreased from 20% to 10%, though no statistical differences were discovered between those accessing by project vehicle and those accessing referral health services by other means.

2.6. Conclusions

The review of literature found that there was a very limited body of literature that looked at the structural or socio-economic environment and factors associated with maternal mortality and even less so with neo-natal mortality and maternal morbidity. Within this, by default, it was clear that

there has been very little that has looked directly the role of poor physical access, especially within the context of rural sub-Saharan Africa where the issue of maternal mortality is a key policy discussion and where distance to services and poor physical access are such a feature of rural livelihoods.

The review highlighted that within this very limited literature there is clear evidence that poor physical access plays a significant role in contributing to mortality and morbidity, not only of women but also of the new-born. The review does not provide conclusive estimates but literature highlights that poor access was a major contributory factor in at least 11-28 per cent of maternal mortality cases. The review also highlighted the role that the poor condition of women arriving at referral facilities played in eventual health outcomes.

The review also highlighted the limited literature that has assessed solutions to overcoming the negative role of poor physical access. The majority of studies focused on distance as a simple variable in the analysis and even these highlighted that the nearer services were to women giving birth and the easier therefore it was for them to access them, the more they were used and the more effective were the health outcomes. It was thus clear that there was scope in this study to look in more detail on the role that transport played in maternal mortality and to focus on the level of patient condition at arrival at referral facilities and how this changed with varying access.

3. Methodology

Following on from this literature review it was clear that few, if any, of the research studies reported in the literature have had differences in access and transportation as a key design element of their work. Many simply used distance as a proxy for the complex access constraints faced by rural communities.

This gap in evidence provided an opportunity for this study to establish a robust evaluation framework, where distance and other related factors are designed in, to understand better the interaction between physical access and maternal health. The methodology that has been developed explores the impact that poor physical access is having on maternal health, particularly in rural areas of West Africa. The work develops a better understanding of the severity of patients' conditions, at the point of admission to Emergency Obstetric Care facilities, having arrived by a range of transport means. It explores to what extent timely arrival (as, for example, that provided by a dedicated ambulance service) has on health outcomes and explores how effective a policy measure such as a national ambulance service may be in delivering improved maternal health for West Africa.

The methodology used focused not only on the Emergency Obstetric Care level facilities, but also on health provision amongst rural communities across the chosen region. This focuses on understanding communities' still very real challenges to accessing maternal health care in medical emergencies.

3.1. Study Area Description and Communities located in Nigeria

As already mentioned in section 1.4, the original idea was to undertake the fieldwork for this study in central Ghana. However, when it became clear that this was not going to be possible because of changes in the approach of our partners in Ghana, it was decided that a new fieldwork site in West Africa should be selected.

As a result of this repositioning of the study, the North Nigerian state of Katsina was selected for the fieldwork. Katsina has an estimated population of over 6 million people and is in the North West of the country, bordering with Niger to the North.

Katsina was selected on the basis of the significant investment that has been made by the State Government in ambulance provision. Each Local Government Area (LGA) across the state has been provided with ambulances. The state has also been an active area for community-led initiatives to improve physical access to healthcare. This has been led by the Emergency Transport Scheme (ETS) programme under the DFID-funded PRINN-MNCH (Programme for Reintroduction of Routine Immunisation-Maternal, Neonatal and Child Health). The ETS is an initiative, now being undertaken across a number of states in Northern Nigeria, initially supported by Transaid, which is carried out by the National Transport Operators Union, the Nigerian Union of Road Transport Workers (NURTW), and involves local driver members of the union volunteering to use their vehicles to carry women in medical emergencies to the nearest health facility in exchange for the fuel cost, a priority place loading at the local motor park and the status of helping the local community in times of emergency.

4 Local Government Areas were selected from the 34 LGAs in the state, by the Katsina State Ministry of Health, based on the following criteria:

- Rural LGAs with an LGA health facility with basic Emergency Obstetric Care provision
- All LGAs have Mobile Ambulance Service provision,
- Two LGAs have a comprehensive Emergency Obstetric Care provision within the LGA and the other LGAs do not.
- Furthermore, two LGAs have Emergency Transport Scheme provision provided by the NURTW within the PRINN-MNCH programme
- Overall degree of accessibility or remoteness of the LGA varies, with two LGA being accessible and the other 2 not.

The 4 Local Government Areas within Katsina that were selected and where surveys were undertaken were:

- Charanchi
- Maidua
- Funtua and
- Zango

3.2. Survey Instrument design process

The vast majority of the development work for the survey instrument process was actually undertaken in collaboration with Ghanaian partners ahead of the decision to move the fieldwork from Ghana to Nigeria. The Survey Instrument was developed through a collaborative workshop in Accra in early 2012. It was decided that much of this work could be adapted to a different West African context with some adjustment.

A survey instrument design workshop was held at the Erata Hotel, Accra, Ghana on the 24th January, 2012 for the evaluation of impact on emergency healthcare in rural areas. This workshop was attended by 16 people and brought together a wide range of stakeholders in maternal and neo-natal health in Ghana. Ministries, National Ambulance Service, health sector NGOs, medical academics, international development partners and health practitioners were all represented. It built upon the contacts established in the initial visit described in the inception report. The workshop featured an introduction to the project and the objectives of the day were explained. The findings of a significant review of health literature on the evaluation of the impact of access on maternal healthcare in sub-Saharan Africa were presented. This was followed by space for other stakeholders to present on related work they are undertaking in this area. The rest of the day was taken up by group discussion on how the evaluation should be designed in a Ghanaian context.

The discussion within the workshop agreed the following issues:

- That two districts for case studies should be chosen; one with and one without good Ambulance coverage

- The data should be collected at the pre-hospital referral stage and at the referral hospital
- There should be an ability to collect data from 3 routes for referral a) from health centre to referral hospital by ambulance b) from health centre to referral hospital by other means of transport including voluntary actions of the passenger transport operators unions and c) self-referral to referral hospital
- Vital signs, Glasgow coma scores, referral times, care in transit if appropriate should be collected on modified referral forms
- Other socio-demographic data should also be collected including transport costs, living arrangements, parity, obstetric history, perceptions and emergency decision-making etc.
- Other data sources and studies should be included
- There should be a clear criteria developed for selecting communities to survey including availability of ambulances; degree of accessibility (e.g. remote rural, passable road, all weather road); level of health centre

The survey instrument developed in this workshop was then revised and adapted when the decision was made to switch the fieldwork to Katsina State, Nigeria. A key element of this revision involved the interaction with the Ethical Clearance Committee of the Katsina State Ministry of Health. A survey protocol was developed for the Katsina fieldwork, submitted to the committee, and revised in line with their suggestions. Approval was then secured for the protocol set out in Appendix 1.

3.3. Community Sampling in Katsina, Nigeria

Within each of the four LGAs selected in Katsina, Nigeria, 10 Community-level Health Centres were selected by the Katsina State Ministry of Health, to reflect the issues relevant to Katsina State raised by this project and around which to focus the data collection efforts. The criteria by which the Health Centres within each LGA in Nigeria were selected included:

- Remote level of accessibility
- Difficulty in accessing an all-weather road
- Difficulty in accessing regular public transport
- Difficulty in terrain
- Low availability and provision of health centre
- Limited coverage of mobile phone network

Two of the LGAs chosen were also covered by the DFID-funded programme called PRRINN-MNCH (Programme for the Return of Routine Immunisation into Northern Nigeria- Maternal, Neonatal and Child Health). PRRINN-MNCH operates through clusters of rural communities within each LGA selected. The selection of these clusters of rural communities by PRRINN-MNCH also includes similar access criteria to that used in this project. The clusters used by PRRINN-MNCH in these 2 LGAs were

accepted as the communities to be surveyed in our study because there was a similarity in selection criteria between the PRRINN-MNCH programme and our study.

3.4. Data collection process in Nigeria

Once the decision had been taken to change fieldwork sites from Ghana to Nigeria, moves were put in place to start the data collection process. No data had been collected in Ghana ahead of the decision to move fieldwork sites. Data collection was undertaken in Katsina State, Nigeria, from mid-February 2013-mid March 2013 and 704 cases were surveyed across the 10 health centres and communities within each of the 4 LGAs selected.

Within each Health Centre or facility sampled, a fieldworker was recruited to record the details of all women giving birth who needed to be referred by the Health Centre for Emergency Obstetric Care due to medical complications to a higher level in the LGA Primary Health Care Centre. There was no upper or lower age limit to the subjects selected.

Women who were referred within 28 days of giving birth were included, but those referred after that period was not included. Those who were referred as a result of unsafe abortions were also recruited. Women who were not in labour, but who were referred for antenatal care were excluded from this study.

Women who were not referred by the health centre but who self-refer, hence 'bypassing' the health centre, obviously could not be selected by the fieldworker at the community health centre. However, women who self-referred were sampled at the referral hospital.

At each referral hospital, a research assistant was also recruited to sample and assess all incoming women with medical complications when giving birth. These included those who had been recruited by the Health Centres and those who self-referred from the communities served by the Health Centres being sampled. Those who self-referred were asked to take part in the study and informed consent was sought from them (or their accompanying adults).

Those who self-referred and were not from the communities served by the Health Centres being sampled were not recruited.

All women who met the inclusion criteria, and who presented themselves at the Health Centre over the survey period and who were clinically assessed by the health centre staff as in need of emergency referral due to medical complications were asked (or their accompanying partners) to authorise an informed consent form for them taking part in the study. Women were recruited after they received the necessary intervention and the data from their initial assessment was used to complete the data forms later.

Special procedures were developed to ensure consent was secured in those cases where the subjects were incapable of giving consent, including:

- adolescents,
- those women initially reluctant to give consent for reasons of social practices of deferring to approval of male head of household or male family elders,
- those travelling without accompanying adults and
- women who were unconscious.

If they consented, a special referral form (designed for the study) was completed (see Appendix 1). This included:

- Personal Identification number
- A Vital Signs assessment of their condition at the point of referral
- A Glasgow Coma Score Assessment
- Record of time of call made for emergency transport
- Record of actual time of departure from Health Centre

They were then referred by the Health Centre in the timeliest manner possible.

The special referral form travelled with the consenting patient.

For those being referred by ambulance, the Emergency Medical Team (EMT) personnel on the ambulance were also trained to undertake a further clinical condition assessment of the subject when they arrive on scene. In addition, times of departure from scene were recorded. If any treatment was administered by the EMT on the journey to the referral hospital, this was also recorded on the special referral form.

The subject was also clinically assessed at arrival at the referral hospital and the details of this assessment completed on the special referral form, together with time and means of arrival.

Once the patient was recovering the hospital-based fieldworker collected a small amount of follow-up information using a separate follow-up form including:

- A matching Subject Identification Number to the one on referral
- Socio-demographic data (including age, household structure, assets, location and consent required for journey to be made).
- Obstetric history

Stopping and discontinuing the study

The study would have been stopped or discontinued if:

- patients objected to it
- the number of people giving consent was too low to be able to get a statistically representative sample
- the data gathering and assessment process was deemed to be unnecessarily delaying the referral process

- changes to the Referral Hospital or Health Centre rendered the results not valid

None of these instances were encountered and the study was completed successfully.

Fieldworker Training in Nigeria

Fieldworkers were recruited from existing health facility staff with some level of medical skill and from ambulance staff. They were trained in a 1-day session on the project and its objectives, the completion of the form, the ethical consent required and the data collection and data entry process.

A total of 71 fieldworkers were recruited and trained across the 4 LGAs that were surveyed, the referral hospitals that served them and the relevant ambulance staff. The tables below set out the distribution of fieldworkers recruited and trained across the different spatial and functional areas.

TABLE 1 - COMMUNITY HEALTH EXTENSION WORKERS [CHEWS] TRAINED

No of Participants Trained	**LGA**
12	Charanchi
11	Maidua
20	Funtua
18	Zango
61	**TOTAL**

TABLE 2 - HEADS OF MATERNITY AND OFFICERS IN-CHARGE OF AMBULANCES TRAINED

No of Participants Trained	**LGA/Organization**
1	Charanchi
1	Maidua
1	Funtua
1	Zango
1	Federal Medical Centre [FMC]
1	Turai Child & Maternity Hospital
4	Officers in Charge of Ambulances from the 4 selected LGAs
10	**TOTAL**

4. Data Analysis

4.1. Data cleaning, verification and analysis process

The data was collected from the fieldworkers on a regular basis and expenses and allowances were paid to them on receipt of the completed data forms. The forms were then checked by the National Consultant and any necessary clarifications were obtained from the fieldworkers at this time. Any further explanations that needed to be shared with the fieldworkers were also shared at this time. The data was then entered by partners in Katsina and cleaning and verification was undertaken using local knowledge and communication with fieldworkers at this stage.

Analysis was undertaken using SPSS analytical software. Descriptive statistics were produced and non-parametric Chi-Square tests were undertaken.

4.2. Descriptive statistics for each LGA and referral hospital surveyed

A total of 704 cases were surveyed across the 40 communities and 4 LGAs in Nigeria. The women surveyed had the following age distribution:

Age (years)	Frequency	Per cent
<16	69	9.8
16-24	273	38.8
25-34	246	34.9
35-45	93	13.2
45>	23	3.3
Total	704	100.0

TABLE 3 DISTRIBUTION OF WOMEN'S AGE ACROSS THE SAMPLE

The study was also successful in reaching poor women in the sample. Developing a composite index from an assessment of household assets (including ownership of fridges, radios, vehicles etc.), it was found that the sample had an overwhelming proportion of women with very limited wealth.

Wealth Index	Frequency	Per cent
Low	672	95.45
Medium	26	3.70
High	6	0.85
TOTAL	704	100.0

TABLE 4 Distribution of wealth amongst the women surveyed

The women surveyed with medical complications were within the expectation ranges of child-bearing age, though nearly 10 per cent were below 16 and a very small number were older than 45. Each group may be viewed as at higher-risk of maternal complications.

The women surveyed also demonstrated a wide range of previous gynaecological history. Evidence from the literature points to key issues: Wort et al., (2008) highlight some evidence of the importance of women giving birth to their first child as a risk factor in complications and especially around neo-natal mortality and morbidity. Only 13.4 per cent of those surveyed were pregnant for the 1st time; 30 per cent of women surveyed had had 6 or more pregnancies.

	Frequency	Per cent
0	94	13.4
1	103	14.6
2	61	8.7
3	89	12.6
4	84	11.9
5	62	8.8
6	70	9.9
7	37	5.3
8	34	4.8
9	16	2.3
10	28	4.0
11	8	1.1
12	12	1.7
13	2	.3
14	2	.3
18	2	.3
Total	704	100.0

TABLE 5 Distribution of No. of pregnancies

The level of possible neonatal mortality could be shown by the following table which shows the number of women who have had different levels of live-births, with twice as many women reporting no live births as reporting 1st pregnancy when surveyed, suggesting that neo-natal mortality is at a noticeable level amongst the women surveyed.

	Frequency	Per cent
0	185	26.3
1	69	9.8
2	95	13.5
3	94	13.4
4	72	10.2
5	62	8.8
6	45	6.4
7	33	4.7
8	22	3.1
9	11	1.6
10	12	1.7
11	1	.1
12	2	.3
14	1	.1
Total	704	100.0

TABLE 6 Distribution of No of live births reported

The women surveyed were mostly referred by their local health workers (70.5 per cent) though a noticeable minority (29.5 per cent) were self-referring in a medical emergency and going straight to a referral hospital and 'bypassing' the referral chain.

	Frequency	Percent
Yes	208	29.5
No	496	70.5
Total	704	100.0

TABLE 7 Number of women self-referring to the referral hospital

The data from the community level fieldworkers shows a range of complications given as the reason for the health worker to refer the women to a higher facility. The most common reason, where one is given, is for haemorrhage (17.2 per cent), which is a very time-dependent condition and one where lack of poor access can very quickly lead to death. Interestingly, the majority of cases do not have a health complication associated with them. This may highlight the level of desire for access to skilled attendant delivery as well as the number of cases who are 'bypassing' and going straight to the referral facility.

	Frequency	Per cent
Bleeding(Ante-Partum Haemorrhage/Post-Partum Haemorrhage)	121	17.2
Prolonged Labour	57	8.1
MIP/Sepsis	9	1.3
Anaemia	54	7.7
Eclampsia	15	2.1
Hypertension/CCF	13	1.8
None	377	53.6
Abdominal Pain	39	5.5
Abortion/Stillbirth/Premature	19	2.6
Total	704	100.0

TABLE 8 Reasons for referral

KEY FINDINGS

The study was also successful in reaching poor women. Using a composite index from an assessment of household assets (including ownership of fridges, radios, vehicles etc.), it was found that the sample surveyed had an overwhelming proportion of women with very limited asset-based wealth.

4.2.1. Descriptive statistics on access to referral facility

The study asked about access to referral facilities and it found that in the vast majority of cases (83.2 per cent), women with maternal complications initially accessed their local health centre.

	Frequency	Percent
PHC	586	83.2
General Hospital	9	1.3
Traditional healer	14	2.0
None	44	6.3
Chemist/TBA/CBSD	44	6.3
Private Clinic	6	.9
Mobile Ambulance	1	.1
Total	704	100.0

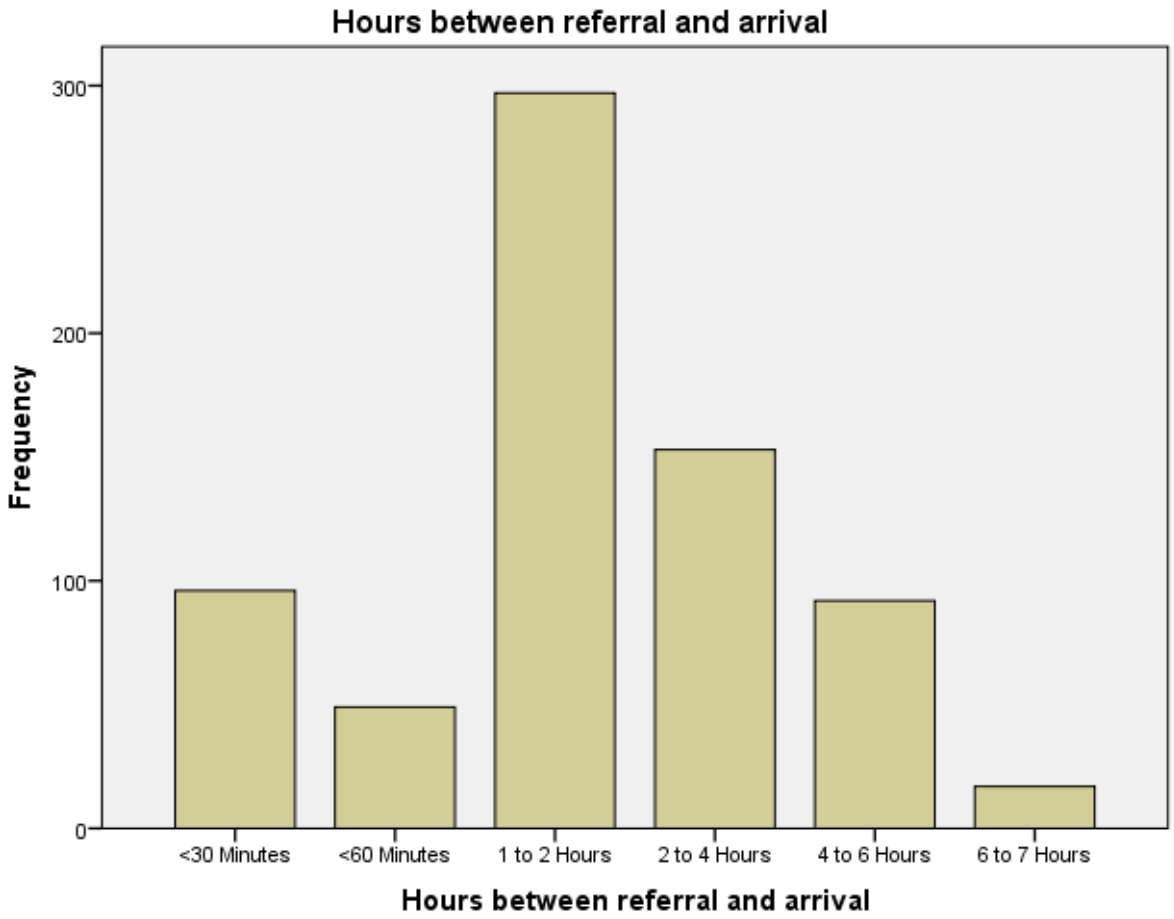
Table 9 First point of contact in medical emergency

The study also found that, probably because of the large catchment areas often served by rural health centres in this region of Africa, the majority of women accessed the local health centre using private vehicles (40.2 per cent) or motorbikes (40.1 per cent). A noticeable number (8.1 per cent) did access using the ambulance provision. Equally notably, 10.7 per cent of women surveyed accessed the local health facility on foot. Whilst in many cases this may be across a short distance, it cannot be discounted that in a number of cases, this walking journey will be over a long distance.

		Frequency	Percent
	Foot	75	10.7
	Motorcycle	282	40.1
	Motor Vehicle	283	40.2
	Bicycle/Wheel barrow	1	.1
	ETS/CDC	6	.8
	/Ambulance/Mobile Ambulance	57	8.1
Total		704	100.0

Table 10 Means of access to health centre

When women are then referred to a higher-level health facility, they often undertake significant journeys as the figure below shows. Whilst the average journey is undertaken within 1 to 2 hours (i.e. from being referred to arrival at the referral facility), there are a significant number for whom this gap between referral and arrival is over 4 hours and for conditions like haemorrhage that can often prove fatal.



These journeys, like the access to the local health centre, are predominately using motor vehicles (54.4 per cent) with motorbikes making up smaller percentages than for access to local health centres. Ambulances and the Emergency Transport Scheme [provided by taxi drivers] are making up an increasing percentage (11.5 per cent) of these journeys, but still they constitute a relatively small number. Interestingly, there is a noticeable number (2.8 per cent) of these further referral journeys are being made on foot.

	Frequency	Percent
Foot	20	2.8
Motor Cycle	220	31.3
Motor Vehicle	383	54.4
ETS	7	1.0
/Ambulance/Mobile Ambulance	74	10.5
Total	704	100.0

TABLE 11 Means of Access to Referral facility

KEY FINDINGS

Amongst the women surveyed for this study, there was, on average, a 1 to 2 hour gap between being referred by a health worker and reaching the appropriate referral facility. However, a significant number took between 4 and 7 hours to reach appropriate care. The majority of women reached their referral facility by motor vehicle or motorbike. Whilst ambulances and the Emergency Transport Scheme did contribute just over 10 per cent of referrals transferred, journeys on foot made up a small but still worrying level.

4.2.2. Descriptive statistics on patient condition on referral

The evidence from the study on the condition of women when they arrive at the referral centre shows clear evidence of the challenges that resource poor health facilities may have to face. Using vital signs measurements it was found that 43.3 per cent of women who presented at the referral facility were weak.

	Frequency	Percent
Normal	399	56.7
Not normal/Weak	305	43.3
Total	704	100.0

TABLE 12 Vital Signs levels of patients on arrival at Referral facility

Using another measurement of patient condition which is optimised for more severe conditions, the Glasgow Coma Score, it was found that although the number of women arriving with severe health conditions was much lower, these were still significant numbers of patients (17.3 per cent of women surveyed with medium or low Coma Score indicating poor health condition) that were severely unwell and would require significant health facilities to be able to manage their condition.

	Frequency	Per cent
Lowest	40	5.7
Medium	82	11.6
Highest	582	82.7
Total	704	100.0

TABLE 13 Glasgow Coma Score of patient on arrival at referral facility (high score= good condition; medium and low score = worsening condition)

KEY FINDINGS

The women surveyed in this study largely arrived at referral facilities in a 'good' condition according to their assessment using the Glasgow Coma Score. However, using the assessment method of measuring Vital Signs, over 43 per cent were assessed to not have normal Vital Signs or that their Vital Signs were associated with being medically weak.

4.3. Relationship between access and patient condition

The analysis sought to assess if there was any statistical relationship between the time of referral and the condition of women on arriving at the referral facility. Cross-tabulation analysis was undertaken of the Glasgow Coma Score and both referral times and socio-economic factors characterised by the wealth index. It was found that the vast majority of the women surveyed were of low-income and hence the data was sufficiently skewed to render the statistically significant result that was found in the analysis to be meaningless.

4.3.1 Glasgow Coma Score and Access

Analysis was also undertaken on the amount of time that elapsed between women being referred and arriving at the referral facility. The analysis found that there was a statistical relationship (at the 98% significance level) between the referral time and patient condition as represented by the Glasgow Coma Score.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.593[a]	10	.012
Likelihood Ratio	20.265	10	.027
Linear-by-Linear Association	.085	1	.770
N of Valid Cases	704		

3 cells (16.7%) have expected count less than 5. The minimum expected count is .97.

TABLE 14 Chi- Squared Test result for the relationship between Glasgow Coma Score and Referral times.

However, the methodology adopted by this study did allow for 2 approaches to measuring patient health condition; Glasgow Coma Score and Vital Signs Assessment. Analysis was undertaken, using chi-square tests, of each of the vital sign categories and the time it took in referral, the means of transport to the nearest Health Centre and means of transport to the referral facility.

4.3.2 The Respiration Vital Sign and Access

The analysis first assessed the vital sign of respiration, i.e. how well a woman with complications was breathing.

Chi-squared tests were undertaken and it was found that there was a significant relationship between the values for respiration and the time between referral and arrival at the referral facility

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.098[a]	15	.063
Likelihood Ratio	25.781	15	.040
Linear-by-Linear Association	1.706	1	.192
N of Valid Cases	697		

a. 4 cells (16.7%) have expected count less than 5. The minimum expected count is 1.03.

TABLE 15 Chi- Squared Test result for the relationship between Respiration Vital Sign and Referral times.

Again using Chi-Squared tests, a significant relationship was also found between the Respiration Vital Sign and the means of transport used to reach the referral centre.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	40.251[a]	12	.000
Likelihood Ratio	34.018	12	.001
Linear-by-Linear Association	12.261	1	.000
N of Valid Cases	697		

a. 7 cells (35.0%) have expected count less than 5. The minimum expected count is .45.

TABLE 16 Chi- Squared Test result for the relationship between Respiration Vital Sign and Means of transport to referral facility.

Finally, a significant statistical relationship was also found between the respiration vital sign and how women with medical complications had travelled to their local health centre.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	36.775[a]	15	.001
Likelihood Ratio	35.325	15	.002
Linear-by-Linear Association	6.694	1	.010
N of Valid Cases	696		

a. 10 cells (41.7%) have expected count less than 5. The minimum expected count is .06.

TABLE 17 Chi- Squared Test result for the relationship between Respiration Vital Sign and the Means of transport to the local health centre.

4.3.3 The Neurological Vital Signs and Access

Chi-squared tests were undertaken to see if there was a statistical relationship between the neurological vital signs and travel times and means of transport. It was found that there was no significant relationship between the time elapsed between referral and arrival at the referral facility.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	43.309[a]	40	.332
Likelihood Ratio	39.564	40	.490
Linear-by-Linear Association	5.696	1	.017
N of Valid Cases	651		

a. 34 cells (63.0%) have expected count less than 5. The minimum expected count is .03.

TABLE 18 Chi- Squared Test result for the relationship between Neurological Vital Sign and Referral times.

However, it was found that there was a significant relationship at the 98% per cent confidence level between the neurological vital signs and the means of transport to the referral centre

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	56.033[a]	32	.005
Likelihood Ratio	33.987	32	.372
Linear-by-Linear Association	.479	1	.489
N of Valid Cases	651		

a. 32 cells (71.1%) have expected count less than 5. The minimum expected count is .01.

TABLE 19 Chi- Squared Test result for the relationship between Neurological Vital Sign and means of transport to the referral centre.

and to the first health centre.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	53.540[a]	40	.074
Likelihood Ratio	54.373	40	.064
Linear-by-Linear Association	.772	1	.380
N of Valid Cases	651		

a. 39 cells (72.2%) have expected count less than 5. The minimum expected count is .00.

TABLE 19 Chi- Squared Test result for the relationship between Neurological Vital Sign and means of transport to the referral centre.

4.3.4 The Blood Pressure Vital Signs and Access

Chi-squared tests were also undertaken to explore the relationship between the blood pressure Vital Signs and methods of transport and travel times to referral facilities. It was found that there was a statistically significant relationship at the 98% level of significance between blood pressure and the time of referral and between blood pressure and the means of transport used to access the initial health facility.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	35.685[a]	20	.017
Likelihood Ratio	31.189	20	.053
Linear-by-Linear Association	.891	1	.345
N of Valid Cases	694		

a. 13 cells (43.3%) have expected count less than 5. The minimum expected count is .27.

TABLE 20 Chi- Squared Test result for the relationship between Blood Pressure Vital Signs and referral times.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	46.383[a]	20	.001
Likelihood Ratio	41.282	20	.003
Linear-by-Linear Association	10.142	1	.001
N of Valid Cases	693		

a. 16 cells (53.3%) have expected count less than 5. The minimum expected count is .02.

TABLE 21 Chi- Squared Test result for the relationship between Neurological Vital Sign and means of transport to local health centre.

However, there was no significance found between blood pressure and the means of transport used to access the referral facility at the 98% confidence level.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.328[a]	16	.105
Likelihood Ratio	18.786	16	.280
Linear-by-Linear Association	5.435	1	.020
N of Valid Cases	694		

a. 10 cells (40.0%) have expected count less than 5. The minimum expected count is .11.

TABLE 22 Chi- Squared Test result for the relationship between Blood Pressure Vital Signs and means of transport to the referral centre.

4.3.5 The Pulse Vital Signs and Access

Chi-squared tests were also undertaken to explore the possible statistical relationship between the recording of women's pulse as a vital sign and the means of transport and travel times to the referral facility. It was found that there was a significant association, at the 98% confidence level, between the pulse Vital Sign and the means of transport to the referral facility.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	35.624[a]	12	.000
Likelihood Ratio	28.328	12	.005
Linear-by-Linear Association	9.862	1	.002
N of Valid Cases	690		

a. 7 cells (35.0%) have expected count less than 5. The minimum expected count is .20.

TABLE 23 Chi- Squared Test result for the relationship between the Pulse Vital Sign and means of transport to the referral centre.

A significant association was also found between the recorded pulse vital sign and the means of transport to the initial health centre.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	39.840[a]	15	.000
Likelihood Ratio	31.692	15	.007
Linear-by-Linear Association	6.274	1	.012
N of Valid Cases	689		

a. 10 cells (41.7%) have expected count less than 5. The minimum expected count is .03.

TABLE 24 Chi- Squared Test result for the relationship between the Pulse Vital Sign and means of transport to the local health centre.

However, there was no statistically significant relationship found, at the 98% confidence level, between recordings of pulse and the time between a woman being referred and their arrival at the referral point.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.249[a]	15	.203
Likelihood Ratio	20.793	15	.144
Linear-by-Linear Association	.271	1	.603
N of Valid Cases	690		

a. 6 cells (25.0%) have expected count less than 5. The minimum expected count is .49.

TABLE 25 Chi- Squared Test result for the relationship between the Pulse Vital Sign and referral times.

4.3.6 The Urine Vital Sign and Transport

Chi-squared tests were undertaken to explore the relationship between the urine vital sign and access. It was found that there was a statistically significant relationship, at the 98% confidence level, between the urine recording taken and the time between being referred and arrival at the referral facility.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.029[a]	10	.001
Likelihood Ratio	28.754	10	.001
Linear-by-Linear Association	1.204	1	.272
N of Valid Cases	701		

a. 2 cells (11.1%) have expected count less than 5. The minimum expected count is 1.53.

TABLE 26 Chi- Squared Test result for the relationship between Urinary Vital Signs and referral times.

There was also a significant relationship between urine recordings and the means of transport used to travel to the referral centre.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.845[a]	8	.002
Likelihood Ratio	24.917	8	.002
Linear-by-Linear Association	1.492	1	.222
N of Valid Cases	701		

a. 4 cells (26.7%) have expected count less than 5. The minimum expected count is .63.

TABLE 27 Chi- Squared Test result for the relationship between Urinary Vital Sign and means of transport to the referral centre.

There was a significant association between the means of transport to the initial health centre and the urine vital signs recordings.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	38.090[a]	10	.000
Likelihood Ratio	40.310	10	.000
Linear-by-Linear Association	1.631	1	.202
N of Valid Cases	700		

a. 6 cells (33.3%) have expected count less than 5. The minimum expected count is .09.

TABLE 28 Chi- Squared Test result for the relationship between Urinary Vital Signs and means of transport to the local health centre.

4.3.7 The Temperature Vital Sign and Transport

Chi-squared tests were undertaken to explore the relationship between the temperature vital sign and access. It was found that there was a statistically significant relationship between the temperature recording taken and the means of transport to the referral centre.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	58.348[a]	12	.000
Likelihood Ratio	43.754	12	.000
Linear-by-Linear Association	12.779	1	.000
N of Valid Cases	695		

a. 7 cells (35.0%) have expected count less than 5. The minimum expected count is .21.

TABLE 29 Chi- Squared Test result for the relationship between the Temperature Vital Sign and means of transport to the referral centre.

There was a statistical association between temperature recordings and the means of transport used to access the initial health centre

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	71.446[a]	15	.000
Likelihood Ratio	51.160	15	.000
Linear-by-Linear Association	9.513	1	.002
N of Valid Cases	694		

a. 10 cells (41.7%) have expected count less than 5. The minimum expected count is .03.

TABLE 29 Chi- Squared Test result for the relationship between the Temperature Vital Sign and means of transport to the local health centre.

But there was no statistically significant relationship at the 98% confidence level between the temperature readings taken and the time taken between women being referred and their arrival at the referral facility

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.471[a]	15	.239
Likelihood Ratio	17.991	15	.263
Linear-by-Linear Association	.065	1	.798

N of Valid Cases	695		

a. 6 cells (25.0%) have expected count less than 5. The minimum expected count is .51.

TABLE 30 Chi- Squared Test result for the relationship between the Temperature Vital Sign and referral times.

KEY FINDINGS

The study found that there was no statistically significant relationship between the Glasgow Coma Score of the women surveyed and how they travelled to the initial health facility, how they travelled to the referral facility or how long it took from them being referred to them arriving at the referral facility.

However, using the Vital Signs assessment approach there is a significant relationship between how long women took from being referred by a local health working to arriving at the referral facility and their respiration, blood pressure and urine vital signs.

There was also a significant relationship between how women travelled to the referral facility and their vital signs for respiration, neurological state, pulse, urine and temperature.

Finally, the study also found a significant relationship between how women travelled to their local health centre before being referred and their vital signs recorded for neurological condition, blood pressure, pulse, urine and temperature.

5. Guidelines for Good Practice for the development and sustainable operation of African Ambulance Services tackling health MDGs in rural areas

Emergency patient care services, national ambulance services in particular, are systems constructed of many components. These components cover a large spectrum of specialised topics that reach far beyond the medical profession. Each component of emergency care needs to be addressed while always keeping their interdependency in mind during design and implementation. To support the capacity development and knowledge management within ambulance provision across sub-Saharan Africa, the development of guidelines was a complimentary and key component of this project. The guide developed for this project focuses on the component of a National Ambulance Service (NAS) but always being mindful of its interdependency within the larger picture of emergency health care.

When implementing such a complex service as a National Ambulance Service it is advisable to first pilot the scheme on a smaller scale to enable a testing phase. Every NAS will be different due to its specific needs; legal, medical and governmental contexts also differ in each country. It would not be to any country's benefit to duplicate another country's NAS; however it is recommended that experiences and lessons learned from other National Ambulances Services should be reviewed by those planning on establishing or hoping to improve their own NAS. These examples through adaption and localisation could greatly help in eliminating or solidifying options and decisions by determining what worked and what did not and, more importantly, why.

There are three set-up options when considering establishing a NAS:

- Option 1: Government owned and operated,
- Option 2: Third party operated, and
- Option 3: Combined government and third party operated.

Great care, consideration and thought must be put into any option that is chosen. A failed, non-operational NAS will not only cost vast amounts of resources but will cost lives.

Health systems throughout the world often face resource constraints, be it a shortage of funding or insufficient human resources. The introduction of a NAS should not contribute to the resource issue. An NAS should attract and be able to keep skilled, dedicated staff. However, this should not be at the expense of other parts of the health care system. If NAS staff receive higher quality training and reap higher wages than nurses in hospitals, it will not only ignite an exodus of nursing staff from hospitals to the National Ambulance Service but cause those thinking of a nursing career to reconsider. This will only compound the common issue of understaffed hospitals and so the NAS could cause more harm to the health care system than good. The hospitals to which patients are being brought must be able to provide adequate quality of care; otherwise what is the point of an effective and efficient NAS?

When operations in the pilot phase become more fluid and any issues which arise during this phase are addressed, then scale up to other cities and rural areas can commence in a carefully structured and planned manner. Of course funding and resources will play a major role in a National Ambulance Service expansion and scale up, so phased stepped expansion is advised to ensure consistency and no reduction in the quality of patient care. A National Ambulance Service must be embraced and accepted by the country's population. A poor quality service will not instil confidence in the beneficiaries.

The guide included as an appendix to this report covers, to varying degrees, the following topics which, when combined, can steer those intent on creating or improving a NAS: Epidemiological Mapping, Stakeholders, Funding and Insurance, Management Structure, Crew and Driver, Training, Staffing, Medical Supplies, Health and Care, Call Centre, Communications and IT, Operational Structure, Testing, Legal, Outsourcing and Transport Management.

The set up and effective management of transport within any health care or non-health care system is a specialty and core competency of Transaid. However within the context of a National Ambulance Service (NAS) the many components that make such a service also had to be discussed to provide the correct context and holistic approach to setting up a NAS. These other components were discussed not only from experience within Transaid but also through consultation and discussions with experts and active operators in these fields.

Transport within a National Ambulance Service (NAS) must be managed effectively and efficiently as without transport a NAS cannot operate. A Transport Management System (TMS) enables the proper management of a transport fleet and thus extends its working life, reduces the overall cost and improves emergency health care service delivery. Transaid's TMS has been used to varying degrees by different Ministries of Health including South Africa and Ghana in the management of their fleets. The principles that underpin TMS apply to any type of transport and any scale.

The essential components of an effective Transport Management System and that are discussed in the NAS guide are as follows:

a) Operational Management
b) Financial Management
c) Fleet Management
d) Health and Safety
e) Human Resources
f) Management Information: Monitoring Performance
g) Situational Analysis
h) Policy

There are many examples of operational NAS of various types. NAS around the world exist in varying operational set-ups. Two examples set out in the guidelines of NAS that have been set-up that relate to the African context are;

Ghana:
Ghana has established an entirely public sector NAS and it has been in operation for a number of years. It is still expanding and introducing new vehicles. The Ghana NAS has utilised external expertise, such as medical training, in its progression as NAS.

South Africa:
Emergency services in South Africa are a public/private system. Each province provides emergency ambulance services. The government system utilises volunteers as well as paid responders and is supplemented by private-for-profit ambulance companies. Both of these services are further supplemented by voluntary ambulance services such as the South African Red Cross and St. John Ambulance. All of the services are required by law to meet the same standards with respect to staff qualifications.

These are examples of NAS that indicate the trend towards NAS and may help steer those interested in NAS towards like-minded individuals, organisation or ministries.

The guide has been developed in conjunction with experts from a variety of backgrounds although the authors' expertise lies in transport management. All aspects of medical care and legal issues discussed or mentioned in the guide should be examined in consultation with the appropriate medical and legal professionals.

6. Dissemination Activities

The dissemination of the outcomes of this study is a key part of the project. The sharing of knowledge, the incorporation of evidence into policy-making and transference of knowledge into professional practice are crucial steps in the use of research into practice. The project incorporates a series of activities that promote the communication of the research findings with practitioners and policy-makers in the health and transport sector, both within West Africa and internationally.

The main activity was an international workshop on 'Maternal Health, Physical Access and Ambulances' that took place at the end of the project in Accra, Ghana (22-23 April, 2013). This involved an international audience of ambulance management specialists from 3 countries across Africa (Uganda, Nigeria and Ghana) as well as health sector policy-makers, development agencies and transport sector professionals. The findings of the research contained in this project were shared with the audience, together with the best practice guidelines that have been developed. The workshop provided an opportunity to highlight practical lessons and good practice from the development of transport solutions to accessing healthcare, including Ambulance Services, across the region and to build analytical capacity within ambulance management professionals within the region. This workshop disseminated the project output to both Nigerian and Ghanaian professionals and thus retained an element of the partnership with Ghanaian stakeholders that the original project was founded upon. The workshop also provided an opportunity for discussion amongst the international audience regarding the future steps for research of this kind and the development of Ambulance Services as a policy response to poor physical access to maternal emergency healthcare. The workshop provided an opportunity to showcase significant developments taking place in Ghana around the building of a nationally available Ambulance Service and the successes and challenges this is delivering. It also provided an opportunity to explore the ambulance-focused and community-focused approaches developing in northern Nigeria. The workshop discussions highlighted:

- The need for a focus on physical access to health in health policy to back up ambulance service development.
- The scope for developing a new cadre of staff, Emergency Medicine Technicians, in order to minimise risk of removing vital staff from existing health services.
- The need for a continuing practitioners and policy-makers network on emergency transport development in Africa.
- The challenge of transport management capacity in emergency transport.
- The need to focus on pre-hospital emergency transport as well as inter-hospital ambulance transfer.
- The need to incorporate pre-hospital care in health training.
- The scope for incorporating private sector transport operators as part of the solution.
- The need to get clear messages to decision makers.

The best practice guidelines are being disseminated through the AFCAP and Transaid professional networks. They will also form the basis of implementation action in Uganda where international best practice is being incorporated into proposals to develop a National Ambulance Service.

Academic papers have also been developed from this research. A paper developed for the AFCAP-supported African Studies Association session at Leeds University on Maternal Mortality and Transport in September 2012 is being updated for publication in an academic journal of international standing. Further opportunities for academic publishing will be actively pursued in the next 2 months.

7. Conclusion and future research needs

This project has added to the very limited literature available that seeks to understand the role that non-clinical factors play in maternal and neo-natal mortality and morbidity. It has added to our understanding of the significant role that poor physical access plays in delaying appropriate care for women with maternal health complication. It highlights the fact that delays in travel-time and delays in arranging for women to be referred to higher level facilities in medical emergencies, as well as the types of transport available to women in such emergencies, exacerbates the health condition of women with medical complications. This impact on the health condition of women received at referral facility makes the challenge in reducing maternal mortality faced by health professionals at these referral facilities in resource-poor environments, even harder.

The project undertook fieldwork in Northern Nigeria, switching from its original proposal of fieldwork in Ghana. The project surveyed 704 women with medical complications over 1 month in 4 Local Government Areas of Katsina State in Northern Nigeria. The overwhelming majority of these women were from rural low-income households.

The project found that, amongst the women surveyed for this study, there was an average 1-2 hour gap between being referred by a health worker and reaching the appropriate referral facility. However, a significant number of women took between 4 and 7 hours to reach appropriate care. The majority of women reached their referral facility by motor vehicle or motorbike. Ambulance and the Emergency Transport Scheme contributed just over 10 per cent of referrals transferred. Travel on foot to referral facilities made up a small but none the less, worrying level.

The health condition of the women surveyed depended largely on how they were assessed. If the assessment used the Glasgow Coma Score, the women surveyed in this study largely arrived at referral facilities in good condition. However, using another valid medical assessment method, the Vital Signs approach, over 43 per cent were assessed not to have normal vital signs or vital signs that are associated with being in a medically weak condition. The lack of significant correlation with the Glasgow Coma Score might be because the Glasgow Coma Score is an aggregate score and not the direct health measurements as seen by practitioners, which is more readily represented by the Vital Signs approach.

There was no statistically significant relationship between the Glasgow Coma Score of the women surveyed and how long they took to arrive at the initial health facility, the referral facility or how long it took for them to arrive.

However, there is a significant relationship between how long women took to arrive at the referral facility and their respiration, blood pressure and urine vital signs. There was also a significant relationship between the means of transport to the referral facility and their vital signs for respiration, neurological state, pulse, urine and temperature. Finally, there was a significant relationship between the means of transport to the initial health centre and their vital signs for neurological condition, blood pressure, pulse, urine and temperature.

The project has shown that poor physical access does contribute to poor health condition of women when they arrive at the appropriate level of care to be treated in case of a maternal medical emergency. This worsened condition will require greater skill, more equipment and drugs and increased capability of the health system than would otherwise be the case when access is good. How women get to referral facilities does make a difference and so investment in ambulance provision, communications systems and community-based emergency response will make a difference to health outcomes for women giving birth and their new-borns.

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APPENDIX 1 – Data Collection Protocol

Katsina State Primary Health Care Development Agency/Transaid

Linking Rural Communities with Health Services: Assessing the effectiveness of an Ambulance Service in meeting the needs of rural communities

Submission for Ethical Clearance

from

Transaid UK

Principal Investigator: Mr Jeff Turner

23rd November, 2012

FULL PROTOCOL

Executive Summary

The objectives of this project are to:

- develop a robust evaluation framework to understand the interaction between physical access and maternal mortality
- understand the impact that an ambulance service can have on the level of maternal mortality in rural Africa caused by poor physical access
- inform the development of Mobile Ambulance services elsewhere in Africa.

The hypothesis for this research is that

'the provision of ambulances as a national policy makes a significant difference to the level of severity of Obstetric Complications presenting at LGA Emergency Obstetric Care centres for women from rural areas in Northern Nigeria who suffer from medical complications when giving birth and who need Emergency Obstetric Care'

The project will undertake a prospective study of women giving birth and needing referral with medical complications to a higher level of Emergency Obstetric Care in selected communities of Katsina State, Nigeria. Women in the selected communities who consent and require transfer due to maternal health complications to a higher level Emergency Obstetric Care facility will have their condition assessed by medical research assistants at community health centres and data collected on the following items:

- A Vital Signs assessment of their condition at the point of referral
- A Glasgow Coma Score Assessment
- Record of time of call made for emergency transport
- Record of actual time of departure from Health Centre

They will then be referred by the Health Centre in the timeliest manner possible. For those being referred by ambulance, the Emergency Medical Team (EMT) personnel on the Ambulance will be trained to undertake a further clinical condition assessment of the subject when they arrive on scene. In addition, times of departure from scene will also be recorded. If any treatment is administered by the EMT on the journey to the referral hospital, this will also be recorded on the special referral form. The subject will also be clinically assessed at arrival at the referral hospital, where appropriate the clinical assessment of the receiving medical Officer will be drawn up or else the details of this assessment completed on the special referral form, together with time and means of arrival.

Once the subject is recovering the hospital-based research assistant will collect a small amount of follow-up information using a separate follow-up form including:

- socio-demographic data (including age, household structure, assets, location and the nature of the household and family consent required for the woman's journey to be made).
- obstetric history

Data will be analysed to assess the differences in conditions between different means of access to healthcare by different means. Statistical analysis will also be undertaken to understand the explanatory power of access and socio-economic variables.

PROTOCOL

Study Rationale

Meeting the Millennium Development Goal of reducing maternal mortality by 2015 is a significant challenge in Africa. The headline level of maternal mortality is significantly worse in Africa than elsewhere in the world. Inadequate transport services and infrastructure currently represents a major contributor to maternal mortality in Africa. It is estimated that 35% of all maternal mortality can be directly attributed to lack of transport Gil-González et al (2006) and that in 75% of maternal mortality cases transport is an influential factor (Babinard and Roberts,2006). Timely access to health facilities is a key element to maternal and newborn health and the lack of adequate and appropriate transport services has a complex impact on the ability of a country's health care providers to provide adequate maternal and neonatal care to those in need. However, there is very limited evidence-based guidance for practitioners and policy-makers in either the health or transport sector on how best to reduce the negative impact that transport has on the substantial efforts being made to reduce Africa's maternal mortality burden. As a result, the main focus of this study will be to develop robust evidence of the health impact of poor physical access to health services due to inappropriate transport services in rural Africa; to evaluate the health impact of a particular transport solution, a Mobile Ambulance service, which has substantial scope for scaling-up and to develop guidance for practitioners on the sustainable operation of this possible solution to health access in rural Africa.

Work already undertaken by AFCAP in its review of the interaction between transport and maternal health (Lema, 2010) found that travelling and the transport services contribute to health outcomes in pregnancy and childbirth in the following ways:

- Poor access, particularly in rural areas of Africa plays a key role in the death of women and newborns in child birth.
- Poor rural access delays decisions in seeking healthcare due to considerations of extra cost and time it places on households seeking healthcare.
- Poor rural access delays women in getting to healthcare in emergency situations.
- Poor access and ineffective transport management capacity delays women and newborns in being referred from health facility to appropriate healthcare professional when medical complications arise.
- Poor access and lack of transport management capacity reduces the ability of community health workers to undertake outreach activities to enhance maternal health access, particularly in pregnancy and post-natal care.
- Poor access of rural communities reduces the morale of health workers and limits the ability to retain skilled health workers
- Poor access and low logistics capacity restricts the ability to deliver medical supplies and drugs in a timely manner for effective maternal healthcare and facility management.
- Poor access impacts on health seeking behaviour in the antenatal period and management of other diseases in pregnancy such as HIV/AIDS and malaria
- Poor access impacts on household's survival if mothers and newborns require post natal care.
- Poor access impacts on the capacity of mothers or households to attend postnatal care for newborns.
- Poor access contributes to the delay in seeking medical attention in the case of sick newborns.

Different sectors need to develop pro-active responses to the worsening of the maternal and neonatal health MDGs. Integrated interventions across the transport and health sectors require robust investigation and evaluation to assess their impact as they address both socio-economic and medical factors contributing to mortality during childbirth. A number of innovative strategies to surmount cost, distance, and time barriers to accessing care have been previously implemented at the community level and many appear to offer solutions. However, few have neither reported or evaluated the possible impact of the wide-scale implementation of these strategies nor offered a route to implementation.

The objectives of this project are to:

- develop a robust evaluation framework to understand the interaction between physical access and maternal mortality
- understand the impact that an ambulance service can have on the level of maternal mortality in rural Africa caused by poor physical access
- inform the development of Mobile Ambulance services elsewhere in Africa

The Research Hypothesis

The hypothesis for this research is that

'the provision of ambulances as a national policy makes a significant difference to the level of severity of Obstetric Complication presenting at LGA Emergency Obstetric Care centres for women from rural areas in Nigeria who suffer from medical complications when giving birth and who need Emergency Obstetric Care'

The Project Design

The design of the project is informed by the undertaking of a systematic literature review. The literature research was undertaken of electronic library resources. A search was undertaken of MEDLINE, Maternity and Nursing Care, HMIC, EMBASE for English language articles over the last 10 years with the terms 'access', 'distance', 'transport', 'travel time', 'ambulance', 'road' and 'emergency referral' always in combination with the term 'maternal mortality'. Additional references were identified from citations in articles retrieved in the initial and second round of searching. Articles were selected for their relevance to the understanding of access and the impact of access on maternal and neonatal health in SSA countries as well as their contribution to the understanding of the access solutions that could be implemented and their evaluation. The outcome of this literature review is contained in Appendix D.

The project will undertake a prospective study of women giving birth and needing referral with medical complications to a higher level of Emergency Obstetric Care in selected communities of Katsina State, Nigeria.

Case study area

It was decided to undertake field work in Katsina State as, in discussion with a range of stakeholders, it was agreed that this was the region where the density and coverage of an Ambulance Service was at its greatest. This would mean that being able to select communities where ambulance coverage is provided and the likelihood of the availability of an ambulance when emergency referral was needed would be at its greatest. It would also mean that the community awareness of the Ambulance Service as an option for emergency referral would also be at its greatest.

Community Sampling

Within Katsina State, three LGAs will be selected to undertake surveys within. The three LGAs will be selected on the following criteria:

- They will all be rural LGAs with an LGA health facility with basic Emergency Obstetric Care provision
- Both will have Mobile Ambulance Service provision, one LGA will have a comprehensive Emergency Obstetric Care provision and the other LGA will not. Furthermore, one LGA will have Emergency Transport Scheme provision provided by the NURTW within the PRINN-MNCH programme
- Overall degree of accessibility or remoteness of the LGA with one LGA being accessible and the other not

Within each of these two LGAs, 10 Health Centres will be sampled using a Cluster Sampling approach. The criteria by which the Health Centres within each LGA will be sampled will include:

- Level of accessibility
- Access to all-weather road
- Access to public transport
- Terrain
- Availability and provision of health centre
- Coverage of mobile phone network

Subject Selection – inclusion and exclusion criteria

Within each Health Centre sampled, a research assistant will be recruited to record the details of all women giving birth who need to be referred by the Health Centre for Emergency Obstetric Care due to medical complications to a higher level in the LGA Primary Health Care Centre. There will be no upper or lower age limit to the subjects selected.

Women who are referred within 28 days of giving birth will be included, but those referred after that period will not be included. Those who are referred as a result of unsafe abortions will also be recruited. Women who are referred after the 28 day period will not be included. Women who are not in labour, but who are referred for antenatal care will be excluded from this study.

Women who are not referred by the health centre but who self-refer, hence 'bypassing' the health centre, will not be able to be selected by the research assistants at the community health centre. However, women who self-refer may be sampled at the referral hospital.

At each referral hospital, a research assistant will also be recruited to sample and assess all incoming women with medical complications when giving birth. These will include those who have been recruited by the Health Centres and those who self-refer from the communities served by the Health Centres being sampled. Those who self-refer will be asked to take part in the study and informed consent will be sought from them (or their accompanying adults).

Those who self-refer and are not from the communities served by the Health Centres being sampled will not be recruited

Recruitment, follow-up and completion procedure

All women, who meet the inclusion criteria, and who present themselves at the Health Centre over the survey period and who are clinically assessed by the health centre staff as in need of emergency referral due to medical complications will be asked (or their accompanying partners) to authorise an informed consent form for them taking part in the study. Women will be recruited after they have received the necessary intervention and the data from their initial assessment will be used to complete the data forms later.

Special procedures will be developed to ensure consent is secured in those cases where the subjects are incapable of giving consent, including adolescents, those unable to give consent for cultural reasons, those travelling without accompanying adults and those unconscious.

If they consent, a special referral form (designed for the study) will be completed. This will include:

- Personal Identification Number
- A Vital Signs assessment of their condition at the point of referral
- A Glasgow Coma Score Assessment
- Record of time of call made for emergency transport
- Record of actual time of departure from Health Centre

They will be then referred by the Health Centre in the timeliest manner possible.

The special referral form will travel with the consenting patient subject.

For those being referred by the Ambulance Service, the Emergency Medical Team (EMT) personnel on the ambulance will be trained to undertake a further clinical condition assessment of the subject when they arrive on scene. In addition, times of departure from scene will also be recorded. If any treatment is administered by the EMT on the journey to the referral hospital, this will also be recorded on the special referral form.

The subject will also be clinically assessed at arrival at the referral hospital and the details of this assessment completed on the special referral form, together with time and means of arrival.

Once the patient is recovering the hospital-based research assistant will collect a small amount of follow-up information using a separate follow-up form including:

- A matching Subject Identification Number to the one on referral
- socio-demographic data (including age, household structure, assets, location and consent required for journey to be made).
- obstetric history

Stopping and discontinuing the study

The study will be stopped or discontinued if:

- patients object to it
- the number of people giving consent is too low to be able to get a statistically representative sample.
- the data gathering and assessment process was deemed to be unnecessarily delaying the referral process
- changes to the Referral Hospital or Health Centre were to rendered the results not valid

Data Analysis

The data from the referral forms will be entered into pre-designed Excel spreadsheet data entry sheets for data cleaning and analysis. Records will be matched to ensure that there is consistency of an individual subjects data over the different points of survey (health centre, ambulance, referral hospital and follow up for example) and that self-refers are correctly identified. This stage will also ensure that the follow up data is matched correctly to the referral data. A cleaned password encrypted combined data file will be created that contains one record per subject with all the necessary data collected over the referral process for that subject.

The data will be analysed to produce descriptive statistics to describe the characteristics of the data set and to describe the characteristics of the subjects being referred. Parametric statistical 'student t' significance tests will be undertaken to test for significance between the assessment scores at referral and at admission at the referral hospital. It will also test for significance of the difference between referral by ambulance and referral by other means.

A multiple regression model will be created to test the degree of explanation provided by the referral mechanism of the differences in the clinical assessment score measured at the referral hospital. Factors used in this analysis will include all of the factors on the referral and follow-up forms as well as the factors used in sampling design for the Health Centre selection.

Maintaining Privacy and Confidentiality of Data

All paper forms will be kept for the rest of the life of the project in secure accommodation by the State Ambulance Service. At the end of the project the paper forms will be destroyed. The electronic data will be securely maintained by the State Ambulance Service according to the regulations of the Data Protection Act. This data will be available for the purposes of further research by the Ambulance Services, other Health Sector organisations and external researchers under clear procedures and rules.

WRITEN INFORMED CONSENT FORM

Title of Research Project:

Research study on role of Ambulance Services in improving maternal and neo-natal health outcomes

Name of Principal Investigators: Mr Jeff Turner

The Katsina State Primary Health Care Development Agency (KSPHCDA) Mobile Ambulance Service, together with Transaid, a UK-based transport charity are undertaking a joint research project which is funded by the UK government. The project is looking at what difference the Mobile Ambulance Service can have on the lives of women who suffer complications when giving birth and need to travel to reach medical attention in an emergency. The project is looking at whether women suffering complications when giving birth arrive at hospital faster and in a better condition than those who arrive by taxi, walking or other means. To help us with this study, we ask that you let the health worker monitor your condition as you are being transferred to the hospital and on arrival. We also ask that you allow us to use the information for our research. The information you give will be kept confidential and your information will remain anonymous.

For further information about the project, please contact .....

Initial the box if you agree with the statement to the left

1 I confirm that I have read and understand the information sheet explaining the above research project and I have had the opportunity to ask questions about the project. ☐

2 I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline. ☐

3 I understand that information will recorded on paper forms and entered into a computer database and that this information will be kept confidential and anonymous. I give my permission for members of the research team to have access to this information. I understand that my name will not be used in any papers, reports or other publications that result from the research. ☐

4 I agree for the information collected to be used in future research ☐

5 I agree to take part in the above research project. ☐

_____ _____ _____ _____

Signature/Thumbprint Date Witness Date

_____ _____ _____

Name of person taking consent Date Signature

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/pre-written script/information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be kept with the project's main documents which must be kept in a secure location.

FIELD GUIDE: REFERRAL FORMS CONDITION ASSESSMENT TOOLS & QUESTIONNAIRES

REFERRAL FORM

1. Unique Identification Number 0
2. Date .....
3. Health Centre: ..... (If Self-Referral to Hospital answer SELF-REFERRAL)
4. Name and signature of Health Worker .....
5. Patient's name (sick person/child) .....
6. Patient's address .....
7. Time of Referral requested ...Hours/...Minutes AM/PM
8. Time of Departure ...Hours/..Minutes AM/PM
9. Time of Arrival at Final Referral Hospital ...Hours/ ... Minutes AM/PM
10. Reason for referral .....
11. Vital Signs Assessment

RESPS	
NEURO	
BP	
PULSE	
URINE	
TEMP	
TOTAL	

Score	4	3	2	1	0	1	2	3
Resp rate			≤ 8		9-14	15-20	21-29	≥30
Neurology Patient responds to OR GCS		≤ 8	9-13	New agitation or confusion 14	A (Alert) 15	V (Voice)	P (Pain)	U (Unresp)
Systolic BP	<80	81-90	91-100	101-110	111-199		>200	
Pulse (BPM)			<40	41-50	51-100	101-110	111-130	>131
Urine Output		<10 ml/hr	<30 ml/hr					
Temp			<35.0	35.1-36	36.1-38	38.1-38.5	≥ 38.6	

(Source: Royal United Bath Hospitals Trust, UK:http://www.ruh.nhs.uk/about/policies/documents/clinical_policies/blue_clinical/Blue_776.pdf)

12. **Glasgow Coma Score**

Eye opening	
Verbal Response	
Motor Response	
TOTAL	

Glasgow Coma Score Instructions (Source: Jevens, P. Neurological Assessment Part 3 – Glasgow Coma Scale (2008) Nursing Times Vol 104, No 29, pp 28-29 July 2008http://www.nursingtimes.net/neurological-assessment-part-3-glasgow-coma-scale/1735582.article)

The 15-point scale assesses the patient's level of consciousness by evaluating three behavioural responses:

- Eye opening;
- Verbal response;
- Motor response.

Eye opening

Assessment of eye opening involves the evaluation of arousal (being aware of the environment):

- Score 4: eyes open spontaneously;
- Score 3: eyes open to speech;
- Score 2: eyes open in response to pain only, for example trapezium squeeze (caution if applying a painful stimulus);
- Score 1: eyes do not open to verbal or painful stimuli.
- Record 'C' if the patient is unable to open her or his eyes because of swelling, ptosis (drooping of the upper eye lid) or a dressing.

Verbal response

Assessment involves evaluating awareness:

- Score 5: orientated;
- Score 4: confused;
- Score 3: inappropriate words;
- Score 2: incomprehensible sounds;
- Score 1: no response. This is despite both verbal and physical stimuli.
- Record 'D' if the patient is dysphasic and 'T' if the patient has a tracheal or tracheostomy tube in situ.

Motor response

Assessment of motor response is designed to determine the patient's ability to obey a command and to localise, and towithdraw or assume abnormal body positions, in response to a painful stimulus (Adam and Osborne, 2005):

- Score 6: obeys commands. The patient can perform two different movements;

- Score 5: localises to central pain. The patient does not respond to a verbal stimulus but purposely moves an arm to remove the cause of a central painful stimulus;
- Score 4: withdraws from pain. The patient flexes or bends the arm towards the source of the pain but fails to locate the source of the pain (no wrist rotation);
- Score 3: flexion to pain. The patient flexes or bends the arm; characterised by internal rotation and adduction of the shoulder and flexion of the elbow, much slower than normal flexion;
- Score 2: extension to pain. The patient extends the arm by straightening the elbow and may be associated with internal shoulder and wrist rotation;
- Score 1: no response to painful stimuli.

QUESTIONNAIRE FOR USE IN REFERRAL HOSPITAL

1. Unique Identification Number .....
2. Name of Community where you live? .....
3. How old are you? <16 16-24 25-34 35-44 45>
4. Are you?

   Single Married Divorced Widowed
5. How many children do you have that are alive today? .....
6. How many other live births have you had?.....
7. How many pregnancies have you had? .....
8. What complications have you had before when giving birth? .....
9. Which of these do you have at home?

   Fridge. Generator. Radio Motor Vehicle. Motorbike. Bicycle.
10. What plan did you have in place for any complications this time?

    Money saved Community fund contributed Transport organised
11. What caused you to seek medical care on this occasion? .....
12. Who and where was the first place you sought medical care? .....
13. How did you arrive at Health Centre? .....
14. Who helped you travel to the Health Centre? .....
15. How did you travel to the Referral Hospital? .
16. How did you arrive at Referral Hospital?
17. Who travelled with you to the Referral Hospital?
18. If you self-referred, what made you come to this centre?

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APPENDIX 2 – Bibliography of Impacts and Evaluation Methods

Introduction

Method

A literature search was undertaken of electronic library resources. A search was undertaken of MEDLINE, Maternity and Nursing Care, HMIC,EMBASE for English language articles over the last 10 years with the terms ‘access’, ‘distance’, ‘transport’, ‘travel time’, ‘ambulance’, ‘road’ and ‘emergency referral’ always in combination with the term ‘maternal mortality’. Additional references were identified from citations in articles retrieved in the initial and second round of searching. Articles were selected for their relevance to the understanding of access and the impact of access on maternal and neonatal health in SSA countries as well as their contribution to the understanding of the access solutions that could be implemented and their evaluation.

The bibliography below is set out into 5 areas:

- Access as part of risk factors for maternal mortality
- Access as part of risk factors for maternal morbidity
- Access as part of risk factors for neonatal and infant mortality
- Access impact on health interventions
- Impact on health of access interventions

QUANTITATIVE MATERNAL MORTALITY RISK FACTORS		
Authors and Year	Method	Transport Findings and Conclusions
Abiodun, O.M. and A.P.Aboyeji (2008) 'From home delay to institutional neglect: an emerging trend in obstructed labour' Research Letters, Tropical Doctor, Vol 38 July 2008	Review of all obstructed labour managed in the hospital over a 2-year period (2005-6). 146 obstructed cases during this period of 2176 deliveries.	Only 4.1% came directly from home. 76.7% came from another health facility. Almost a fifth (18.5%) came from a general hospital that should have been well equipped to carry out a caesarean section.
Acharya L B and J. Cleland, 2000 Maternal and child health services in rural Nepal: does access or quality matter more? Health Policy & Planning Vol 15, No 2, pp 223-229	Community Survey of 237 sample clusters of the National Fertility, Family Planning & Health Survey (NFFHS) in western and mid-western hill region on Nepal, with limited info on access and quality of services. Additional more detailed community survey by visiting 56 NFFHS clusters, 28 health posts and 42 community health volunteers. The clusters selected on the basis that they have a health post within 3 hours walking distance. In total information on 592 children under five from 56 clusters and 28 health posts. Questions asked of those in receipt of antenatal care and BCG immunization.	In terms of net or adjusted results, travel time to the nearest health post has a significant effect on both outcomes. Compared to communities that 2-3 hours away from a health post, use of both antenatal care (4.1 times higher) and BCG immunization services (2.04 times higher) is higher when the health post is located in the village. In the absence of outreach services, health post quality exerts a much more pronounced influence on service utilization than access. Antenatal care utilization is twice as high where there is a health post in a cluster than when there is no health post, but when there is no health post, travel time is unrelated to service uptake. This is even more pronounced for child immunization services. The conclusions regarding the access-quality trade-off are clear. Evidence strongly suggests that basic improvements to health-post quality is more important priority than increases in the number of health posts.
Baiden, F., K. Amponsa-Achinano, A.R. Oduro, T.A.Mensah, R.Baiden and A. Hodgson (2006), 'Unmet need for essential obstetric services in a rural district in northern Ghana: Complications of unsafe	Descriptive analysis of data extracted from monthly returns charts and clinical notes on all maternal deaths from Jan 2001 to Dec 2003 at the District Hospital for Kassena-Nankana District	71% of maternal deaths in hospital occurred in women who lived within 15km of the hospital. The authors reported that, either women who live further from the hospital are purposefully not using the emergency services of the hospital or were dying before even reached the hospital. They reported that access was unlikely to be one of lack of finance as services in the hospital were free, but no mention was

abortions remain a major cause of mortality' Public Health, No 120, pp 421-426.		made of transport costs. Geographical and cultural factors were, the authors claimed, needs to be explored as 50% of deaths occurred within 24hr of arrival suggesting that women were waiting too long before reporting to the hospital.
Van den Broek, N.R, S.A. White, C. Ntonya, M. Ngwale, T.R. Cullinan, M.E.Moyneux, J.P.Neillson (2003) 'Reproductive Health in Rural Malawi: a population-based survey' BJOG: An international Journal of Obstetrics and Gynaecology, Vol 110, pp 902-908	Quantitative structured questionnaire interviews with women in 20,649 households.	The study reported that average distance for those household surveyed was 4.85km with The distance of a household from a health centre was found to be important by the authors for outcomes. They found that for households situated within 1km of the health centre, 79.1% of pregnancies resulted in a currently living child, whereas they found that for households living 7km or more away this had reduced to 73.3% ($p<0.0001$). The study also found that as distance from health centre increased assistance at birth is more likely to be given by a traditional birth attendant of female relative than by a trained midwife.
Fawcus, S., M. Mbizvo, G. Lindmark, and L. Nystrum (1996) Studies in Family Planning Vol 27 No 6 pp 319-327	The research team in the area of rural Zimbabwe followed up all reports of maternal death and traced events occurring prior to and at the time of the death by visiting the home of the deceased woman and all health-care locations (both community and formal) that she had visited. Interviews were conducted with her relatives and with traditional birth attendants, clinic staff, and hospital staff when these were relevant. Any existing case notes were analyzed and photocopied. The information gathered was recorded by means of a detailed questionnaire that included socioeconomic, reproductive, medical, and health-service data. In addition, the total number of live births for the woman who had died was documented in both areas using information obtained from the health-information systems and from the informal study network	Problems of access to care from home to health facilities that were the result of non-availability of transportation contributed to 28 per cent of deaths in Masvingo and 3 per cent of those in Harare. In the cases studied, some families who could raise the money resorted to hiring a private car for urgent transport. TBAs' delays in referring problem cases were the result of non-availability of any method of emergency transport or communication. In Masvingo, the non-availability of emergency transportation for referral contributed to the deaths of 17 (of 105) women who needed to go from a clinic to a hospital and two women (of 105) who needed transport from a rural to a provincial hospital. Seven women (of 105) had been staying in a specially designed shelter or lodge for waiting mothers before their deaths, but died anyway. A review of the case histories showed that 20 women might have benefited from being in a waiting shelter when they went into labour. These included women with risk

		factors for haemorrhage (for example, previous caesarean section and high parity), and all women who lived more than 30km (18.6 miles) from a health facility.
Garenne, M., K. Mbaye, M. Diawo Bah, and P. Correa (1997) 'Risk Factors for Maternal Mortality: A case-control study in Dakar Hospitals (Senegal)' African Journal of Reproductive Health, Vol 1, No1. Pp14-24	Each case of the 152 maternal deaths over a 12-month period were matched with two controls: safe delivery in the same clinic and safe delivery in the same neighbourhood of residence. Controls were matched on age, birth order, place and time of delivery.	The study found that women who were referred late, defined as 24hours or more after the onset of symptons, often as a result of delays in seeking care or travel to hospital, had a 23.2% Odds Ratio (95% C.I between 13.25% and 40.21%) or increased risk of mortality. The study also found that women referred from further away were more likely to have had severe complications and to arrive late and this may have inflated the odds ratio associated with complications with distance from hospital and with late referral.
Filippi, V., C. Ronsmans, V. Gohou, S. Goufodji, M. Lardi, A. Sahel, J. Saizonou and V. De Brouwere (2005) 'Maternity wards or emergency obstetric rooms? Incidence of near-miss events in African hospitals' Acta Obstetric GynaecologicaScandanavia, Vol 84, pp 11-16	Prospective and retrospective reviews of medical records were conducted in 9 referral hospitals. 2864 near miss cases were identified. The incidence of near-miss obstetric events was calculated as well as for near-miss cases and maternal deaths related to hemorraghe, hypertensive diseases, of pregnancy, dystocia, infections and anemia. Analysis undertaken of these in relation to hospital and timing relative to admission.	83% of the near-miss cases were in a critical condition on arrival at the hospital (range 54%-90%) and 69% of them (range 19%-81%) had been referred from another health facility. Those referred, were more statistically more likely to be a near miss case on arrival (88% compared to 77% for non referred ($p<0.0001$)). The proportion of near misses after admission was similar between diagnostic categories. The importance of the condition on referral and admission is stated by the research that women with near-miss events make up a very large proportion of deliveries in some African hospitals, with them representing nearly a quarter of admissions in 2 referral hospitals in Cote d'Ivoire. Overall, near miss cases were 15 times more common than deaths.
Kawuwa, M.B., A.G. Magira, H.A. Usman. (2007) 'Community Perspective of Maternal Mortality: Experience from Konduga Local Government Area, Borno State, Nigeria' Annals of African Medicine, Vol 6	The study took place between 10th October and 10th December, 2003. An in-depth interview guide developed by the Network for Prevention of Maternal Mortality which contains mainly opened questions, modified to suit the socio-cultural setting was used. 30 people were interviewed from representatives of traditional leaders, religious leaders, local government administrators,	The main problem considered in deciding to take a woman to hospital was reported by 93.8% of those interviewed to be lack of money and transport. A range of motorised vehicles were used to transport patients with obstetric complications as well as animal and other non-motorised means in the rainy season when access is difficult. The husband, a relation or the local government council provides the money, though

No 3 pp 109-114.	teachers, civil servants, members of the transport unions, women community leaders, women NGO's and staff of primary health centres.	sometimes, respondents reported that a patient has to sell her farm produce or seek a loan to finance transport.
Mhlanga, R.E., P.Tiebere, N. Xundu (2006) 'Maternal deaths of non-pregnancy-related infections: 3rd report of confidential enquiry into maternal deaths in South Africa 2002-2004' South African Journal of Obstetrics & Gynaecology, Vol 12, No 3, pp 130-138	Study of all the reported maternal deaths in South Africa for the 2 year period	Lack of access to health facilities is a major factor in 5.8% of all cases. Delay in transport from home to health facility had improved from 4.9% in 1999-2001 to 1.6 % in 2002-04. Delay in transport between institutions had worsened from major factor in 2.3% in 1999-01 to 3.3% of all cases in 02-04. Lack of available health care facility had improved from a major factor in 8% of all cases in 1999-01 to 5.8% in 02-04.
Okong, P, Byamugisha, J, Mirembe, F, Byaruhanga, R and Bergstrom, S (2006) Audit of severe maternal morbidity in Uganda – implications for quality of obstretric care. ActaObstretricia&GynecologiaVol 85 pp 797-804	Audit of maternal near miss cases from Jan 1999 to Sept 2000. Midwives identified cases. Resident obstretician reviewed cases. Efforts made to identify 2 key factors from clinical criteria for near miss. Women were then identified once recovered but before discharge. Verbal consent secured as well from relatives and relevant health workers. Open-ended questionnaires to collect demographics, medical history, efforts to seek care etc. Midwives out of uniform undertook the interviews. 685 women with checked with 229 meeting the criteria of near miss.	122 or 53% of cases reported had delays due to lack of transport, long distances or inappropriate means of travel. 34% also reported a lack of blood or lack of transport to the blood bank.
Okonta, P.I, U.K. Ovali, V.O. Otoide, and D. Twomey (2002) 'Exploring the causes of and risk factors for maternal death in a rural Nigerian referral hospital' Journal of Obstetrics and Gynaecology, Vol 22, No 6 pp 626-629	A 10-year review was conducted of all maternal deaths at the hospital. Records were reviewed from delivery, abortion and 'born before arrival' registers and cross-checked from maternal death register of the head of obstetrics & gynaecology. Case notes reviewed and causes of death determined clinically as no post-mortem data available.	Of the 104 studied. 72.9% occurred in women who had been labouring at home without supervision. Almost half of the maternal deaths occurred in women who lived more than 10km away from the hospital.
Onah, H.E., J.M.Okaro, U.	Study carried out of all maternal deaths in 5 health	The 2nd phase study found that 70.8% of deaths had been

Umeh, C.O. Chigbu (2005) Maternal Mortality in health institutions with emergency obstetric care facilities in Enugu State, Nigeria' Journal of Obstetrics and Gynaecology, Vol 25 No 6 pp 569-574	facilities with Emergency Obstetric Care facilities over the period of 1999-2003. The study was carried out in 3 phases. The 1st phase was a retrospective analysis of all 141 maternal deaths in the 5 institutions, 2nd phase was a detailed study of 89 deaths to determine characteristics, causes of death and degree of preventability. In 3rd phase, in-depth interviews were conducted with service providers about the state of maternal death in their institutions	referred from another health institution with 52.4% of these referred from a private hospital, 14.3% from private midwives and the same from TBA's and only 9.5% from a health centre. 52.8% of deaths experienced some form of delay according to the 3-delay model. 53.2% of these experienced a type 3 delay in receiving the appropriate care. The majority of this Type 3 delay (46.4%) was attributed to a delay in referral.
Tiebere, P., D. Jackson, M. Loveday, L. Matizirofa, N. Mbombo, T. Doherty, A. Wigton, L. Treger and M. Chopra. (2007) 'Community-based situation analysis of maternal and neonatal care in South Africa to explore factors that impact on utilisation of maternal health services' Journal of Midwifery and Women's Health, Vol 52, No. 4 pp 342-350.	Multiple methods were undertaken across the 3 sites. Quantitative semi-structured interviews were undertaken with 178 subjects. 57 qualitative case studies using the verbal autopsy approach were conducted of adverse outcomes such as maternal death across the 3 sites.	The study found that higher maternal and infant services utilisation ($p<0.1$) was related to, amongst other factors, multiple transport and distance related variables. It also found that a lack of financial resources for transport was cited most often as the reasons women gave for having difficulty in accessing antenatal care. The causes of 18 maternal deaths were reviewed and 67% occurred in the hospital. Lack of transport was considered a possible cause in only one of the 6 non-hospital deaths. In-depth interviews were conducted with the care-givers of 15 infants who died. Themes that emerged regarding factors that influenced the utilisation of child health services included socio-economic such as no money for transport to a health facility.
Walraven, G., M. Teller, J. Rowley and C. Rosmans (2000) 'Maternal mortality in rural Gambia: levels, causes and contributing factors' Bulletin of the World Health Organisation, Vol 78, No 5 pp603-613	Demographic Study carried between Jan 1993 and December 1998 recorded the deaths 74 women aged 15-49 from a longitudinal surveillance system. Maternal mortality questionnaire using a verbal autopsy and a section on contributing factors was then filled out for 18 deaths that were classified as maternal by at least 2 physicians in the team.	The medical reviewers found that a lack of transport was a contributory factor in between 5.6% and 16.7% of cases and delays in seeking care contributed in between 11.1% and 27.8% of mortality cases.
Witter, S and Diadhiou, M (2008) Key informant views of a free	Key informant interviews carried out from Nov 2006-Jan 2007. Using purposive sampling 54 individuals with	One of the themes that came out strongly from the key informant interviews at lower levels was the reality of

delivery and caesarean policy in Senegal. African Journal of Reproductive Health Vol 12 No 3 pp 93-112	technical and administrative, or political responsibility for the free delivery policy at the national, regional, district and health post level.	geographical isolation. It was reported that women living in remote villages have very little chance of benefiting from this policy as they do not use the facilities where it is being applied. The study found that even when the policy is being applied and free Caesarean Section kits are available then there are still ongoing costs of arriving at and using formal health services including postnatal care items, food, transport and plus costs due to potential complications.
Ziraba, A. S. Mills, N. Madise, T. Saliku and J-C, Fotso (2009) 'The state of emergency obstetric care services in Nairobi informal settlements and environs: Results from a maternity health facility survey', *BMC Health Services Research*, Vol 9 No 46	Survey of 25 maternal health facilities within or near 2 informal settlements in Nairobi, Kenya, drawn from locations women mentioned in the Nairobi Urban Health Demographic Surveillance System household survey of 60,000 individuals across 23,000 households across the communities.	The study did not measure physical distance and since it was an urban study it was not considered as a significant factor, however, it did comment that accessing facilities at could be difficult due to rampant insecurity within these communities. It reported that almost all health facilities had working telephones or shortwave radio. Only 5 health facilities had emergency transport on site for referral of obstetric emergencies. The lack of ambulances was reflected, the study argued, for the high level of emergencies that arrive at referral hospitals on foot or public transport.

QUANTITATIVE MATERNAL MORBIDITY RISK FACTORS		
Kadowa, I. (2010) Ruptured uterus in rural Uganda: prevalence, predisposing factors and outcomes' Singapore Medical Journal, Vol 51 No 1 pp 35-38	A five-year retrospective review of all ruptured uterus admitted to Mityana Hospital, Uganda from Jan 1, 2003 to Dec 31, 2007	The study found that 64.4% of the women admitted with ruptured uterus lived over 10km from the hospital. It found that women who lived over 10km from the hospital had an odds ratio (OR) of 3.62 of attending with a ruptured uterus
Muleta, M., S. Rasmussen and T. Kiserud (2010) 'Obstetric Fistula in 14928 Ethiopian women' ActaObstetrica&GynecologicaVol 89 pp 945-951	Self-reported age, marital status, education, distance from home to health facility, parity, duration of labour, neonatal outcome and sex, time lag to treatment, measurement of weight, stature, extent of lesion and clinical assessment of continence before hospital discharge were measured for the population admitted to the Addis Ababa Fistula Hospital between 1974-2006	The study found that primiparity had the strongest and most consistent association with longer duration of labour, stillbirth, urethal damage and vaginal scarring. Height of <145cm and walking distance to the nearest health facility, it was found, did not influence those parameters.
Okong, P., J. Byamugisha, F. Mirembe, R. Byaruhanga, S. Bergstrom (2006) 'Audit of severe maternal morbidity in Uganda – implications for quality of obstetric care'. ActaObstetrica&GynecologicaVol 85 pp 797-804	This study is an exploratory systematic enquiry into the care of a subset of women with severe morbidity designated as near miss cases by organ failure or dysfunction. Patient factors and environmental factors were also explored. Data was abstracted from clinical records for 229 cases and from interviews with patients, relatives and health workers.	The study found that 1 in 5 cases cited a lack of money, lack of transport and interference by relative who advised the women not to go to hospital as reasons for delays in seeking care.
Ramphal, S.R., G.Kalane, T. Fourie& J. Moodley (2008) ' An audit of obstetric fistula in a teaching hospital in South Africa' Tropical Doctor, Vol 38, pp 162-163	The Clinical data of women admitted with a diagnosis of vesico-vaginal fistula from 1999 to 2003 was documented. Demographic and obstetric information was obtained using a structure data sheet. For descriptive purposes, obstetric urinary fistula werecatergorised into simple VVF, complicated VVF and vesico-uterine fistula.	It found that 40 of the 41 sampled had cited lack of transport as a major factor of delay in seeking emergency medical care.

QUANTITATIVE CHILD MORTALITY RISK FACTORS		
Authors and Year	Method	Transport Findings and Conclusions
Anyamele, O.D (2009) 'Urban and Rural Differences across countries in Child Mortality in Sub-Saharan Africa Journal of Health Care for the Poor and Underserved, Volume 20, Number 4, Supplement, pp. 90-98	Data from Demographic and Health surveys from 11 sub-saharan Africa countries. Using logit models to analyse the differences between urban and rural child mortality with a range of socio-economic variables including household wealth, level of education of the mother, access to clinics and other environmental variables as control variables. The odds ratios are calculated for under-fives mortality in urban and rural areas.	It could be argued that this study has urban and rural place of residence as a proxy for the level of access to healthcare. It finds that in many countries the level of access afforded by urban living reduces the likelihood of mortality for children. In Benin, it falls by 11.61%, Cameroon, 15.45%, Chad, 29.75%, DRC, 23.13%, Ethiopia, 25.42%, Mali, 17.74%, Malawi, 26.96%, Madagascar, 21.7%, Niger, 39.16%, Nigeria, 16.89% and Rwanda, 33.15%.
Becher, H and O. Muller and J. Albrecht and A. Gbangou and G. Kynast-Wolf and B. Kouyate (2004) 'Risk Factors of infant and child mortality in rural Burkina Faso' Bulletin of the World Health Organisation April 2004, Vol 82, No. 4, pp265-273.	The team performed a survival analysis of births within the population under demographic surveillance from 1992-1999 based on a demographic surveillance system for 39 villages around Nouana with a total pop'n of 30000. All children born alive in the period Jan 1993-Dec 1999 followed up until Dec 1999 were included. All-cause childhood mortality was used as an outcome variable	The research found that being born in the rainy season was associated with significantly higher risk of mortality during the 1st year of life compared with being born in the dry season (rate ratio of 1.21, P=0.04) and it would be interesting to see to what extent poor access in the wet season plays in that increased mortality. Furthermore, it was found that there was a 33% significantly increased infant mortality risk for those who were living more 10km from their nearest health centre.
Benzier, J., R. Sauerborn, (1998) 'Rapid Risk Household Screening by neonatal arm circumference: results from a cohort study in rural Burkina Faso' Tropical Medicine and International Health Volume 3, No 12 pp 962-974	Neonatal Arm Circumference and other attributes of newborn children and its household were measured across a cohort of 1367, which the majority of children born from 1992-94 in a rural area of Burkina Faso. Using regression modelling of risk factors for child mortality as well as Neonatal Arm Circumference, a rapid scoring system was developed for households at risk of child death.	The study found that prescence of a nearby health centre was a significant factor associated with the child's survival in the first 2 years of its life. Overcoming significant distances and accessing antenatal care was also found to be a significant
Enweronu-Laryea, C.C., K. Nkyekyer, O.P.Rodrigues, (2008) 'The impact of improved neonatal intensive	Hospital records were reviewed for place of birth, birth weight and outcome (discharge or death) for all admissions at Korle Bu Teaching Hospital, Accra, Ghana NICU from October 2003 to September 2005. Birth asphyxia was defined according to the WHO International Classification	The study argued that the high mortality among out-born asphyxiated NBW may have been due to the mode of transportation (usually in a taxi by their relatives) to NICU. Poor outcome of out-born asphyxiated newborns has been observed in studies in more developed countries as well.

care facilities on referral pattern and outcome in a teaching hospital in Ghana' Journal of Perinatalogy, Vol 28, pp 561-565	of Diseases Code 10.9 Newborns weighing X2500 g who required resuscitation at birth, had weak/absent cry at birth or were assessed by the primary health-care worker to have blue/white asphyxia as the reason for NICU referral were recorded as having birth asphyxia.	
Rutherford, M.E., K. Mulholland and P. C. Hill (2010) How Access to health care relates to under-five mortality in sub-Saharan Africa: a systematic review' Tropical Medicine and International Health, Vol 15, No 3 pp 508-519	Search of PubMed and EMBASE without date restrictions for terms 'access', 'distance', 'cost', 'transport', 'travel-time', 'social', 'automony', 'time availability' alone and in combination with 'health care', 'SSA', 'case control' and 'cohort' and always in combination with 'child mortality'.	There was no robust evidence of an association between distance to health services and child death. There has been some studies that have shown a significantly increased risk of death in infants but not in children, though others have shown no association in children under 4 months. However, the authors highlight that whilst distance was not significant in the more robust studies, the adopted measures were often a binary value for distance; thus the relationship between increasing distance and increasing risk of child death could not be assessed. Distances were measured as a straight line and may under-report true distance and no measure of time taken or public transport availability. The authors suggest travel time may be a superior measure.
Rutherford, M.E., J.D. Dockerty, M. Jasseh, S.R.C. Howie, P. Herbison, D.J. Jeffries, M. Leach, W. Stevens, K. Mulholland, R. A. Adegbola, P.C.Hill (2009) Bulletin of World Health Organisation No 89 pp 216-224	This study conducted a case control study in a population under demographic surveillance. 140 children under the age of 5 who died between 1 Dec 2003 and 30 April 2006 were examined. Each was matched in age and sex to 5 controls. Information was gathered from primary caregivers. The data analysed using conditional logistical regression.	Whilst the study found that living in a rural areas was significantly associated with an increased risk of death, other measures of rurality particularly longer physical distance to a health care facility did not explain the increased risk of death. The study concluded that simple measures of health facility access such as distance and travel time may not be adequate to understand access issues to health in rural areas and highlighted possible further exploration of issues such as financial autonomy of the care giver.
Wort, U.U. M. Warsame, B.J.Brabin (2008) 'Potential use of birthweight indicators in rural Tanzania for monitoring malaria control in	Birthweight data were obtained for the years 1997-2001 from Kilosa district hospital (n=6269), nine dispensaries (n=3688) and for home deliveries (n=677)	Prevalence of low birthweight in primigravidae increased with distance of the dispensary from the district hospital. Mean birthweight for dispensaries was associated with distance from main district hospital, with deliveries at distances of greater than 25km at highest risk for low birthweight. Access to health

pregnancy' Public Health, Vol 122 pp 923-932		facilities providing antimalarials for use during pregnancy and access to hospital were governed by proximity to the road which linked the dispensaries and the hospital. The increased risk of low birthweight observed with increasing distance from hospital, the authors argued most likely indicates limited accessibility to malaria-related measures in pregnancy.

QUANTITATIVE EVALUATION OF TRANSPORT IMPACT ON OTHER HEALTH INTERVENTIONS		
Gage, A., (2007) 'Barriers to utilisation of maternal health care in rural Mali' Social Science & Medicine Vol 65 pp 1666-1682	The study used the 2001 Mali Demographic and Health Survey. The analysis was based on the most recent birth in the past 5 years to rural women, an effective sample of 6178 births. Muti-level logistical regression was carried out.	The study found that in areas where it took 15mins or less to access the pre-natal clinic the odds of receiving 4 or more pre-natal clinics were 1.44 times higher than in areas that were more than 15 mins away. The odds (OR 1.409) were also significantly higher of having delivery assistance by trained personnel for those within 15 mins of the clinic. Distance alone was found to be unrelated to the utilisation of pre-natal care but had a strong constraining effect on the odds of delivery care with OR = 0.304 for women living between 10 and 14km away from the nearest source of delivery care.
Gikandi, P., A.M.Noor, C. W. Gitonga, A.A. Ajanga, R.W. Snow (2008) 'Access and barriers to measures targeted to prevent malaria in pregnancy in rural Kenya.' Tr	All women aged 15-49 were interviewed during a community survey in 4 districts in different regions in rural Kenya between Dec 2006 and Jan 2007. Women pregnant in the last 12 months were asked about age, parity, education, use of bed nets, Insecticide Treated Nets, antenatal care services and SP use during pregnancy. Homestead assets were recorded to develop a wealth index and travel times were computed using GIS travel time. algorithms.	It found that the use of bed nets were statistically associated with use of IPT from antenatal clinic (OR 1.73) , those who were least poor households (OR 2.53), those who were multigravid (1.53) and those who were within 1hr walking distance of the antenatal clinic (OR 0.67). Distance was also found to be significant (OR 0.61) with the use of Insecticide Treated Nets (ITN).
Hounton, S., G. Chapman, J. Menten, V. De Brouwere, T. Ensor, I. Sombie, N. Meda, C. Ronsmans (2008) ' Accessibility and utilisation of delivery care within a Skilled Care Initiative in rural Burkina Faso' Tropical Medicine and International Health Vol 13 Supp 1 pp 44-51	Data was collected on staffing, equipment, water and energy supply for all health centres and a functionality index for health centres was constructed. A household census was conducted in 2006 to assess assets of all household members and document pregnancies lasting more than 6 months, between 2001 and 2005 with place of delivery and delivery attendant. Analysis undertaken using univariate and multi-variate logistic regression.	Distance to health centre was a major determinant of institutional delivery – ¾ of births within a 1km of health centre took place in a facility where as less than a 1/5 took place in a facility if the women lived more than 10km away. The distance to health centre and socio-economic characteristics of mother were found to be important determinants of institutional birth up to 7km away (with OR 0.77/km) levelling off beyond that (OR 0.97/km)
Meda, N., S. Hounton, V. De		This paper recommends that from the rural Burkina Faso

Brouwere, I. Sombie, P. Byass (2008) 'From evaluating a Skilled Care Initiative in rural Burkina Faso to policy implications for safe motherhood in Africa' Tropical Medicine and International Health Vol 13 Supp 1 pp 68-72		studies, utilisation of maternal health services falls off sharply with distance from health facility. It claims that outreach services are at best only an interim solution and to this problem; countries need to embark on policies leading to 24-hr universal coverage of basic emergency obstetric care with 5km and these facilities must have adequate logistics for upward referral.
Mills, S. J. E. Williams, M. Adjuik, A., Hodgson (2008) Use of Health Professionals for Delivery Following the Availability of Free Obstetric Care in Northern Ghana Maternal and Child Health Journal Vol 12, pp 509-518	The comprehensive women's questionnaire administered consisted of sections on background characteristics, routine household decision-making, birth history, perceived access to care, perceived quality of care, use of antenatal care, use of delivery care, use of postnatal care, obstetric complications, health seeking following obstetric complications, breakdown of antenatal, delivery and postnatal care, how services were paid for, and household possessions.	In the final parsimonious model, physical access factors [such as availability of public transport (OR = 1.50), travel distance to the district hospital (for 20+ km, OR = 0.31)] as well as community perception of use of access to the nearest health facility (for highest quintile, OR = 4.44) showed statistically significant associations with use of health professionals at last delivery in the Kassena-Nankana district.
Mpembeni, R. J. Z. Killewo, M.T.Leshabari, S.N. Massawe, D. Mushi, H. Mwakipa (2007) 'Use pattern of maternal health services and determinants of skilled care during delivery in Southern Tanzania: implications for achievement of MDG-5 targets' BMC Pregnancy and Childbirth Vol 7, No 29.	Interviews were conducted with a random sample of women between 14 and 50 who gave birth within 1 year prior to the survey using a structured questionnaire.	The study found that living within 6km of a health centre was a significant impact on whether mother would use a skilled attendant (OR 4.09 CI 2.72-6.16) as well as discussions with male partners on location of delivery, advice from health workers and knowledge of pregnancy risk factors.

QUANTITATIVE EVALUATION OF TRANSPORT OR EMERGENCY REFERRAL INTERVENTION		
Essien, E., D. Ifenne, K. Sabitu, A. Musa, M. Alti-Muazu, V. Adidu, N. Golji, M. Mukaddas (1997) 'Community Loan Fund and transport services for obstetric emergencies in northern Nigeria' International Journal of Gynecology& Obstetrics, Vol 59, Supt 2 S237-S244	A community loan program was established in early 1995. Community members determined its features: compulsory contributions, community administration, loans for obstetric complications only, no interest, a 6-month grace period and 24-month repayments. A transport service was also established in which private drivers agreed to respond to calls for emergency transport for a set fee. The outcome of this measure was recorded.	The study reported 18 women transported in obstetric complications over a 10 month period. A successful community loan scheme was established. The evaluation of the health outcomes of these interventions was less than robust. It was not possible to say how many of the women would have reached EmOC without the intervention in place or to evaluate the level of utilisation of the community emergency loan fund and transport service.
Fournier, P., A. Dumont, C. Tourigny, G. Dunkley and S. Drame (2008) 'Improved access to comprehensive emergency obstetric care and its effect on institutional maternal mortality in rural Mali' Bulletin of World Health Organisation Vol 87, pp 30-38	A maternity referral system that includd basic and comprehensive emergency obstetric care, transportation to obstetric health services and community cost sharing schemes were implemented in 6 rural health districts in Kayes region of Mali between Dec 2002 and No 2005. In an uncontrolled 'before' and 'after' study all obstetric emergencies, major obstetric interventions and maternal deaths were recorded for the year prior to the intervention and for the 3 years of the intervention. The primary outcome was risk of death among obstetric emergency patients, calculated using crude case fatality rates and crude odds ratios.	The study found that in women treated for obstetric emergency, the risk of death 2 years after implementing the measures was half the risk recorded before the intervention (OR 0.48 95% CI 0.30-0.76). Maternal mortality rates decreased (from a CFR of 15.4 to one of 5.97) more among women referred by the community health posts for emergency obstetric care than among those who presented to the district health centre without referral (from a CFR of 7.83 to one of 4.33). Nearly half (47.5%) of the reduction was attributable to fewer deaths from haemorrhage and here again the reduction in risk for those referred is more marked than those not referred. This is because the women referred have the benefit of all components of the intervention particularly faster transport and communication and reduced treatment waiting times.
Hofman, J.J., C. Dzimadzi, K. Lungu, E.Y.Ratsma, J. Hussein (2008) 'Motorcycle ambulances for referral of obstetric emergencies in	Motorcycle ambulances were placed at 3 remote rural health posts in Malawi. Data was collected over a 1-year period from October 2001 to September 2002, using logbooks, cashbooks, referral forms and maternity registers. Mean and median times were recorded between	The study found that on average 16 patients per month were referred by motorcycle ambulance of which 5.7 per month were obstetric complications. In total 68 obstetric referrals by motorbike and 44 by other means. The study found that the motorbike ambulance reduced delay vis-a-vis the 4-wheel

rural Malawi: Do they reduce delay and what do they cost?' International Journal of Gynecology and Obstetrics, Vol 102 pp 191-197	the health post hospital	ambulance by between 2-4.5 hours or by between 35-76 per cent.
Samai, O., and P. Sengeh (1997) ' Facilitating emergency obstetric care through transport and communication, Bo, Sierre Leone International Journal of Gynecology& Obstetrics, Vol 59, Supt 2 S157-S164	A 4-wheel drive was posted at the hospital. Motorbikes to summon the vehicle were posted at the 8 project area primary healthcare unit. Due to problems with the motoribikes and their upkeep, radio communication between the hospital, vehicle and the health posts was implemented. These were complemented by community education activities and improvements to health facilities.	The intervention was measured in health terms on the condition on arrival and on the case fatality rate. In the 16 month period 31 calls for the referral vehicle was made. Of the 21 who were carried 38% were assessed as arriving good condition compared with only 30% of women not arriving by project vehicle and 38% as fair compared to 45% for those not arriving by project vehicle. The case fatality rate for women in the project area decreased from 20% to 10% though no difference between how they accessed services.

Appendix 3 – Data Analysis Output

Vital sign Respiration * Hours between referral and arrival

Crosstab

Count

		Hours between referral and arrival						Total
		<30 Minutes	<60 Minutes	1 to 2 Hours	2 to 4 Hours	4 to 6 Hours	6 to 7 Hours	
Vital sign Respiration	9-14	20	6	44	20	21	3	114
	15-20	51	24	148	66	31	7	327
	21-29	17	17	82	58	31	6	211
	>30	8	2	20	7	8	0	45
Total		96	49	294	151	91	16	697

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.098[a]	15	.063
Likelihood Ratio	25.781	15	.040
Linear-by-Linear Association	1.706	1	.192
N of Valid Cases	697		

a. 4 cells (16.7%) have expected count less than 5. The minimum expected count is 1.03.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[d]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.000	.000	.[b]	.[b]
		Vital sign Respiration Dependent	.000	.000	.[b]	.[b]
		Hours between referral and arrival Dependent	.000	.000	.[b]	.[b]
	Goodman and Kruskal tau	Vital sign Respiration Dependent	.014	.006		.013[c]
		Hours between referral and arrival Dependent	.008	.003		.032[c]
	Uncertainty Coefficient	Symmetric	.014	.005	2.711	.040[e]
		Vital sign Respiration Dependent	.016	.006	2.711	.040[e]
		Hours between referral and arrival Dependent	.012	.005	2.711	.040[e]

a. Not assuming the null hypothesis.

b. Cannot be computed because the asymptotic standard error equals zero.

c. Based on chi-square approximation

d. Using the asymptotic standard error assuming the null hypothesis.

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.186	.063
	Cramer's V	.107	.063
	Contingency Coefficient	.183	.063
N of Valid Cases		697	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital sign Respiration * Means of transport to referral centre

Crosstab

Count

		Means of transport to referral centre					Total
		Foot	Motor Cycle	Motor Vehicle	ETS	/Ambulance/Mobile Ambulance	
Vital sign Respiration	9-14	11	45	50	2	6	114
	15-20	4	101	185	3	34	327
	21-29	3	62	121	2	23	211
	>30	2	10	23	0	10	45
Total		20	218	379	7	73	697

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	40.251[a]	12	.000
Likelihood Ratio	34.018	12	.001
Linear-by-Linear Association	12.261	1	.000
N of Valid Cases	697		

a. 7 cells (35.0%) have expected count less than 5. The minimum expected count is .45.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.010	.006	1.812	.070
		Vital sign Respiration Dependent	.019	.010	1.812	.070
		Means of transport to referral center Dependent	.000	.000	.[c]	.[c]
	Goodman and Kruskal tau	Vital sign Respiration Dependent	.016	.006		.001[d]
		Means of transport to referral center Dependent	.011	.005		.003[d]
	Uncertainty Coefficient	Symmetric	.022	.008	2.811	.001[e]
		Vital sign Respiration Dependent	.021	.007	2.811	.001[e]
		Means of transport to referral center Dependent	.023	.008	2.811	.001[e]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.240	.000
	Cramer's V	.139	.000
	Contingency Coefficient	.234	.000
N of Valid Cases		697	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital sign Respiration * Means of transport to health centre

Crosstab

Count

		Means of transport to health center						Total
		Foot	Motorcycle	Motor Vehicle	Bicycle/Wheel barrow	ETS/CDC	/Ambulance/Mobile Ambulance	
Vital sign Respiration	9-14	19	49	37	0	3	6	114
	15-20	28	144	130	1	0	23	326
	21-29	19	70	101	0	2	19	211
	>30	9	14	14	0	0	8	45
Total		75	277	282	1	5	56	696

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	36.775[a]	15	.001
Likelihood Ratio	35.325	15	.002
Linear-by-Linear Association	6.694	1	.010
N of Valid Cases	696		

a. 10 cells (41.7%) have expected count less than 5. The minimum expected count is .06.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.037	.025	1.469	.142
		Vital sign Respiration Dependent	.008	.005	1.736	.083
		Means of transport to health center Dependent	.063	.046	1.322	.186
	Goodman and Kruskal tau	Vital sign Respiration Dependent	.017	.005		.002[c]
		Means of transport to health center Dependent	.013	.006		.000[c]
	Uncertainty Coefficient	Symmetric	.021	.007	3.129	.002[d]
		Vital sign Respiration Dependent	.021	.007	3.129	.002[d]
		Means of transport to health center Dependent	.021	.007	3.129	.002[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on chi-square approximation

d. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.230	.001
	Cramer's V	.133	.001
	Contingency Coefficient	.224	.001
N of Valid Cases		696	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign Neuro * Hours between referral and arrival

Crosstab

Count

		Hours between referral and arrival						Total
		<30 Minutes	<60 Minutes	1 to 2 Hours	2 to 4 Hours	4 to 6 Hours	6 to 7 Hours	
Vital Sign Neuro	0	39	18	113	63	50	10	293
	1	29	7	66	39	17	4	162
	2	15	12	55	32	14	2	130
	3	5	6	25	7	6	1	50
	4	3	1	2	1	2	0	9
	5	0	0	0	1	0	0	1
	6	0	0	4	0	0	0	4
	7	1	0	0	0	0	0	1
	9	1	0	0	0	0	0	1
Total		93	44	265	143	89	17	651

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	43.309[a]	40	.332
Likelihood Ratio	39.564	40	.490
Linear-by-Linear Association	5.696	1	.017
N of Valid Cases	651		

a. 34 cells (63.0%) have expected count less than 5. The minimum expected count is .03.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.005	.004	1.416	.157
		Vital Sign Neuro Dependent	.000	.000	.[c]	.[c]
		Hours between referral and arrival Dependent	.010	.007	1.416	.157
	Goodman and Kruskal tau	Vital Sign Neuro Dependent	.009	.005		.180[d]
		Hours between referral and arrival Dependent	.016	.003		.082[d]
	Uncertainty Coefficient	Symmetric	.021	.006	3.401	.490[e]

	Vital Sign Neuro Dependent	.023	.006	3.401	.490[e]
	Hours between referral and arrival Dependent	.020	.006	3.401	.490[e]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.258	.332
	Cramer's V	.115	.332
	Contingency Coefficient	.250	.332
N of Valid Cases		651	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign Neuro * Means of transport to referral center

Crosstab

Count

		Means of transport to referral center					Total
		Foot	Motor Cycle	Motor Vehicle	ETS	/Ambulance/Mobile Ambulance	
Vital Sign Neuro	0	8	87	156	4	38	293
	1	5	60	89	1	7	162
	2	3	45	68	1	13	130
	3	3	13	28	0	6	50
	4	0	3	3	0	3	9
	5	0	0	1	0	0	1
	6	0	0	4	0	0	4
	7	1	0	0	0	0	1
	9	0	0	1	0	0	1
Total		20	208	350	6	67	651

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	56.033[a]	32	.005
Likelihood Ratio	33.987	32	.372
Linear-by-Linear Association	.479	1	.489
N of Valid Cases	651		

a. 32 cells (71.1%) have expected count less than 5. The minimum expected count is .01.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.002	.004	.378	.705
		Vital Sign Neuro Dependent	.000	.000	.[c]	.[c]
		Means of transport to referral center Dependent	.003	.009	.378	.705
	Goodman and Kruskal tau	Vital Sign Neuro Dependent	.008	.004		.092[d]
		Means of transport to referral center Dependent	.015	.004		.160[d]
	Uncertainty Coefficient	Symmetric	.022	.007	3.024	.372[e]

	Vital Sign Neuro Dependent	.019	.006	3.024	.372[e]
	Means of transport to referral center Dependent	.024	.008	3.024	.372[e]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.293	.005
	Cramer's V	.147	.005
	Contingency Coefficient	.282	.005
N of Valid Cases		651	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign Neuro * Means of transport to health center

Crosstab

Count

		Means of transport to health center						Total
		Foot	Motorcycle	Motor Vehicle	Bicycle/Wheelbarrow	ETS/CDC	/Ambulance/Mobile Ambulance	
Vital Sign Neuro	0	27	122	107	1	3	33	293
	1	13	78	68	0	0	3	162
	2	15	46	60	0	1	8	130
	3	10	16	17	0	1	6	50
	4	1	5	0	0	0	3	9
	5	0	0	1	0	0	0	1
	6	1	1	2	0	0	0	4
	7	1	0	0	0	0	0	1
	9	0	0	1	0	0	0	1
Total		68	268	256	1	5	53	651

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	53.540[a]	40	.074
Likelihood Ratio	54.373	40	.064
Linear-by-Linear Association	.772	1	.380
N of Valid Cases	651		

a. 39 cells (72.2%) have expected count less than 5. The minimum expected count is .00.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.026	.016	1.581	.114
		Vital Sign Neuro Dependent	.000	.000	.[c]	.[c]
		Means of transport to health center Dependent	.050	.031	1.581	.114
	Goodman and Kruskal tau	Vital Sign Neuro Dependent	.016	.005		.000[d]
		Means of transport to health center Dependent	.021	.005		.003[d]
	Uncertainty Coefficient	Symmetric	.033	.007	4.348	.064[e]

	Vital Sign Neuro Dependent	.031	.007	4.348	.064[e]
	Means of transport to health center Dependent	.034	.008	4.348	.064[e]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.287	.074
	Cramer's V	.128	.074
	Contingency Coefficient	.276	.074
N of Valid Cases		651	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign BP * Hours between referral and arrival

Crosstab

Count

		Hours between referral and arrival						Total
		<30 Minutes	<60 Minutes	1 to 2 Hours	2 to 4 Hours	4 to 6 Hours	6 to 7 Hours	
Vital Sign BP	<80	2	1	3	1	2	2	11
	80-80	25	13	80	34	28	2	182
	81-18	52	15	122	69	31	7	296
	111-199	14	17	73	45	28	6	183
	>200	2	3	12	2	3	0	22
Total		95	49	290	151	92	17	694

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	35.685[a]	20	.017
Likelihood Ratio	31.189	20	.053
Linear-by-Linear Association	.891	1	.345
N of Valid Cases	694		

a. 13 cells (43.3%) have expected count less than 5. The minimum expected count is .27.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.002	.007	.354	.724
		Vital Sign BP Dependent	.005	.014	.354	.724
		Hours between referral and arrival Dependent	.000	.000	.[c]	.[c]
	Goodman and Kruskal tau	Vital Sign BP Dependent	.013	.005		.012[d]
		Hours between referral and arrival Dependent	.008	.003		.150[d]
	Uncertainty Coefficient	Symmetric	.016	.006	2.790	.053[e]
		Vital Sign BP Dependent	.018	.006	2.790	.053[e]
		Hours between referral and arrival Dependent	.015	.005	2.790	.053[e]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.227	.017
	Cramer's V	.113	.017
	Contingency Coefficient	.221	.017
N of Valid Cases		694	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign BP * Means of transport to referral center

Crosstab

Count

		Means of transport to referral center					Total
		Foot	Motor Cycle	Motor Vehicle	ETS	/Ambulance/Mobile Ambulance	
Vital Sign BP	<80	1	4	5	0	1	11

	80-80	7	61	97	1	16	182
	81-18	8	92	160	5	31	296
	111-199	4	57	104	1	17	183
	>200	0	3	11	0	8	22
Total		20	217	377	7	73	694

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.328[a]	16	.105
Likelihood Ratio	18.786	16	.280
Linear-by-Linear Association	5.435	1	.020
N of Valid Cases	694		

a. 10 cells (40.0%) have expected count less than 5. The minimum expected count is .11.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[d]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.000	.000	.[b]	.[b]
		Vital Sign BP Dependent	.000	.000	.[b]	.[b]
		Means of transport to referral center Dependent	.000	.000	.[b]	.[b]
	Goodman and Kruskal tau	Vital Sign BP Dependent	.004	.003		.778[c]
		Means of transport to referral center Dependent	.007	.004		.303[c]
	Uncertainty Coefficient	Symmetric	.012	.006	2.088	.280[e]
		Vital Sign BP Dependent	.011	.005	2.088	.280[e]
		Means of transport to referral center Dependent	.013	.006	2.088	.280[e]

a. Not assuming the null hypothesis.

b. Cannot be computed because the asymptotic standard error equals zero.

c. Based on chi-square approximation

d. Using the asymptotic standard error assuming the null hypothesis.

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.183	.105
	Cramer's V	.092	.105
	Contingency Coefficient	.180	.105
N of Valid Cases		694	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign BP * Means of transport to health center

Crosstab

Count

		Means of transport to health center						Total
		Foot	Motorcycle	Motor Vehicle	Bicycle/Wheelbarrow	ETS/CDC	/Ambulance/Mobile Ambulance	
Vital Sign BP	<80	2	4	4	0	0	1	11
	80-80	15	76	77	0	4	9	181
	81-18	42	130	102	1	0	21	296
	111-199	12	64	88	0	1	18	183
	>200	1	5	9	0	0	7	22
Total		72	279	280	1	5	56	693

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	46.383[a]	20	.001
Likelihood Ratio	41.282	20	.003
Linear-by-Linear Association	10.142	1	.001
N of Valid Cases	693		

a. 16 cells (53.3%) have expected count less than 5. The minimum expected count is .02.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.040	.019	2.055	.040
		Vital Sign BP Dependent	.010	.005	2.006	.045
		Means of transport to health center Dependent	.068	.036	1.812	.070
	Goodman and Kruskal tau	Vital Sign BP Dependent	.020	.006		.000[c]
		Means of transport to health center Dependent	.014	.006		.000[c]
	Uncertainty Coefficient	Symmetric	.024	.007	3.272	.003[d]
		Vital Sign BP Dependent	.024	.007	3.272	.003[d]
		Means of transport to health center Dependent	.024	.007	3.272	.003[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on chi-square approximation

d. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.259	.001
	Cramer's V	.129	.001
	Contingency Coefficient	.250	.001
N of Valid Cases		693	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign Pulse * Hours between referral and arrival

Crosstab

Count

		Hours between referral and arrival						Total
		<30 Minutes	<60 Minutes	1 to 2 Hours	2 to 4 Hours	4 to 6 Hours	6 to 7 Hours	
Vital Sign Pulse	51-80	49	23	131	74	49	7	333
	81-18	29	20	103	43	22	5	222
	111-130	12	4	44	31	19	5	115
	>130	4	1	12	1	2	0	20
Total		94	48	290	149	92	17	690

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.249[a]	15	.203
Likelihood Ratio	20.793	15	.144
Linear-by-Linear Association	.271	1	.603
N of Valid Cases	690		

a. 6 cells (25.0%) have expected count less than 5. The minimum expected count is .49.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[d]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.000	.000	.[b]	.[b]
		Vital Sign Pulse Dependent	.000	.000	.[b]	.[b]
		Hours between referral and arrival Dependent	.000	.000	.[b]	.[b]
	Goodman and Kruskal tau	Vital Sign Pulse Dependent	.008	.005		.288[c]
		Hours between referral and arrival Dependent	.007	.003		.071[c]
	Uncertainty Coefficient	Symmetric	.011	.005	2.450	.144[e]
		Vital Sign Pulse Dependent	.013	.005	2.450	.144[e]
		Hours between referral and arrival Dependent	.010	.004	2.450	.144[e]

a. Not assuming the null hypothesis.

b. Cannot be computed because the asymptotic standard error equals zero.

c. Based on chi-square approximation

d. Using the asymptotic standard error assuming the null hypothesis.

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.167	.203
	Cramer's V	.096	.203
	Contingency Coefficient	.165	.203
N of Valid Cases		690	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign Pulse * Means of transport to referral center

Crosstab

Count

		Means of transport to referral center					Total
		Foot	Motor Cycle	Motor Vehicle	ETS	/Ambulance/Mobile Ambulance	
Vital Sign Pulse	51-80	7	123	172	4	27	333
	81-18	9	60	129	2	22	222
	111-130	4	30	69	0	12	115
	>130	0	4	7	1	8	20
Total		20	217	377	7	69	690

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	35.624[a]	12	.000
Likelihood Ratio	28.328	12	.005
Linear-by-Linear Association	9.862	1	.002
N of Valid Cases	690		

a. 7 cells (35.0%) have expected count less than 5. The minimum expected count is .20.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.004	.008	.539	.590
		Vital Sign Pulse Dependent	.006	.011	.500	.617
		Means of transport to referral center Dependent	.003	.012	.258	.796
	Goodman and Kruskal tau	Vital Sign Pulse Dependent	.011	.006		.026[c]

	Uncertainty Coefficient	Means of transport to referral center Dependent	.014	.007		.000[c]
		Symmetric	.019	.007	2.573	.005[d]
		Vital Sign Pulse Dependent	.018	.007	2.573	.005[d]
		Means of transport to referral center Dependent	.019	.007	2.573	.005[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on chi-square approximation

d. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.227	.000
	Cramer's V	.131	.000
	Contingency Coefficient	.222	.000
N of Valid Cases		690	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign Pulse * Means of transport to health center

Crosstab

Count

		Means of transport to health center						Total
		Foot	Motorcycle	Motor Vehicle	Bicycle/Wheel barrow	ETS/CDC	/Ambulance/Mobile Ambulance	
Vital Sign Pulse	51-80	39	141	124	0	5	24	333
	81-18	23	94	92	0	0	12	221
	111-130	11	36	57	1	0	10	115
	>130	2	6	5	0	0	7	20
Total		75	277	278	1	5	53	689

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	39.840[a]	15	.000
Likelihood Ratio	31.692	15	.007
Linear-by-Linear Association	6.274	1	.012
N of Valid Cases	689		

a. 10 cells (41.7%) have expected count less than 5. The minimum expected count is .03.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.029	.028	1.022	.307
		Vital Sign Pulse Dependent	.003	.003	1.001	.317
		Means of transport to health center Dependent	.051	.051	.977	.329
	Goodman and Kruskal tau	Vital Sign Pulse Dependent	.013	.004		.026[c]
		Means of transport to health center Dependent	.011	.006		.001[c]

	Uncertainty Coefficient	Symmetric	.020	.007	2.819	.007[d]
		Vital Sign Pulse Dependent	.021	.007	2.819	.007[d]
		Means of transport to health center Dependent	.019	.007	2.819	.007[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on chi-square approximation

d. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.240	.000
	Cramer's V	.139	.000
	Contingency Coefficient	.234	.000
N of Valid Cases		689	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

VitalSign Urine * Hours between referral and arrival

Crosstab

Count

		Hours between referral and arrival						Total
		<30 Minutes	<60 Minutes	1 to 2 Hours	2 to 4 Hours	4 to 6 Hours	6 to 7 Hours	
VitalSign Urine	<8ml/hr	5	5	21	27	3	2	63
	<30ml/hr	63	30	175	79	70	10	427
	>30ml/hr	26	13	101	47	19	5	211
Total		94	48	297	153	92	17	701

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.029[a]	10	.001
Likelihood Ratio	28.754	10	.001
Linear-by-Linear Association	1.204	1	.272
N of Valid Cases	701		

a. 2 cells (11.1%) have expected count less than 5. The minimum expected count is 1.53.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.009	.010	.866	.386
		VitalSign Urine Dependent	.000	.000	.[c]	.[c]
		Hours between referral and arrival Dependent	.015	.017	.866	.386
	Goodman and Kruskal tau	VitalSign Urine Dependent	.019	.008		.003[d]
		Hours between referral and arrival Dependent	.012	.005		.000[d]
	Uncertainty Coefficient	Symmetric	.017	.006	2.675	.001[e]
		VitalSign Urine Dependent	.023	.009	2.675	.001[e]
		Hours between referral and arrival Dependent	.014	.005	2.675	.001[e]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.207	.001
	Cramer's V	.146	.001
	Contingency Coefficient	.203	.001
N of Valid Cases		701	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

VitalSign Urine * Means of transport to referral center

Crosstab

Count

		Means of transport to referral center					Total
		Foot	Motor Cycle	Motor Vehicle	ETS	/Ambulance/Mobile Ambulance	
VitalSign Urine	<8ml/hr	1	26	24	0	12	63
	<30ml/hr	17	139	230	6	35	427
	>30ml/hr	2	53	128	1	27	211
Total		20	218	382	7	74	701

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.845[a]	8	.002
Likelihood Ratio	24.917	8	.002
Linear-by-Linear Association	1.492	1	.222
N of Valid Cases	701		

a. 4 cells (26.7%) have expected count less than 5. The minimum expected count is .63.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.003	.012	.283	.777
		VitalSign Urine Dependent	.000	.000	.[c]	.[c]
		Means of transport to referral center Dependent	.006	.022	.283	.777
	Goodman and Kruskal tau	VitalSign Urine Dependent	.018	.007		.002[d]
		Means of transport to referral center Dependent	.012	.006		.000[d]
	Uncertainty Coefficient	Symmetric	.018	.007	2.628	.002[e]
		VitalSign Urine Dependent	.020	.008	2.628	.002[e]
		Means of transport to referral center Dependent	.016	.006	2.628	.002[e]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.184	.002
	Cramer's V	.130	.002
	Contingency Coefficient	.181	.002
N of Valid Cases		701	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

VitalSign Urine * Means of transport to health center

Crosstab

Count

		Means of transport to health center						Total
		Foot	Motorcycle	Motor Vehicle	Bicycle/Wheelbarrow	ETS/CDC	/Ambulance/Mobile Ambulance	
VitalSign Urine	<8ml/hr	1	35	16	0	0	11	63
	<30ml/hr	58	177	163	1	4	24	427
	>30ml/hr	16	68	103	0	1	22	210
Total		75	280	282	1	5	57	700

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	38.090[a]	10	.000
Likelihood Ratio	40.310	10	.000
Linear-by-Linear Association	1.631	1	.202
N of Valid Cases	700		

a. 6 cells (33.3%) have expected count less than 5. The minimum expected count is .09.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.048	.028	1.672	.094
		VitalSign Urine Dependent	.000	.000	.[c]	.[c]
		Means of transport to health center Dependent	.079	.045	1.672	.094
	Goodman and Kruskal tau	VitalSign Urine Dependent	.026	.009		.000[d]
		Means of transport to health center Dependent	.017	.007		.000[d]
	Uncertainty Coefficient	Symmetric	.027	.008	3.412	.000[e]
		VitalSign Urine Dependent	.033	.009	3.412	.000[e]
		Means of transport to health center Dependent	.024	.007	3.412	.000[e]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.233	.000
	Cramer's V	.165	.000
	Contingency Coefficient	.227	.000
N of Valid Cases		700	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign Temprature * Hours between referral and arrival

Crosstab

Count

		Hours between referral and arrival						Total
		<30 Minutes	<60 Minutes	1 to 2 Hours	2 to 4 Hours	4 to 6 Hours	6 to 7 Hours	
Vital Sign Temprature	<35	29	20	86	44	35	4	218
	35.1-36	42	14	139	70	34	6	305
	>36.5-38	19	11	61	34	19	7	151
	>38	6	2	7	2	4	0	21
Total		96	47	293	150	92	17	695

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.471[a]	15	.239
Likelihood Ratio	17.991	15	.263
Linear-by-Linear Association	.065	1	.798
N of Valid Cases	695		

a. 6 cells (25.0%) have expected count less than 5. The minimum expected count is .51.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.010	.014	.743	.457
		Vital Sign Temprature Dependent	.021	.027	.743	.457
		Hours between referral and arrival Dependent	.000	.000	.[c]	.[c]

	Goodman and Kruskal tau	Vital Sign Temprature Dependent	.009	.005		.208[d]
		Hours between referral and arrival Dependent	.005	.003		.358[d]
	Uncertainty Coefficient	Symmetric	.010	.004	2.153	.263[e]
		Vital Sign Temprature Dependent	.011	.005	2.153	.263[e]
		Hours between referral and arrival Dependent	.009	.004	2.153	.263[e]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

e. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.163	.239
	Cramer's V	.094	.239
	Contingency Coefficient	.161	.239
N of Valid Cases		695	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign Temprature * Means of transport to referral center

Crosstab

Count

		Means of transport to referral center					Total
		Foot	Motor Cycle	Motor Vehicle	ETS	/Ambulance/Mobile Ambulance	
Vital Sign Temprature	<35	6	84	102	4	22	218
	35.1-36	11	95	174	3	22	305
	>36.5-38	3	36	95	0	17	151
	>38	0	3	7	0	11	21
Total		20	218	378	7	72	695

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	58.348[a]	12	.000
Likelihood Ratio	43.754	12	.000
Linear-by-Linear Association	12.779	1	.000
N of Valid Cases	695		

a. 7 cells (35.0%) have expected count less than 5. The minimum expected count is .21.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.007	.012	.602	.547
		Vital Sign Temprature Dependent	.003	.018	.140	.889
		Means of transport to referral center Dependent	.013	.013	.943	.345
	Goodman and Kruskal tau	Vital Sign Temprature Dependent	.015	.005		.002[c]
		Means of transport to referral center Dependent	.025	.009		.000[c]

	Uncertainty Coefficient	Symmetric	.028	.009	3.152	.000[d]
		Vital Sign Temprature Dependent	.027	.008	3.152	.000[d]
		Means of transport to referral center Dependent	.029	.009	3.152	.000[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on chi-square approximation

d. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.290	.000
	Cramer's V	.167	.000
	Contingency Coefficient	.278	.000
N of Valid Cases		695	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Vital Sign Temprature * Means of transport to health center

Crosstab

Count

		Means of transport to health center						Total
		Foot	Motorcycle	Motor Vehicle	Bicycle/Wheelbarrow	ETS/CDC	/Ambulance/Mobile Ambulance	
Vital Sign Temprature	<35	22	103	71	0	5	17	218
	35.1-36	36	122	129	1	0	16	304
	>36.5-38	16	50	73	0	0	12	151
	>38	1	4	6	0	0	10	21
Total		75	279	279	1	5	55	694

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	71.446[a]	15	.000
Likelihood Ratio	51.160	15	.000
Linear-by-Linear Association	9.513	1	.002
N of Valid Cases	694		

a. 10 cells (41.7%) have expected count less than 5. The minimum expected count is .03.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.052	.025	2.041	.041
		Vital Sign Temprature Dependent	.015	.016	.974	.330
		Means of transport to health center Dependent	.087	.045	1.832	.067
	Goodman and Kruskal tau	Vital Sign Temprature Dependent	.021	.005		.000[c]
		Means of transport to health center Dependent	.020	.008		.000[c]
	Uncertainty Coefficient	Symmetric	.031	.009	3.422	.000[d]
		Vital Sign Temprature Dependent	.032	.009	3.422	.000[d]
		Means of transport to health center Dependent	.030	.009	3.422	.000[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on chi-square approximation

d. Likelihood ratio chi-square probability.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.321	.000
	Cramer's V	.185	.000
	Contingency Coefficient	.306	.000
N of Valid Cases		694	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

APPENDIX 4 – CHEWs Trained

S/NO	NAMES	LGA	COMMUNITY	MALE/FEMALE
1	ASIYA GARBA MATSAI	FUNTUA	U/MOTA HEALTH CLINIC	FEMALE
2	AISHA JIBIRIN	FUNTUA	GWANGWAN H/C	FEMALE
3	BASIRA ABDULRAHAMAN	FUNTUA	MAI GAMJI H/C	FEMALE
4	HAJARA MUSA	FUNTUA	MDG NASARAW	FEMALE
5	HADIZA ABDULLAHI	FUNTUA	KAUYAN MAILAYA H/C	FEMALE
6	JAMILA LABO	FUNTUA	UNGUWAR INJI	FEMALE
7	HABI YA'U BAGIWA	FUNTUA	JABIRI H/C	FEMALE
8	BARA'ATU AMADU	ZANGO	ROGOGO GABAS	FEMALE
9	MARYAM SANI INUA	FUNTUA	DAN LAYI H/C	FEMALE
10	HADIZA LAWAL GWANDA	FUNTUA	T/WADA H/C	FEMALE
11	FATIMA HAMISU	ZANGO	ROGOGO CHIDANI	FEMALE
12	HADIZA BASIRU	ZANGO	YARDAJI/BULUNGUDU	FEMALE
13	BARAKA RABE	ZANGO	UN/GAJE	FEMALE
14	HAFSAT AHMED	ZANGO	PHC ROGOGO	FEMALE
15	HALIMA SURAJO	ZANGO	DARGAGE M.C.H	FEMALE
16	SAKINA ABDU	ZANGO	CHC ZANGO	FEMALE
17	DAN ASABE YAKUBU	ZANGO	KUTUTTURE	MALE

			H/F	
18	AUWALU DAN IYA	ZANGO	MCHC SARA	MALE
19	MUSTAPHA HABIBU	ZANGO	BIDAWA H/C	MALE
20	UMAR MUHMED GOYA	FUNTUA	MAIWALLA H/C	MALE
21	SANUSI SANI ZANGO	ZANGO	MPHC ZANGO	MALE
22	NURA SANI	ZANGO	MPHC YARDAJI	MALE
23	YUSUF SALISU	FUNTUA	ANG BIRI H/C	MALE
24	SAIDU SALISU	FUNTUA	MASKA CCHC	MALE
25	YUSUF SHUA'AIBU GOYA	FUNTUA	PHC GOYA	MALE
26	SA'ADU IDRIS	FUNTUA	DANKAWO H/F	MALE
27	NASIR ABDULSALAM	FUNTUA	DUKILE P.H.C	MALE
28	AHMED SALEH	FUNTUA	I.W.C PHC DSPT	MALE
29	YAHAYA MUHAMMAD	FUNTUA	ZAMFARAWA H/C	MALE
30	LAWAL GARBA	FUNTUA	KWANGWAI H/C	MALE
31	BELLO BALA	FUNTUA	UNGUWAR DAHIRU H/C	MALE
32	BABANGIDA BALA	FUNTUA	CHIBAUNA H/C	MALE
33	HASSAN MAMMAN	ZANGO	MCHC KANDA	MALE
34	IBRAHIM SAN	ZANGO	K/MALAMAI DISP	MALE
35	AUWALU ABDULKAREEM	ZANGO	RAHAMAWA DISP	MALE
36	MAMMAN ANDU	ZANGO	UNG. DUMA	MALE

			MCHC	
37	AHMED SANUSI	ZANGO	CHC ZANGO	MALE
38	USMAN HABU	ZANGO	DISHE DISP	MALE

APPENDIX 5 – Ambulance Management Guidelines

Guidelines for National Ambulance Service in the African context

March 2013

Version 1.5

Author: Edward O' Connor

Table of Contents

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Abbreviations

EMS	Emergency Medical Service
EMT	Emergency Medical Technician
GPS	Global Positioning System
HF	Health Facility
IT	Information Technology
KM	Kilometre
KPI	Key Performance Indicator
MoH	Ministry of Health
MoU	Memorandum of Understanding
NAS	National Ambulance Service
NDA	National Drug Authority
PPE	Personal Protective Equipment
PPM	Planned Preventative Maintenance
PPP	Public Private Partnership
PR	Public Relations
RTC	Road Traffic Crash
SOP	Standard Operational Procedure
TMS	Transport Management System
TO	Transport Officer
ToT	Training of Trainers
VO	Vehicle Operator

Introduction

Emergency patient care is a system constructed of many components. This system needs to be approached and addressed in a holistic manner and to address just one of these components independently and assume it will solve the emergency care problem as a whole is ill-advised.

While keeping this interdependency in mind during design and implementation, each component of emergency care needs to be addressed. This guide focuses on the component of a National Ambulance Service (NAS) within the larger picture of emergency care.

The set up and effective management of the transport aspects of a National Ambulance Service (NAS) will be the main focus of this guide but it will also touch on other elements of the National Ambulance Service as a whole and the links and stakeholders which will help ensure a National Ambulance Service's success within an emergency care system.

This guide is aimed at those who are considering improving their current National Ambulance Service and those who are considering moving their emergency health care system forward by introducing a National Ambulance Service. In recognising this, a National Ambulance Service is not simply a transport service for moving a patient from one location to another; it is an emergency health care service with the aim of improving patient care.

It must be noted that while the guide has been developed in conjunction with experts from a variety of different backgrounds, the author of this guide is not a medical or legal expert or practitioner and thus any references or comments touching on the subjects of health care or legal issues are simply observations and not medical or legal advice. All aspect of medical care and legal issues should be discussed in consultation with the appropriate medical and legal professionals.

Reflections

Adaptation and localisation are key to overcoming the complexity of establishing a National Ambulance Service. For example, a large metropolitan city like New York will have a different ambulance service to another large metropolitan city like London. This is due to specific needs; legal, medical and governmental, all of which differ in each country despite the fact they are both large, economically developed, and highly populated urban centres. Even within a country the ambulance service will vary. For example, in the UK the London ambulance service will have different vehicles and response teams to the East Midlands regional ambulance service yet they are both part of the UK NAS.

It would not be to any country's benefit to attempt to exactly duplicate another country's NAS. However, it is recommended that experiences and lessons learned from other National Ambulances Services should be reviewed by those planning on establishing or hoping to improve their own NAS. Taking into account these examples can help in eliminating or solidifying options and decisions by determining what worked and what did not and more importantly, why.

Although this guide discusses many complex components looking to the future of a nation's health care system, the part that an effective National Ambulance Service plays is vital and must be taken as seriously and with the dedication it deserves and warrants.

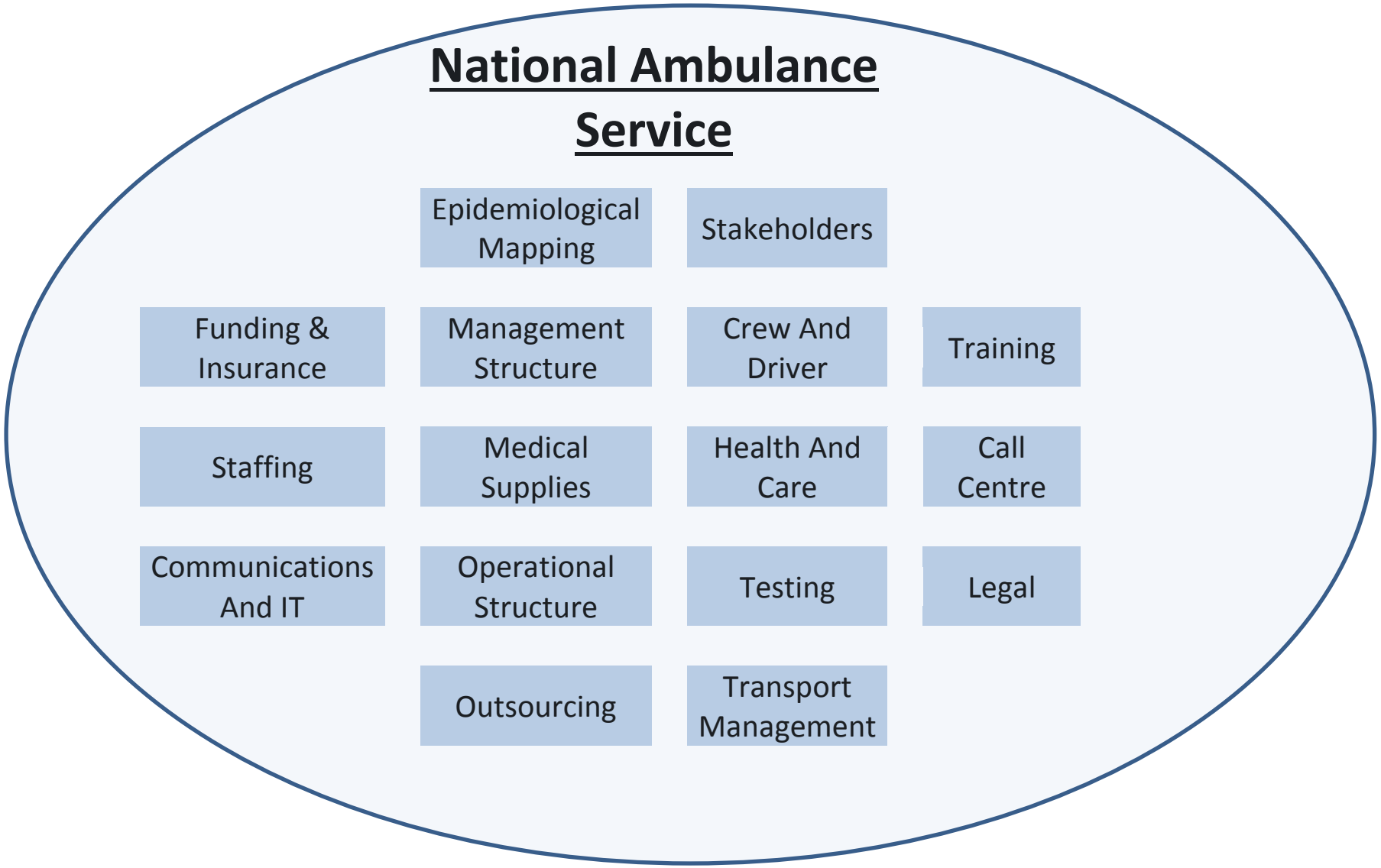
- As with the implementation of many complex activities it is advisable to start with a smaller pilot first. This constitutes a testing phase and enables the correction of any errors to find out what works, and what needs improvement. Even if a template from a country of similar geographical, economic and political makeup is used, there are always local variations that should be explored and tested before implementation takes place on a nationwide scale. It is advised that a large, relatively highly populated city (in relation to the country of operation) is chosen as the first test site. This may or may not be the capital city. If funding and resources allow, a secondary test site in a rural area may also be chosen to make simultaneous comparisons with the urban site.

  Once operations become more fluid and the issues which arise during the pilot phase are addressed, extending to other cities and rural areas can commence in a carefully structured manner. Of course funding and resources will play a major role in the expansion of a National Ambulance Service so a phased approach is advised to ensure consistency and that there is no reduction in the quality of patient care. A National Ambulance Service must be embraced and accepted by the country's population and a poor quality service will not instil confidence in its beneficiaries.

- Health systems throughout the world often face resource constraints, be it a shortage of funding or insufficient human resources. The introduction of a NAS should not add to this problem. Although a NAS should attract, and be able to keep skilled, dedicated staff, it should not be at the expense of other parts of the health care system. For example, if NAS staff receive higher quality training and earn higher wages than nurses in a hospital, it will not only ignite an exodus of nursing staff to the NAS but may also cause those thinking of a nursing career to reconsider. This scenario could compound the issue of understaffed hospitals and health facilities and so cause more harm to the health care system than good. A NAS is only a component of a nation's health care system and the hospitals the patients are being brought to must be of adequate quality to continue care.

Diagram of NAS Components

Below is a diagrammatic representation of some of the many components involved in the establishment and operation of a National Ambulance Service.



NAS Operational options

When considering establishing a National Ambulance Service there are three main options to be considered, the feasibility of which should then be assessed according to each individual context:
Option 1: Government owned and operated
Option 2: Third party operated
Option 3: Combined government and third party operated.
These options are explained in some detail below and this guide does contain components and guidance which would be useful in setting up each of the three options.

Great care, consideration and thought must be put into any option that is chosen. A failed, non-operational National Ambulance Service will cost lives.

Option 1: Government owned and operated

The NAS is owned and operated by the government. Its fleet, staff, buildings etc. are all owned by the government, specifically the Ministry of Health (MoH). This is a widely used and accepted method for establishing a NAS. This approach has it pros and cons in all aspects of the service.

Advantages: Enables the MoH to have full control and provides an opportunity for close collaboration between the relevant MoH departments (i.e. A&E) and the ambulance operation.
Disadvantages: It could be argued that the MoH should be focusing all of its resources and skills on improving the facility based health care system and that it should not try to diversify its approach thus shifting its focus to an area they lack expertise in.

Option 2: Outsourced - Third party operated

This option of setting up a NAS involves outsourcing the entire operation to a third party. In essence, much like in the logistics sector for example, you are paying someone else to do the job for you to a specified and agreed upon standard. This means none of the staff, fleet or buildings etc. are owned by the government, they are simply paying for a service. A NAS run by a third party needs to be effectively managed by the MoH for it to be a success, which can be time consuming Complex contracting and regulation are also needed for such an arrangement.

For security of the operation and diversity in its different operating theatres it is possible to employ multiple service providers to provide the service. Different third party providers could cover different areas, possibly by region, urban/rural or another geopolitical divide.

Advantages: Can potentially lead to lower costs as the provider is able to focus purely on the ambulance operation and not have to worry about other operations and competing priorities, a means of accessing expertise in the private sector, the provider can focus on their core competencies, some risk can be reduced or better managed with the provider bearing some of the risk i.e. regarding capital investment in vehicles, staff costs (such as pensions provision) etc.
Disadvantages: Risk of confidential data and information being leaked, the provider may see the work as simply another “job” and not give it the focus and attention it needs to operate properly, sub-standard quality service, there may be hidden costs involved which in the long run make outsourcing a more expensive option, may be more suited to the urban scenario as it may be quite difficult to find operators willing to operate very small services in remote areas as business wise it may not be profitable for them, the business(es) employed to deliver the service stops operating, for

example, due to contractual or financial disagreements and then an entire region or nationally the population is left without any ambulance service.

Option 3: Combined government and third party operated

This option is a combination of the previous two. Part of the NAS would be owned and operated by the government while another part of it would be operated by a third party. This option, for example, might be set up so the third party operates within the large urban, highly populated areas and the government operates everywhere else in the country. This option would require significant management.; not only is the government in question operating its own system and everything that comes with it, but it also has to manage a third party operation. If not managed correctly with a good management team and structure this option would be difficult to maintain.

Advantages: Enables the MoH to have full control, provides an opportunity for close collaboration between the relevant MoH departments (i.e. A&E) and the ambulance operation. Also provides an opportunity to directly compare the service and costs of both options in a live environment.
Disadvantages: It could be argued that the MoH should be focusing all of its resources and skills on improving the facility based health care system and that it should not try to diversify its approach thus shifting its focus to an area they lack expertise in.

Epidemiological mapping

In order to begin to solve the problem of urgent care you must first know what the problem is, where the problem is and the extent of the problem. A NAS must know its demand needs or else making decisions around its design would be guess work at best and at worst completely inaccurate and set the NAS up to fail. Mapping must occur in the very early stages of the design phase, before any service implementation begins.

In order to complete this task every accident and emergency department, urgent care facility and maternity facility must provide details on;

- Geographical location of health facility (HF)
- Number of patients
- Origin of patient (home city/town/village)
- Complaint they present with
- Day and time they are presented
- Treatment provided by the accepting facility

The output of this activity would be a demand analysis and mapped profile of the potential workload based on time and day which would help determine the resource requirements. Incident "black spots" (a section of roadway that has been designated as being particularly accident-prone) must be identified too in order to help the NAS plan where and when their resources will be allocated. This will form part of this mapping process.

There will also be a need to determine and define which facilities will be "receiving" facilities and what medical care they are capable of providing. Depending on the resources available, there could be structured rotation of this responsibility between hospitals, i.e. two hospitals offering cardiac care will rotate every second day so as not to be overwhelmed constantly by emergency cardiac cases. It is important that an ambulance does not bring a patient to a health facility that is incapable of providing the appropriate care. Investigation will need to be done concerning specialised services, regionalisation, referral, bypassing local facilities etc and plans and structures put in place to ensure appropriate care. Also catchment areas including travelling distances and times will have to be considered as part of this process and in relation again to the time and day of the week.

Note: the above section is only a short sample to the type of information and processes needed. It is not a definitive step by step procedure. Appropriately trained and experienced professionals must conduct this activity.

Transport Management System

Transport within a National Ambulance Service must be managed effectively and efficiently as without transport a NAS cannot operate. A Transport Management System (TMS) will enable the proper management of a transport fleet and thus extend its working life, reduce the overall cost and improve emergency service delivery.

The follow section is a consolidation of Transaid's *Transport Management System* that is based on years of extensive experience in many countries throughout Africa and elsewhere. Transaid's TMS has been used to varying degrees by different MoHs including South Africa and Ghana in the management of their fleets. The principles that underpin TMS apply to any type of transport on any scale.

The essential components of an effective Transport Management System (TMS) are as follows:

i) Operational Management
j) Financial Management
k) Fleet Management
l) Health and Safety
m) Human Resources
n) Management Information: Monitoring Performance
o) Situational Analysis
p) Policy

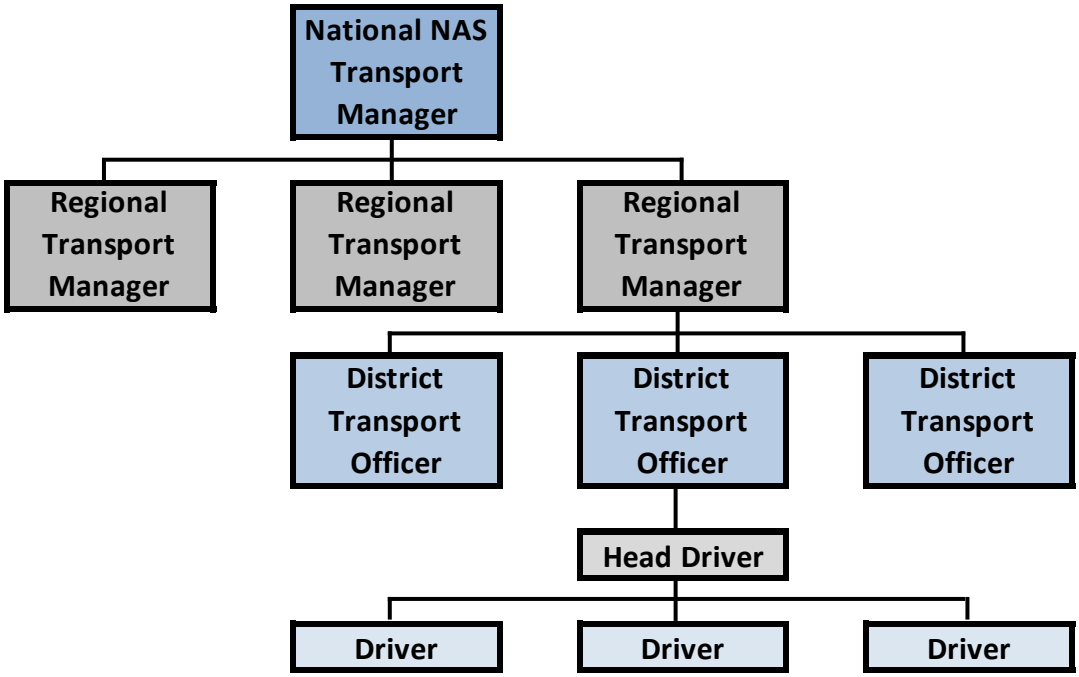
Operational Management

Operational Management is the day to day management required to operate a fleet of vehicles. It is defined as "who needs to take what action, when and how". It is the means by which the Policy is adhered to. This includes systems and processes for planning and allocating vehicles, as well as the operational controls that manage their daily use.

Tasks and Responsibilities

There is not one standard management structure for managing transport however for a NAS there will need to be several levels of management from the national coordination and control level to local management teams managing the transport activities.

Below is an illustrated example of a NAS national transport management structure.



In order for everyone within the NAS team to have a good understanding of the operational management and responsibilities, a matrix should be completed which defines the key responsibilities of the post holders at different levels.

Within the NAS, transport must be a regular agenda item for NAS management meetings to discuss performance, issues and recommendations. This is important as it will ensure that all departments within the NAS will understand the impacts they have on each other, which will ultimately build understanding and improve the operation.

Operational Controls

Operational controls are the Standard Operating Procedures (SOPs) that connect management activities and vehicle management planning. Standard Operating Procedures should be specific to each element of the system and be included in the NAS transport policy to ensure TMS is implemented and, in the long term, effective. The following is a brief summary, not exhaustive, of some SOPs related to different components of TMS needed for a NAS.

Component	Description	SOPs
Human Resources	Personnel structure for all aspects of management including responsibilities.	Organisational charts, job descriptions, staff names in transport positions.
Vehicle Issuing	Issuing and returning vehicles to include log sheets, keys, vehicle equipment etc.	Keys, vehicle equipment, expenditure during movement, check sheet.
Fuelling	To include documentation,	Location of fuel stations, fuel

	suppliers, process for fuel issue etc.	issue documentation, fuel cards, authorisation.
Usage Planning	Defines clear guidelines in vehicle planning.	Responsibility for trip authorities, movement plan, schedule.
Allocation	Procedures for vehicle assignment and for new and decommissioned vehicles.	Pooling, inventory record, information sheets.
Passengers/patient	Guidelines on passenger/patient transportation.	Waiver or indemnity form.
Safety	Safe operation of vehicles.	Safety equipment, insurance, crash/incident reporting.

Fuel:
Fuel can potentially be up to a third of the entire NAS transport budget and must be managed with strict, clear processes to avoid misuse, errors and wastage within the service. It is preferable to contract a local garage/fuel supplier to supply all fuel and employ a period credit check account arrangement. Having one method of fuel supply is far easier to monitor than several, so long as it gives adequate cover in terms of time or location. Where fuel is stored and managed at a NAS site, thorough stock control procedures and health and safety procedures must be observed.

Vehicle Operator

This person will be employed directly, or as part of a medical crew member's duty depending on set-up, as a professional driver and is responsible for the effective, safe, and economic operation of a NAS vehicle. Vehicle operator also refers to any NAS personnel who use a NAS vehicle for an official duty.

All vehicle operators (VOs) are required to have a valid license and must be properly trained to safely use and care for all forms of transport they will be required to operate within in the NAS. These can include four-wheel vehicles, large vehicles, motorcycles, and bicycles.

The VO will be responsible for the following:

- Health and safety; crash and incident procedures, safe vehicle operation
- Vehicle Checks; daily checks (oil, lights, safety equipment, defects etc.), vehicle defect documentation
- Relevant documentation; for keys, fuelling, logbook, trip authorities
- Policy responsibilities; correct procedures for authorized usage, correct documentation, loads and passengers.

Driver training is a very important aspect of the VO. For a NAS, being an emergency response service, there will be a great deal of skilled driving required to ensure the safety of the ambulance crew, the patient, passengers and other road users. Specifically tailored emergency or "blue light" driver training must be developed for the NAS. There are several options to conduct this training.

- External training of trainers (ToT); Using an external expert to train trainers within the NAS. This will give the skills within the NAS maximising sustainability.

- External training (private driving school); A driving school which has the ability, capacity and skills to delivery emergency service driver training could be contracted to do all training and testing of NAS staff. This would be a form of outsourcing an aspect of the NAS.
- External training (Police or military); If the police or the military already have a driving course which is to the level required for emergency service driver training then they could be utilised to train and test NAS staff. There may be a combination of the first option and this option by getting external trainers to raise the level of the police or military driver training and then utilise this service for the NAS. This also increases skills within other services.

Due to the fact that a NAS is nationwide, consideration must be taken for the training process. Regional trainers or driving schools may have to be utilised and so a combination of the above options may have to be used to cover the service nationwide.

Operational Vehicle Planning

Vehicle planning is essential for the effective and cost efficient use of transport resources. It relies upon the cooperation and participation of everyone who manages, operates or uses vehicles. A Transport Officer (TO) should coordinate vehicle planning and must have the full support and confidence of their senior manager. TOs must be given the authority to implement the policy, and therefore have to be senior within the system to ensure they have the influence to affect change.

Vehicle planning involves a 3 step process that has been tried and tested and it is highly recommended that the transport policy ensures that it is adhered to. Although work plans are not always completely known at the time of planning, this is not an acceptable reason not to plan. A preferred option would be to change an already established plan as and when circumstances change, rather than reacting to needs on a daily basis. Planning in advance also identifies potential problem areas in advance and allows appropriate actions to be taken.

Step 1: Period Movement Plan

Five working days from the end of a reporting period, all managers and regular users of transport prepare their movement plans for the following period using a Period Movement Plan. A reporting period can be quarterly or monthly. It is up to the transport management team to decide the period length. This will enable a TO to plan and coordinate movements to best utilise the transport resources. As part of the on-going planning process authorised Trip Authority Forms must be issued for any movement not included in the Period Movement Plan as far in advance as possible.

Step 2: Period Transport Schedule

This schedule differs from the Movement Plan in that it is used to allocate planned activities to specific vehicles. The TO completes a Period Transport Schedule Form based on the data from the Movement Plan from Step 1. Any planned vehicle maintenance, service delivery requirements and the levels of urgency are taken into account. This plan will continually change and the TO is responsible for keeping the schedule up to date and communicating the details.

Step 3: Seven-day Transport Schedule

On the last day of the working week, the TO prepares the following week's Seven Day Transport Schedule which is used to give the most up-to-date information about planned activities and trips and the vehicles to be used. This is based on the information received in Step 2 and any new Trip

Authorities and other necessary changes must be updated daily. The schedule must be displayed in the office, generally next to the Period Schedule, as it will show all vehicle locations.

Other Procedures:
At the end of each period TOs should compare actual movements against what was planned. This should show successes, achievements, problems and failures. It will also be worthwhile to calculate the percentage of requests received versus requests completed.

All of this information should be presented to senior NAS management in the form of a written period transport report. By gathering information through monitoring and learning from the results, higher levels of service delivery performance can be achieved by the NAS.

Financial Management

The Transport Finance Vision

A transport finance vision must cover all parts of a TMS and also include future needs as it is essential for making accurate cost estimates to ensure the delivery of an effective and efficient transport service for a NAS. The size of the fleet that can be operated is defined by the amount of funding available. The cost of purchasing vehicles, the initial capital cost, will make up a substantial portion of the budget of the NAS; however there are a number of other costs that are necessary to maintain and protect these vehicles. These costs include:

- Depreciation; the decline in value of a vehicle over time must be taken into account to determine when would be the most cost effective time to replace a vehicle
- Fixed costs; costs that do not vary with level of activity i.e. vehicle insurance, taxes etc.
- Variable costs; these directly relate to the use of the vehicle including running costs (directly related to the distance a vehicle travels i.e. fuel, tyres, maintenance) and indirect costs (costs that do not affect the actual running costs i.e. breakdowns, fines, crashes)
- Human Resource costs; fixed costs (salaries) and variable costs (per diems)

It is essential that every department prepares an expenditure and income plan for the entire department that estimates annual requirements over a period of time long enough to achieve a comprehensive and realistic view, i.e. between five and ten years.

There are three steps involved in producing a transport finance vision:

a) Look at historical date and the results from the Ideal Fleet Model.
b) Calculate estimated expenditure and income i.e. vehicle disposal, vehicle replacement, additional purchases, fixed, variable and HR costs.
c) Identify potential shortfalls to be covered by expected income.

Annual Budget

TOs and managers who are conscious of the financial implications of their actions will make more effective decisions. The annual transport budget for a NAS serves as an annual health-check for the Transport Vision and is used to monitor and update that plan. Budget planning should involve the people who manage activities and are responsible for on-going monitoring. For every reporting

period, they must analyse what has happened against what was originally planned in financial terms. The Period Transport Report is the means by which this is achieved in a fully functioning TMS.

Budget setting and monitoring becomes more manageable once it is delegated to the appropriate management levels and all those involved have easy access to the data they need. Delegated budget management should have parameters that are clearly defined to avoid any misunderstanding and prevent errors.

The most effective means of budgeting for transport is using the all-inclusive cost per kilometre figure. Estimated travel distances in KMs multiplied by the all-inclusive cost/km allow the calculation of the true cost of the trip and provide a realistic sum for budgeting. Whichever cost formula is utilised, it is important that it be used consistently across the NAS to allow the comparison of data.

Paying for vehicles through an all-inclusive per kilometre charge in conjunction with a Trading Account (a bank account that income is paid into and bills are paid out of) is a very effective way of managing financial resources.

Fleet Management

The Ideal Fleet, Replacement and Disposal

The first step in managing transport is to know what transport resources you presently have, in other words, the Current Fleet. Although a simple concept, most departmental inventories and asset registers are out of date and do not depict a true up-to-date representation of the situation.

A Needs Analysis of what resources are needed in order to meet the expected service delivery requirements of the NAS must be conducted. To achieve this, the Ideal Fleet must be calculated using the following the steps:

- Complete a vehicle inventory.
- Gather information for the 'Needs Analysis'
    - Which jobs require transport support?
    - What are the transport requirements for that job?
    - What are the vehicle operating conditions for that job?
    - What are the service delivery priorities?

  This information can be gathered through interviews and the number of vehicles required should be calculated in terms of days needed.
- A table must be completed detailing each vehicle type and the number of days that will be required for each to achieve service delivery. A safety factor of approximately 20% should be calculated and added to the final tally to account for vehicle downtime for PPM, servicing and repairs.
- Calculate the number of vehicles required by 'vehicle days required by each vehicle type' divided by 'number of working days in a month'.
- From this data it can be calculated whether more or fewer vehicles are needed, and their type, to achieve an Ideal Fleet. This data can be used in the confidence that this is the right action to be taken for the operation's success.

Achieving an 'ideal fleet' is rare, however, there is value in striving for such a goal as the ability to objectively compare actual performance against ideal indicators is a key part of effective transport management.

Replacement of Vehicles
A review of the Current Fleet against the Ideal Fleet must be conducted in order to determine the vehicle replacement needs for a defined period of time, such as the next five years. To calculate the point at which a vehicle should be replaced, depreciation cost per km should be set against the Running cost per km (based on the all-inclusive cost per km over distance) to create a graph. This graph will clearly demonstrate the point where the Running costs gradually rise to meet the falling Depreciation and when the All Inclusive Costs per Km is at its lowest point. At this point the replacement of a particular vehicle should be considered.

Disposal of Vehicles
Disposal procedures must form part of the NAS TMS policies and procedures. This will enable the NAS to correctly deal with transport equipment when it is at the end of its useful life. Procedures are a must when having to examine and write-off equipment. Safe and prompt disposal of equipment is advised in order to avoid unnecessary retention and storage of non-operational/unusable equipment.

Specification, Selection and Procurement

There are three stages in the vehicle specification and selection process:

- Operational; what conditions and environment will the vehicle operate in and what is required of the vehicle. For a NAS these could include;
    - Road condition
    - Distances
    - Budget
    - Maintenance facilities
    - Load
- Technical; what specific engineering and performance specifications will be needed from the vehicle in order to satisfy the operating requirement. For a NAS these could include;
    - Ground clearance
    - Fuel type
    - Carrying/seating capacity
    - Engine size
    - Availability and price
- Selection; considering points 1 and 2 the best vehicle at the best price that meets the needs is selected bearing in mind the following;
    - Delivery time
    - Policies around fleet standardisation
    - In-country support for spare parts and servicing

Specific to motorcycles:
Motorcycles can be a cost-effective, safe, and efficient form of transport for the NAS. The appropriate make and model must be chosen and thorough training for riders in safe riding

techniques must be conducted. The use of crash helmets and protective clothing at all times is a must. Without appropriate training they will be expensive and dangerous.

Planned Preventative Maintenance (PPM)

PPM is an extremely important factor in achieving appropriate levels of vehicle availability and safety. Not conducting PPM regularly will lead to increased failure rates and downtime and increased maintenance costs. The operational performance of the NAS will suffer.

Planned Preventative Maintenance involves the following:

- Vehicle operator training
- Vehicle inspection(carried out daily on or off site)
- Vehicle operators daily defect reports
- Vehicle servicing; at pre-determined intervals in accordance with the vehicle manufacturers recommendations but taking into account any local conditions that may demand more frequent servicing
- Rectification of defects (carried out on or off site)

Maintenance Options

There are three main maintenance options;

- In house maintenance; performed using the facilities and staff of the NAS/MoH
- Outsourced maintenance; under taken by an outside contractor
- Contract hire; undertaken by an outside contractor as part of a vehicle operating system

A mixture of the above three options may be needed in order to satisfy the maintenance requires of a NAS nationally. Whichever option or combination of options is chosen, correct management is essential in order to ensure the constant and correct maintenance of the NAS fleet in order to ensure a fleet that can deliver a consistent service in a cost effective manner.

Maintenance Planning

Whichever maintenance options are chosen, vehicle maintenance schedules must be created by the TO and published as part of the vehicle planning process. All staff members, management and other, must be committed to respecting the scheduled dates for maintenance.

Vehicle servicing is a compromise between inadequate attention to PPM, resulting in progressive deterioration in condition of the vehicle and the ensuing serious consequences, and too much attention by means of unwarranted servicing, which is costly and unnecessary.

Maintenance Documentation

The following are examples of documentation associated with vehicle maintenance.

- Vehicle Maintenance Summary; A detailed written Servicing Record Report must be kept listing work done such as parts and fluids used and costs incurred on each job. The TO keeps this on the individual vehicle file and transfers a synopsis of this information onto the Vehicle Maintenance Summary. This information will also be utilised on the Period Transport Report.
- Workshop Job Cards (for in-house maintenance); the workshop raises a workshop job card for each vehicle entered for inspection, service and/or defect rectification. Each job card should include the following information:

- Details of all work required to be carried out
- Actual work carried out
- Name of staff and hours worked
- Details of spare parts and materials used
- cost of the work

Health and Safety

The key to successful observance of health and safety is the development of a NAS culture of awareness of, and compliance with, the health and safety standards that are drawn from national standards and codes. The main reason for doing this is to avoid injury or death to not only the NAS staff and its patients but all those potentially at risk from a road traffic crash (RTC). To help ensure that this is possible the Health & Safety Policy Document must be practical and be incorporated within day to day tasks. It should be incorporated into inductions for new staff and practice drills for fire evacuation etc. should take place frequently.

A NAS Health & Safety Policy Document should include the following and must have clear information covering all these required areas:

- The NAS and legal requirements
- Legal responsibilities
- The person responsible for providing specific Health & Safety guidance
- Risk assessments – responsible person
- Training arrangements
- Crash reporting and investigations – responsible person
- Review dates of policies and procedures
- How the NAS meets legal requirements and the implications if they do not

There are five main areas specific to transport management where local health and safety procedures will need to be agreed and documented by the transport technical staff:

a) Fuel stores
b) Safe operation of vehicles
c) Crash and incident procedures for vehicles
d) Vehicle workshops (if applicable)
e) Security of vehicle assets

Insurance and Transport Management

Careful consideration should be given to the form of insurance selected for the vehicles belonging to the NAS. The minimum requirements of the law must always be complied with which is usually a minimum of third party cover. Again there may be governmental requirements to be considered too. To ensure compliance with the vehicle insurance requirements, all personnel using operation vehicles under the responsibility of the NAS must be familiar with crash and incident reporting procedures for vehicles and personal injury.

Human Resources

This topic is also discussed in the Management Structure section of the guide.

Organisational Structure

Transport is a means by which the NAS service is delivered and so transport management rests with those responsible for managing service delivery. Effective transport management requires a clearly defined organisational structure that has clear job specifications (skills and qualifications) and job descriptions (nature and content of the work itself). There are many variable factors that contribute to the right HR structure for transport management and below are the main ones:

- The size and structure of the NAS (which will depend on its stage of growth, i.e. pilot and/or expansion)
- The size of the vehicle fleet
- The maintenance arrangements for the vehicle fleet

Competent, Committed Workforce

Careful planning and a detailed recruitment and selection process will go a long way towards guaranteeing the appointment of the necessary qualified staff to the correct posts. Although staff attrition is expected to a certain degree once people have been hired, it is imperative to do all that is possible to retain them and the expertise that they gain during their employment.

Staff Reviews

The aim of this process is to have an honest and open discussion in a relaxed environment. The review must be utilised correctly and it must have three clearly understood and agreed goals:

- Organisational – performance levels, placement, promotion and pay
- Feedback and evaluation
- Coaching and development

Vehicle Operator Assessment

This process is needed to assess the standard of competence reached by a vehicle operator, and to identify training requirements. It is to ensure that vehicle operators operate vehicles to an acceptable standard and in a safe and competent manner.

The following areas should be covered in the assessment:

- Driving assessment; this should be carried out annually
- Frequency of crashes, damage or violations of traffic law
- Operational requirements; administration, vehicle checks

Training & Development

A proper development program increases capability and effectiveness for meeting both personal and organisational goals. The development of staff is one of the key responsibilities of a manager but the manager and the staff members must share this responsibility.

There are a number of ways in which to carry out training and development:

- on the job training
- external / internal courses

- job rotation
- projects or special assignments

Management Information: Monitoring Performance

Management information is often seen as an unnecessary burden that increases the workload; however, this is usually borne out of not fully understanding its purpose. Quality information is needed for good decision making at all levels of an operation. The true purpose of transport management information is to improve overall efficiency without increasing staff workloads. A NAS must have a clearly defined management information system that entails knowing what information will be collected when, by whom, and how it will be analysed, used and communicated. Management information systems must be in place before vehicles begin working in the field.

KPI Analysis

Key Performance Indicators (KPIs) are implemented to better direct the NAS so that continuous improvements can be made towards operational efficiency. The table below shows some recommended KPIs for the NAS fleet.

Key Performance Indicator	Suggested Target
Kilometres Travelled – While not necessarily a useful indicator on its own, the Kilometres Travelled indicator can highlight disparities between the distances covered by vehicles and/or driver. It is also the foundation of almost every calculation required for the KPIs listed below.	N/A (dependent on vehicle type and operating period i.e. 5 days or 7 days a week)
Fuel Consumption – Fuel consumption measured in KMs per Litre can provide an early indication of fuel theft, poor driving technique or potential maintenance problems. Measuring fuel consumption is also key for calculating the running cost of each vehicle and thus the cost per item distributed.	7-10kms per litre*
Running cost per KM – Monitoring the running cost of each vehicle in the fleet is a fundamental part of best practice fleet management. Sudden changes in running cost can indicate maintenance problems, erratic driving, or even theft of fuel. Running cost per km is calculated by taking a single vehicle, adding its monthly fuel and maintenance costs, and dividing them by the number of kilometres travelled in that same month. For vehicles which don't travel long distances it may be more appropriate to observe the costs over a three month period in order to get a more accurate average.	Specific target figures are not given as there are many variables to consider such as vehicle size, engine size, vehicle age, and the cost of spare parts. It is possible to identify problem vehicles or costly servicing arrangements by comparing running costs for similar

	vehicles.
Vehicle Availability – This is a measure of the amount of time that a vehicle is available for completing the duties of an organisation versus the amount of time it spends undergoing maintenance or repairs. This is calculated by looking at the number of days the vehicle spends in maintenance each month according to logbook data. An availability score of 100% for a vehicle within in an organisation can be disconcerting as it implies that the vehicle is not undergoing necessary and appropriate maintenance. Poor availability scores can represent a poor maintenance system with vehicles spending too long undergoing maintenance either due to the poor service offered by maintenance providers or an inconsistent maintenance regime resulting in regular mechanical failures.	80-95%
Vehicle Utilisation – This is a measure of the amount of time which a vehicle is used when it is available according to the definition of availability above. Within some organisations the utilisation figure is calculated by dividing the number of days which the vehicle is used in a month by the number of days which that vehicle is available to give a percentage figure for each vehicle. However a more precise way of monitoring utilisation is by conducting the analysis on a per hour basis rather than on a per day. Some organisations prefer to put the emphasis on “unutilised” time and report against an indicator called standing time. A more precise utilisation calculation allows management to identify if capacity problems lie in a shortage of vehicles or poor planning of the existing fleet.	60-95%
Needs Satisfaction - This is a measure of the ability of the fleet to fulfil the needs of the distribution operation. Essentially it is calculated by comparing the number of return trips necessary to meet service delivery expectations (e.g. one shipment per delivery point per month) versus the number of return trips actually undertaken. This analysis will provide a percentage score, allowing any gap to be identified and analysed to understand what element within the supply chain was the cause.	95-100%
Safety – Road Traffic Crashes (RTCs) result in death and injury for thousands of people each year. They also cause disruption to transport operations, increase operational costs through increased insurance premiums, and affect service delivery. Anybody responsible	0 Accidents

for vehicles, regardless of the size of the fleet, should monitor near misses (instances when a vehicle was almost involved in a crash) and crashes. The target for this indicator should be zero near misses and zero crashes each month.	

** This target fuel consumption is an example based on a four-wheel drive pick-up (diesel). However, these targets should be amended based on vehicle size, manufacturer's specifications, age and terrain of operation.*

It is important that all of the people involved in collecting the data and filling out the reports, to varying degrees, are shown and understand the outputs in order to build confidence in the system and not have it be seen as just more paperwork.

Collecting data is only the first part of the monitoring and evaluation process. It is important to regularly compare data with targets and determine what actions, if any, are required. Management information is about informed decision making for the greater good of a NAS.

Situational Analysis

Situational analysis is applied when a holistic look at the total transport system is required, for example for strategic planning purposes. It is a structured way of looking at any management issue and this type of situation analysis will enable you to be able to identify the strengths and weaknesses of your operation and how to move forward in a positive manner. It is vital to ask;

- What type of transport is available?
- What do we do at the moment with our transport?
- Where?
- How?
- Why?
- Who does it?
- What improvements are needed?

The Approach

The greater the attention and detail given to a situation analysis, the more valuable the results will be. The end result will enable the NAS to build the foundations of the TMS and ensure the development of any current operation.

This process will require;

- Commitment: it must be fully understood and supported by the entire team
- Access: all doors must be open and transparency is vital
- Effort: high levels of effort will lead to high quality results
- Time: a project leader will be required to co-ordinate and manage the working groups and the process itself.

Realistic deadlines must be monitored and met along with the team's current day to day workloads taken into account.

Steps of a Situational Analysis

The following is a brief description of the steps needed to complete a situational analysis.

a) The external environment and background information
   - Geographical area and location
   - Type of operating conditions - road network and condition
   - Population density and distribution
   - Security considerations

b) Administrative structure
   - How many districts, health facilities and hospitals?
   - What areas do we currently provide services to?
   - Staffing levels
   - Document current structure including roles, responsibilities, and authorisation procedures.

c) Current fleet and Ideal Fleet
   - Compile a list of the current vehicle fleet by vehicle type and also by different locations. This should also include the condition of the vehicles.
   - As described before an Ideal Fleet should be calculated using information such as required transport, vehicle types, distances, operating conditions etc.

d) Policy
(procedures and operating guidelines)
   - Ensure information is gathered on:
     - How are the procedures and guidelines communicated i.e. verbally, documented?
     - Who communicates them?
     - How broadly is their existence recognised, understood and implemented?
     - How are they reviewed and updated?

e) Current transport management systems
   - How the documents in place are used and revised
   - There should be reports and statistics in place to provide evidence of this.

f) Finance
   - What financial planning and budgeting is completed for the transport?
   - How much money is made available for transport management?
   - What is this calculation based on?
   - How is the budget distributed across locations?
   - How this relates to the running of transport (a) how much is actually spent? (b) how much is actually needed?
   - Can there be cut backs i.e. fleet, cost, personnel, etc.?

g) Assess maintenance, repair, purchase and disposal
   - Identify procedures outlined in policy and operational guidelines and analyse differences in actual practice.

h) Human Resources
   - Job descriptions of those who operate at different levels. Training, recruitment and disciplinary actions.

i) Present report
   - To include facts and details and once reviewed by senior management presented to each department.
   - To include realistic recommendations.

Policy

Policy steers the transport management system. Policy must be developed through a participatory process, so that all transport users have an opportunity to contribute. It is important to remember that a policy does not remain static .It must be reviewed and updated at reasonable intervals and also after significant changes to the operation.

The following are core areas that every transport policy as a minimum must cover;

- Operational Management
- Fleet Management
- Human Resources
- Management Information Systems
- Health & Safety
- Accident Reporting

Managing transport for a NAS will be the direct responsibility of the Ministry of Health, if not outsourced, however certain transport elements may be controlled by other ministries' policies or impacted on by the procedures of another ministry. As an example publishing tenders for the purchase of vehicles or for the disposal of government property will likely conform to government-wide policies rather than MoH specific policies. This must be considered when constructing or reviewing a NAS transport policy as it cannot contradict pre-existing governmental policies.

As with a situational analysis policies must be systematically reviewed and updated. A policy that is not up to date and not adhered to will impact on the operation of the transport of the NAS and its effectiveness as a service.

Additional Transport Management System guides

The above section on Transport Management Systems (TMS), as stated, is a synopsis of Transaid's years of experience and knowledge managing transport. The main source for this section is the Transaid's "Transport Management Manual", published 2001, reviewed 2007.

There are other documents that, as an additional guide, can contribute to establishing TMS within a NAS. These free guides can be found on the Transaid website in the resources section;

http://www.transaid.org/resources/transaid-systems

These include a consolidated TMS guide and a self-learning TMS manual, created by Transaid, requested by John Snow International (JSI) through USAID. This guide is aimed at those without formal transport management training.

Components and considerations

This section of the guide deals with the components of an emergency system that need to be considered while planning and operating a National Ambulance Service. As mentioned before there are many components to an emergency system and similarly there are many components which combined make up a successful National Ambulance Service.

Stakeholders: Governmental and Non-Governmental

In order for a National Ambulance Service (NAS) to operate correctly and efficiently many stakeholders need to be involved all of whom must clearly understand their role and responsibilities. The Ministry of Health may have ownership of a NAS but they alone and independently cannot operate a NAS to its full potential.

Like many initiatives, health or otherwise, many governmental and non-governmental departments or other entities need to be involved to ensure the success of the system. The following examples are several of the key stakeholders which need to be, at the very least, involved in the process of designing a NAS. Depending on the governmental and non-governmental structure of the country undertaking this initiative there may be other entities that need to be involved. The following examples are a starting point to emphasize the complexity of a NAS but also to start the thought process of who should be engaged in the process.

The public

A NAS is a service that is for the public and that the public will benefit from and therefore they must be included in its creation. The experts in the different fields needed to create a NAS will of course be those designing and leading its implementation. However the public need to be and must be involved in design phase. Focus groups and similar forums are ideal to gather information around expectations and thoughts around the service. They are also an ideal situation for gathering information on cultural norms and expectations to contribute to answering some of the difficult questions such as the issue of drivers being medical personnel. The public need to feel engaged and 'a part of the system' in order for them to trust it and use it to make it a success.

Hospitals

Hospitals play a vital role in how a NAS service operates, after all hospitals are the destination for the patients in the ambulances. It is vital that hospitals, both public and private, are part of the process of a NAS being set up. Their willingness to accommodate the ambulances and their patients is clearly vital otherwise the ambulances will simply be moving patients from one location to another without any substantial and sustained care.

The hospital, the end destination for an ambulance, must be capable of accepting and caring for the patient that is being delivered. If hospitals are understaffed and underequipped then having a functioning NAS will only overwhelm the hospitals which may lead to patients receiving inadequate or no care. The point of a functioning NAS is to improve the health care system in a country, not exacerbate the problem of an overcrowded, understaffed, underequipped health care system.

When considering establishing a NAS, hospitals (with recognition of their capabilities and capacities) must be part of the design phase. If a MoH is to embark on the establishment of a NAS it must form part of a ministry wide approach to improving the health care system which has to include hospitals and their trauma/accident and emergency units and post hospital care.

Hospitals can play a role in the training and operation of the ambulance crews. Doctors trained in trauma care can form part of the training structure for ambulance crews. Also, if linked correctly with the ambulance crew's, doctors can also be available for high level technical advice in certain situations.

Police

The police will play a very important role within a NAS. In many cases, RTCs (Road Traffic Crashes), disturbances, riots, attacks etc., the police may be the first authorities on the scene. This role of "first responder", which is expanded upon further on in the guide, is a crucial link within the emergency care system and thus within a NAS.

The police also have a role to play in the structure and operation of a NAS. In some countries the police service themselves have a limited version of an ambulance system in place, which they own and operate. In many cases such police ambulance services are purely a transport operation and do not offer any medical intervention to those in need during transit. In saying that, the police ambulance can be a good addition to a NAS if integrated correctly. The basic transportation function a police ambulance service can provide would be vital for the mass transportation of "walking wounded" during certain incidences such as;

- Coach or bus RTC with multiple casualties
- RTC with multiple vehicles and casualties
- Flooding
- Landslides
- Earthquakes
- Terrorist attack – bombings etc.

Communication is a vital part of any NAS and the police can also play a part in this in two ways;

- Jointly with the NAS operate a call centre/command centre for emergency services
- In rural areas where either mobile phone coverage is low or ownership is low the police service could use their mobile phones or radio system to request an ambulance.

Fire service

The fire services of a country have to operate with the NAS in many of the eventualities it encounters. Fires, chemical spills, bombings, RTCs, train crashes etc. will all require both the fire service and ambulances. How they operate and function together is important to ensuring the best possible emergency care when needed.

Engaging the fire services, public or private, is again vital for the design phase of setting up a NAS. Cooperation between these services will help ensure the most effective and efficient NAS.

Much like the police they will quite often be the first responders to an incident. This role of first responder, which is expanded upon further on in the guide, is a crucial link within the emergency care system and thus within a NAS.

Military

The military's link to the NAS will more often than not be during a national scale emergency or in the aftermath of a natural disaster. This connection is expanded upon later in this guide. Having the ability to cohesively link these two entities together in times of emergency must form part of the NAS design and set up. The military will more than likely have some form of ambulance service within its structure. Having the ability to organise the military's ambulance service and the NAS cooperatively will aid in the response to an emergency and also limit duplication of response and thus minimise the inefficient use of valuable resources and valuable time.

National Drug Authority (NDA)

The National Drug Authority plays a major role operationally within any NAS by way of its own operation and legal position. In its simplest form a NDA determines the types of drugs and medical supplies a country uses and which entities and individuals are legally permitted to administer those drugs and medical supplies.

For the NAS this is a major component to its operation and its ability to administer care to its patients. The NDA can, in an indirect way, determine the care which can be administered by the ambulance crew by, in conjunction with the MoH, determining which drugs can legally be carried and administered by ambulance staff. Much like the legal constraints of which drugs and medical supplies a nurse can use versus a doctor, the types of drugs that can be administered by trained ambulance crews will influence the level of care they can offer their patients.

As with many of the components of the NAS that are all interlinked, the NDA and its role links directly to legal issues, doctors giving high level technical advice from hospitals, the ambulance crew training and drugs and supplies held on board an ambulance.

Emergency Preparedness /Disaster Management Authority or equivalent entity

Considering the bigger picture of national emergency preparedness, the NAS has its own role to play. Having a disaster management and preparedness policy which includes the role the NAS plays in different scenarios is essential. During any number of situations and emergencies, how and when a NAS is involved and how it interacts with other services such as the army must be clearly defined. An unorganised, unmanaged response is an ineffective response.

As part of this emergency/disaster system the NAS must have clearly defined operational boundaries and limitations. For example if a NAS ambulance and crew are not equipped to manage a chemical spill then they should only respond within their operational limitations. If they attempt to intervene in a situation they do not know how to deal with, they potentially will not help to resolve the emergency but may become part of the emergency through injury and may even cause more panic and chaos in an undoubtedly already chaotic scenario. This train of thought must also be adapted for incidents such as large fires, terrorist attacks, bio hazardous situations etc. A NAS must know how and when to react to a situation and not become casualties themselves – a specific

interagency/authority policy document detailing the role and function of the NAS during an emergency must be established and adhered to.

Consultation and discussion with an Emergency Preparedness Authority or its equivalent during the design phase of a NAS must take place.

Red Cross, St Johns Ambulance and other NGOs or Civil Society Organisations including private providers

Organisations such as the Red Cross and private sector ambulances are an important part of the operation of a NAS and their level of importance will vary depending on the country and its structures.

In the context of setting up a NAS, organisations such as the Red Cross and St Johns Ambulance can be invaluable. Their skills, knowledge and experience can be utilised to great effect. Their First Aid and first responder manuals and skills can be incorporated into the training curriculum for the ambulance crews.

Even in a well organised and structured NAS, there will always be a need for nongovernmental/private sector ambulances. During peak times, in emergencies, or at sporting events etc. the NAS will always need additional ambulances and crews. For example, during large sporting events or concerts private sector ambulances can be hired to enhance the necessary capacity required leaving the NAS to operate as normal responding to calls. During peak times of the year, for example the Christmas and New Year period, the private sector ambulances can be hired as an addition to the NAS to help cover the increased demand during such a busy holiday time.

However any private sector or nongovernmental ambulance service which is to be used by the NAS must meet a certain standard of quality and competency in order to ensure consistency in the quality of care. Later in this guide training of the ambulance crews is discussed in slightly more detail. For non NAS ambulance crews there must be a uniform standard in terms of skills, knowledge, medicines and equipment, which is comparable to the standards of the NAS. A form of structured vetting and competency testing must be undertaken by qualified medical professionals. The non NAS ambulance services that are hired in times of need must be annually inspected and certified to operate under the banner of the NAS when hired. It is feasible that different levels of competency can be certified for different circumstances. For example during a large terrorist attack the majority of NAS ambulances in that area may have to respond to the incident. However the NAS has a duty of care to deliver the service of emergency health care to its beneficiaries as a whole and so those non NAS ambulances that will be recruited must have comparable skills, knowledge and medical supplies to NAS ambulances to provide the public with a quality service. On the other hand an ambulance may be required to attend a small local sports event. This may not warrant a NAS ambulance being allocated to that position and so a local ambulance service that may not have the same level of skills, knowledge and medicines as the NAS ambulance could fill this role. This decision may be dictated by the amount of nongovernmental ambulance services in the country and their skill and equipment levels.

Funding& Insurance

Budgeting for vehicle purchase, maintenance and fuelling is discussed later on in the Transport Management System (TMS) section of this guide.

Funding

It is difficult to provide a comprehensive budget, including capital and operational expenditure that is needed to set up a functioning NAS. There are a vast array of factors and components which would be location and situation specific.

The following list is an example of some components which would need to be accounted for in a budget (this list is not exhaustive);

- Crew/driver training facility
- Crew/driver trainers
- Training course medical equipment and supplies
- Course supplies
- Production and continual update of course content
- Retraining and annual competency testing
- Medical supplies and drugs (on-going supply for the ambulances)
- Vehicles
- Vehicle and personnel Insurance
- Maintenance
- Vehicle equipment
- Command centre and equipment
- Command centre staffing and training
- Management and other non-operational staffing
- IT and communication equipment
- HR
- Legal
- Policy and procedural creation including legal issues
- Consultants and external training (if needed)
- Cost of care/service (funded by the government and/or insurance)

When budgeting you must always be mindful of the initial start-up size and then, in the long term, the growth to a full NAS. Factors such as population growth must also be taken into account.

Nationally decisions about how the health care system is funded and recovers cost will already have been made. It may be through, for example;

- Free or subsidised health care made available through government taxes
- Fees for every service offered, including or excluding life treating emergency care, payable through insurance and/or cash

The system that is decided upon or is already in operation, will determine/influence the funding mechanism for the NAS. This document is not a funding guide or indeed a guide on how a MoH should operate. The purpose of this document is to stimulate thought and discussion and to point its readers in the right direction when it comes to establishing a NAS.

A NAS is intrinsically linked to hospital care, either trauma care or longer term care. Funding of both is also intrinsically linked just as a NAS is not a standalone entity within the health care system. Therefore hospitals must also be adequately funded as the care of the patient continues once the ambulance reaches a hospital.

Insurance

In a national forum insurance companies and regulatory bodies along with the MoH, must broach the topic of insurance. The caps and systems which health and motor insurance companies place on their policies will have a great effect on the provision of health services. This must be seen as a step forward not only in ensuring the health service can continue to operate through on time policy settlements but also patient care.

Management structure

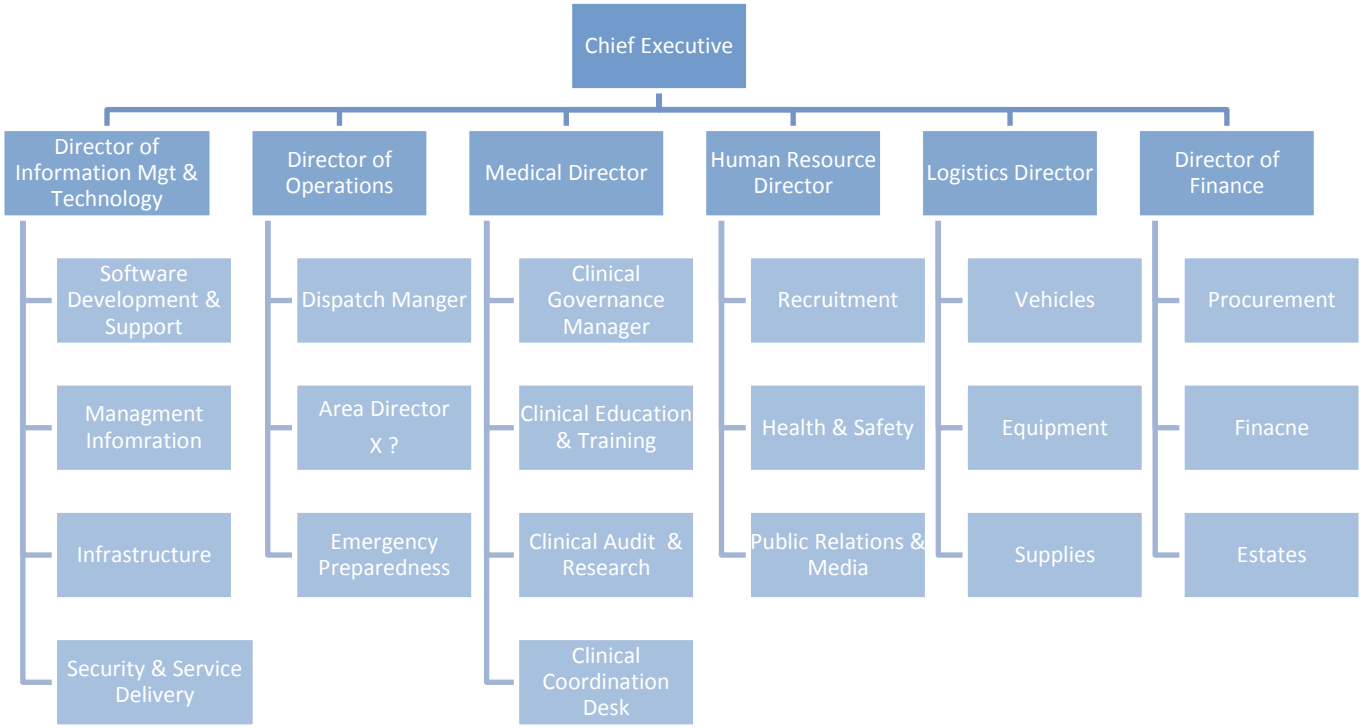
In order to have a service that functions correctly the management structure must be carefully thought through and planned. Although it is recognised that certain aspects will be predetermined by the structure and set up by the MoH and/or central government, it still warrants sufficient time and consideration. Ultimately having the correct line management, reporting structure and roles and responsibilities will ensure cohesion and stability within the NAS.

The basic principles of management must always be adhered to while planning the management structure. Managers at varying levels will have to deal with anything from recruitment, accounts, planning, training, and resources to monitoring performances and tasks. It is not only the role of a manager to manage activities but they must manage people too. Managers who have good organisational and management skills are a must as are social and interaction skills. Managers will have to deal with conflict, delegation, discipline and motivation among other issues and must be able to deal with such circumstances in a professional manner. Managers themselves must have the correct mix of technical, ethical and emotional skills to carry out this role effectively.

Responsibility and decision making are key factors within the NAS. It must be clearly defined who reports to who. A clear definition of people's roles and responsibilities for different tasks is also essential in clarifying who has the authority to make important and critical decisions, while at the same time minimising bureaucracy which might threaten the efficiency of the service provided.

There are different management structures which can be used in a NAS but ultimately, how the service is designed and pre-existing governmental policies etc. will shape the management structure. In the design stage of establishing a NAS one has to be aware of how the NAS will start small and scale up and not fall into the trap of having a "top heavy" management structure i.e. having too many managers compared to staff on the ground.

Below is just one example of what a NAS management structure may look like;



Crew and Driver

Designation & uniform

Throughout this guide the staff in the ambulance are referred to as "crew". This has been a conscious decision in relation to the designation of the staff. Although in some countries those with medical training in an ambulance who attend to the patient are referred to as paramedics or Emergency Medical Technicians (EMTs) these terms may not be applicable in all countries. The term "paramedic", for example, in different countries can apply to lab technicians and other medical positions. Whatever term is to be used for the medically trained staff it must be carefully considered and chosen. The term used can, in the public's eye, have the right or wrong connotations and thus affect the degree to which the NAS is accepted.

Continuing with the topic of perception and acceptance, the uniform of the staff is also very important. Careful thought must be put into the overall uniform;

- colour
- style
- emblems/rank markings
- badges

A uniform which is similar in colour or style to a military uniform, to the public, may not instil an attitude of openness and friendliness which is needed in a service that deals directly with the public all the time. The NAS uniform should look professional and be completely non-confrontational. Again emblems and badges on the uniform, if to show rank, role, region or organisation, must be carefully thought out. If military style rank markings are being used to indicate position within the

organisation then thought must be given to whether it will be acceptable and not portray any negativity, either perceived or actual.

Roles

An important decision when establishing a NAS is the roles the crew of the ambulances will take. The role the personnel will take will dictate the training they need but also the way in which the operation and day to day running of the ambulances will function.

There are two main roles or functions to be covered in the daily operation of an ambulance; patient care and driving. In various countries these two roles are undertaken by the same staff, that is one or both (depending on the staffing level within the ambulance) of the medical crew also drive the ambulance. The other option is to have a designated driver and designated medically trained crew members who all fulfil one role each.

The following points may be considered when deciding upon which option is most appropriate;

- It may be a cultural norm that the drivers drive vehicles and that is their principal function. Having a crew member who is medically trained but also drives may, in the eyes of the beneficiaries, diminish the perceived level of skill, training and education of the medically trained crew member and thus diminish the confidence in their abilities. Also, potential crew members may be unwilling to be both a driver and a medical crew member due to the same cultural norm or stigma which may be associated with the driver's role.
- It may be appropriate to have a designated driver who has local knowledge of the area for ease of navigation around the operational area and in finding patients' locations. Drivers could be sourced locally whereas the medical crew can originate from any geographical location.
- Safety and security of the vehicle and its contents may be a concern and therefore having a driver who stays with and secures the vehicle and contents as the medical crew attend to their patient(s) may be desirable.
- Having separate designated drivers and medical crew will increase the amount of staff needed for the NAS and thus may increase operational costs depending on how a dual role such as combined medical crew member and driver would be paid versus individual roles of a driver and a medical crew member.
- Human Resources; the additional work load on the HR operation in relation to having so many additional staff nationally. This may include such issues as payroll, sick pay, pensions, training etc.
- When having to fill roles due to attrition or new openings it may be easier to fill the roles if only one skill is required, that is a driver or a medical crew member. The wider the range of skills or prerequisite conditions for a position the narrower the pool of potential applicants is.
- Having a designated driver may allow time for the driver to be given more responsibilities such as performing basic maintenance or even other duties in an ambulance station. In the same regard having a designated medical crew member may allow time for basic outreach or training programmes as discussed elsewhere in this guide.

**It is important to note that being a trained driver is internationally recognised as a professional position.*

Training

Ambulance crew

The quality and duration of the medical training provided to the ambulance crews will have a significant impact upon the efficiency of the NAS. The training that the crews receive is medical training and must be in line with standards associated with other medical training in the country. As in other medical professions there must be a set structure, curriculum, certification, competency and proficiency testing process.

The actual curriculum and training must be decided upon taking into account the environment that the NAS will operate in. The following components will need to be considered:

- Should the crew;
  - Have basic first aid training only
  - Have a level of training similar to a nurse
  - Have a level of training higher than a nurse
  - Receive the same remuneration and benefits as a nurse?
  - Be trained to the level of a university diploma, certificate or degree
- Should the training;
  - Be at a medical university
  - Be conducted at multiple facilities in the country or one central facility
  - Be conducted out of country (a neighbouring country with facility and capacity. Potential to fill a gap to set up the NAS and until in country facilities and expertise are established)
  - Be outsourced to an organisation such as Red Cross or St Johns (dependant on level and capacity of provider and level of skills wanted)

Driver training is covered in the Transport Management System (TMS) section of this guide.

All other staff including management

Depending on the set up of the NAS, as discussed below in the Staffing section, there may be a need to train many different professions and levels of staff. Various departments including the call centre (discussed in more detail in this guide), IT, storage, mechanics, administration etc. will all require differing levels of training. Although the management chosen will inevitably have training and experience they will also require some level of training for such a new and ever developing and evolving service.

Training of all staff must be, at a minimum, to a national standard that must have been agreed and established before any training commences. It would be advised that international standards are considered and investigated to try and achieve the best possible service. At all times the service should aim for excellence in every aspect of its operation.

Staffing

Non-operational staff

Non-operational staff will be defined by the structure and set up of the NAS. It may include many positions in the following disciplines;

- Mechanics
- Administration
- Data and IT
- Warehouse and stores
- Cleaners etc.

In order to have a functioning, well equipped crew operating an ambulance it takes a lot of "behind the scenes" staff to coordinate, manage, repair, order etc. and this must be factored in. A NAS does not simply consist of ambulance crews and someone on the end of a telephone to take calls.

Ambulance crews

Operational staffing levels must be calculated correctly to ensure continuity, taking into account the operating parameters of the service. For example a simple calculation which could be adapted and used would be;

$$\frac{OT}{IWT} = Nc$$

OT =Operational time
IWT =Individual Working Time
Nc =Number of crews (note a crew may be 1, 2 or 3 staff depending on the ambulance set up)

$$\frac{168 \text{ hours (i.e. 7 days x 24 hours)}}{42 \text{ hours}} = 4 \text{ crews (8 staff members if an ambulance has a 2 person crew)}$$

Note:

- This formula does not account for annual leave, training or absenteeism which also needs to be accounted for and so will raise this number.
- A working week is defined as 42 hours however working time directives will vary in different countries and so needs to be adjusted appropriately.
- A crew is those operating the ambulance and the size of the crew will depend upon the NAS design. It may be 1, 2 or 3 crew members.
- This formula indicates the staffing level needed to operate one ambulance on a 24 hours, 7 days a week operating schedule.

Other disciplines to consider

When designing a NAS, decisions will be made that will influence the staffing levels within the service. One decision may well be to outsource parts of the service to third parties to operate with

the NAS management team's role limited to contracting and managing these third parties. Examples of parts of the service which might be outsourced are;

- Call centre
- Data management
- IT
- Driver training
- Supply ordering and warehousing

If these parts of the service are not outsourced then they will require staffing on all levels from operation to management. This staffing level is also dictated by the size of the NAS and of course the stage of expansion the NAS is at.

Medical equipment including drugs

The relationship between the NDA and the set-up of the NAS has already been discussed in this guide. Here the drugs, medical supplies and equipment are discussed in a little more detail.

Drugs and medical supplies

The system of order, storage and supply of drugs and medical supplies for the ambulances needs to be given significant attention during the planning phase of the NAS. Decisions will have to be taken as to whether the drugs and supplies should be part of the national drugs and medical supplies supply chain. If they are part of the supply chain then the logistics involved will have to be carefully designed. Just like a hospital or any other medical facility if supplies run out then the ambulances cannot function in the way they are designed to and lives may be put at risk.
The physical locations where the ambulances operate will also play a role in this system. A national medical store may have problems transporting drugs and medical supplies to remote rural areas which can affect the supplies to the NAS. Local stores may be considered for stockpiling supplies however feasibility and security involved in this must be carefully thought through.

For the actual ordering and supply of the drugs and medical supplies a coherent and well-structured system must be used. One option could be to utilise a system which is already being used by a national medical stores. Alternatively a new system which is deemed more appropriate for the NAS could be established although this may lead to duplication of efforts within the MoH as a whole. Ambulances must have the availability and supply of the drugs and supplies they need in order for them to function correctly. Although this document is not a guide for supply chains and warehousing, these factors will be an integral part of the NAS and so must receive the necessary attention.

Note: medical supplies for the purpose of the NAS refers to such items as oxygen, medical gloves, mask, bandages and all the other supplies needed to fulfil the crews role depending on their level of training as already discussed in this guide.

Other Equipment

There are many items in an ambulance's interior that need to be carefully planned and can, if done incorrectly, cause functionality and operational problems in an ambulance. Here are two simple but constant errors that are made with ambulance equipment in other parts of Africa;

1. Oxygen systems - Many NASs which duplicate designs from ambulances operating in other parts of the world use piped oxygen in their ambulances. This is an integrated system of pipes and tubes to transport the oxygen from the storage tank located somewhere in an ambulance to the equipment the ambulance crew are using. This system unfortunately has many flaws in an African context. The piping and tubing needs constant cleaning, maintenance and repair. The piping and tubing is constructed from many small, delicate parts that all too often fail and need replacing. As in the field examples demonstrate that the maintenance does not occur and when the parts inevitably fail there is no way of replacing them and so the system becomes redundant. The simplest yet effective and operationally sound option is to simply have free standing oxygen tanks secured in the ambulance cabins. This is simple, effective and easy to replace.
2. Stretcher selection – As with the oxygen system above many NASs will duplicate stretcher designs from other parts of the world. The concern about this is more often than not the stretcher is a stretcher that has been designed for operation in a country such as the USA and is not designed for the African context. Complicated stretcher design, such as hydraulically assisted stretcher systems, with highly specialised components and parts often end up in the back of African ambulances. Again like the oxygen system, when they fail, spare parts and repairs become a major issue. Simple, easily repairable basic stretchers that can be used in urban and rural settings tend to be far more appropriate. The simpler the design the greater chance of longevity in its operation. Investigating alternative backup systems such as canvas, foldable, hand held stretchers should be considered.

We live in an age when the newest designs and newest technologies are not only forced upon us by those selling them but they are actively sought after. However the newest most up to date design and technology may not be suitable or function in the way that is promised in a real life environment. The most basic, but functional, designs are often those that will last the longest and function the best and should not be overlooked.

Note: the basic interior design/layout considerations are discussed in the Vehicle section in more detail.

As with other medical professions, such as doctors who deal with trauma and emergencies, the ambulance crew will need the right Personal Protective Equipment (PPE). Apart from the basic items such as surgical gloves, consideration must be given to other items such as protective eye wear, masks, aprons etc. Practical operational PPE must also be budgeted for and purchased such as helmets for motorcycle and bicycle riders.

In addition, PPE such as hazardous chemical protection suits, respiratory equipment, bio hazardous suits etc. may have to be purchased depending on the range of emergencies the NAS will be capable of responding to.

Health and Care

The National Ambulance Service set up must look beyond its day to day operation of ambulance vehicles responding to emergency calls. Its set up must look at the wider picture of health care in general. There are several components outside of the day to day operation of responding to

emergency calls that a NAS and MoH can help organise and implement which will help in the overall operation of the NAS. These components will inevitably do two things for health care in relation to a NAS; save money and make the NAS more efficient and effective. However when discussing this topic it is very important to make note that operations outside of responding to emergency calls does not include transporting dead bodies or using ambulances as utility vehicles. A very clear vehicle operational structure must define these activities as unacceptable and outside of the National Ambulance Services scope and work practices. Both of these activities could have detrimental effects on the not only the ability of the NAS to deliver its service but also the public's perceptions and acceptance of the service.

Below are some examples of these components;

- First Aid training in other services: First Aid training should be part of other services who will inevitable be first responders. These should include the police force and the fire service but also where possible include military forces at the very least. This training does not have to be by the NAS but can be can be outsourced to the likes of the Red Cross, St Johns or equivalent organisations providing they reach the predetermined standards. A system of train the trainers would be ideal and therefore negate the need to annual hire external trainers for trainings.
- Community programmes: Particularly in more rural areas where time plays a much larger role in response, selected community members could receive First Aid training. This training again could be outsourced or even done by police or fire service First Aid trainers. If planned correctly it could be done over a number of weeks during slow periods as not to interfere with normal operations and cut down on costs.
- Youth programmes: It is important to start young when talking about health issues and this is where youth programmes in schools and communities could benefit the NAS. This does not have to be as detailed as First Aid training; however First Aid training would be an ideal for a number of staff members in every school. It could be visits from NAS staff, police staff, Red Cross St Johns etc. who simply discuss topics such as when to call the emergency services, how to contact them and also to help instil respect for the service. These simple steps will help reduce unnecessary call outs but also help ensure some level of first responder knowledge, even if it is just to call the right number at the right time and ask for the right service.
- Correct advertising and PR is a useful tool for the operation of the NAS. One issue that arises within almost every ambulance service is people requesting an ambulance when they really do not need it. This incurs a cost and also means that an ambulance potentially cannot respond to an actual emergency. When not to request an ambulance and when to use public transport instead, such as a taxi or bus, must be conveyed to the population. With inevitably limited resources the NAS must operate as efficiently as possible. This will also link into the call centre and its operators. There will have to be a system that will allow the call centre staff to determine if there is a need to send an ambulance and when to tell the caller to use other transport means.

Call Centre, Communication& IT

Call Centre

ANAS needs a structured call taking system that can respond effectively to requests for assistance from members of the public. This system should have a toll free universal emergency number enabling everyone to easily contact the service.

There are several components of an Emergency Medical Service (EMS) call centre to take into account during design;

- Universal toll free emergency number; a single toll free number that the public can easily remember, for example in the UK it is 999 and in the USA it is 911. This number must be toll free so there are no restrictions on who can access it. An advertising campaign to introduce this number to the public would be essential.
- Structured call reception and dispatch system; upon receipt of a call - location, number of people involved, nature of incident or problem. Decision and advice systems that help the call receiver make decisions around the response in a focused and directed manner.
- Multilingual staffing; many countries will have many regional and local dialects. It is important that the call centres accommodate this by employing multilingual staff to operate in the call centres. Language should not be a restriction in accessing the NAS.
- Telephone triage system (this is seen as a potential part of the service moving forward, that is an aspiration rather than a necessity); those who receive the emergency call can give pre-arrival advice on the phone until the ambulance arrives. This would require medical training for the call centre staff.

In the first test site(s) of the NAS the first call centre(s) will be established, in the same geographical area/region. However as the NAS expands to all regions of the country each region will have to have its own call centre. During the design of the call centres and the dispatch systems the potential for expansion must be built into all the components, locations, staffing, trainings, electronic systems, communications, data storage etc.

Communications

When the National Ambulance Service is established those who will benefit from it i.e. the public, will need to be informed about its establishment and the type of service it provides. This can only be achieved by a good advertising strategy which hopefully in turn will also generate positive Public Relations (PR). Advertising will build visibility and PR will build credibility. This type of communication links back to the previously discussed topic of youth and community programmes and teaching the public what the NAS is and what they do. It will also teach the correct use of the identified universal number and the service itself.

Communication within the NAS itself is an important topic to cover. The Call Centre has already been discussed but how they communicate with the ambulances and how different services such as the fire service communicate with the NAS is critical. Several types of systems can be adapted and a few examples will be discussed here. Communication between the Call Centre and the ambulance crew could be done using;

- Radio – Analog or Digital;

Two way radio system using either analog or digital mode. This guide is neither advocating nor discouraging the use of either type of radio system. Analog; limited features, limited encryption, simple group conversation (one to many). Digital; many features such as text messaging and IP connectivity plus same features as analog, better battery life, increased range. Radios in general are of a rugged and long lasting design. They are made for the type of environments that a NAS would be operating. Current radio infrastructure such as masts and coverage areas will play a role in deciding this option and the type of radio system. Radio systems do not have to rely on public communication systems so if that should fail the radio system will still be fully functional.

- Mobile phone;

Mobile phones within Africa are becoming increasingly prolific, affordable and the systems that operate them are becoming progressively more sophisticated. This guide is neither advocating nor discouraging the use of mobile phones however, as a system or a backup system to the NAS or any other service there are some operational structures which can be investigated. A mobile phone system can be set up with SIM prioritisation protocols. This gives a different level of operational priorityto each phone number within the mobile phone service. These prioritisation levels allow the mobile phone operators to break its users into different groups. These priorities can be broken down into a structure of levels, for example levels 1-14. The public and businesses may be given priority levels 1-7. An emergency service could be allocated higher priority levels, for example 12-14, so that when the system is overloaded, fails or there is a major incident such as a terrorist attack, the system can be switched off for all the lower priority levels, meaning the emergency services will still have communication. If any emergency service decides to operate using a mobile phone service then closed user groups can be arranged. These are free calls between certain mobile phone numbers such as ambulances, control centres and hospitals. Anyone within the user group can call each other free of charge. This means there will never be an incidence of someone running out of phone credit at an important time.

There will be technical, operational and cost considerations in the choice of the appropriate system.

IT &Data

Within any NAS there is going to be a lot of data collected and generated. This information will include all of the operational data relating to the running and operation of the ambulances and the call centre. It will also include personal data about those benefiting from the service, such as name, age, location, injury etc. The data needs to be stored safely and securely as the majority of this information will be sensitive personal and medical information.

It would be an accurate assumption that this data will be in both paper and digital form. The safety and security of this type of information must be considered. For paper based records the following are some of the considerations that need to be taken into account;

- Standardised forms; meaning that all the same data is collected in the same way so neither too much nor too little data is collected.
- Fire and theft proof storage; where the data is stored needs to be able to withstand fire damage (within reason) and the security risk of theft to protect all the valuable data which has been gathered such as the personal information of beneficiaries and the operational data of the NAS itself.
- Duplication policies; who, when, how and for what reason data can be duplicated. This must be restricted so that no personal or operational data could be leaked or sold to unscrupulous people or organisations.

- Destruction policies; it is important when data is being destroyed that it is done properly so as to avoid any risk of the data leaking. For paper this could be through incineration to reduce the possibility of someone recovering this information from somewhere such as a landfill or dump.

For electronic based data the following are some of the considerations that need to be taken into account;

- Secure Servers
  - Secure location – secure building, guards, entry protocols etc.
  - Secure system – firewalls, anti-hacking systems etc.
- Backup system
  - Policies around when and how to back up data
  - Secure location (may be outside of country) – secure building, guards, entry protocols etc.
  - Secure system – firewalls, anti-hacking systems etc.
- Destruction policies

There also must be access and usage policies around the data. Who can access it and what it will be used for and by whom. It is important that those benefiting from the NAS are confident about its operation and its security with their personal information.

Operational structure

This section directly links to the epidemiological mapping section of this guide. In order to plan where and when ambulances should be operating and where they should be stationed a NAS needs to know the vital information from the epidemiological mapping. This information is what will form the basis for the operating structure of the NAS.

Another important aspect of a NAS operational structure is deciding the operational scope of the service. Is the service a 24 hour a day, 7 days a week service? Are the service parameters a constant throughout the service nationally or do they vary depending on location, population coverage and available resources. Can the service operate an “on call” system in more rural and/or lower populated areas? An “on call” system could be operated, due to lack of staff, by allowing staff to bring ambulances home overnight and through the chosen type of communication respond to calls if and when needed. This can negate the need for a station to be open and several staff being used.

Geographical positioning

In order for a NAS to function correctly it must be able to access its patients as quickly as possible. Firstly the actual location and type of ambulance stations needs to be designed. There are varying levels of “ambulance stations” which can be considered;

Regional hub – this type of station may be the highest level of station under a national office. These hubs may house several ambulances and other NAS related vehicles and services. It may have facilities for staff such as sleeping quarters, shower, toilet and kitchen. It may, depending on the set up of the NAS, have drugs and medical supplies stored on site. It may also have some basic spare parts and equipment for vehicles such as oil, lubricants, air pump, spare tyres etc. They

would most likely have senior management staff along with other non-ambulance crew staff that would warrant office facilities at the hub. These stations or hubs would serve a coordination role for all National Ambulance Services in their region as well as being a functional station.

Large, medium or small ambulance station – these are solid constructions which may house anything from one ambulance up to several. It may have facilities for staff such as sleeping quarters, shower, toilet and kitchen. It may, depending on the set up of the NAS, have drugs and medical supplies stored on site. It may also have some basic spare parts and equipment for vehicles such as oil, lubricants, air pump, spare tyres etc.

Stand point – this could come in two forms. Firstly it may literally be just a designated area to park an ambulance such as near a major road or busy market. It would have no facilities or structure at all. It would however be a designated parking space so no other vehicles would legally be allowed to park there and also the police or other authorities would not be able to move the vehicle or harass the crew due to their location. The second type of stand point would be somewhere in between a small ambulance station and a stand point. It would be a designated parking area but could have a temporary or movable structure accompanying it. This structure would be very basic and potentially built in such a way that it could be moved quite easily if needed, maybe a prefabricated structure. The structure may only be a single room for sleeping in or a place to sit and rest for the crew.

An important point to be mindful of is that the stand points or stations are not seen as a type of health facility. It would be detrimental to the work that the NAS is trying to achieve and the health care system in general if the stations become overrun with walk in cases looking for basic general practice care instead of attending their nearest health facility (HF). This is another example of the importance of interactions and cooperation between different stakeholders. If the NAS is better equipped and has drugs and medical supplies that HFs and hospitals don't then the public will quickly learn where to go for even the most basic treatment. This will not only interfere with the operation of the NAS but also may sour the relationships between the hospitals and HFs and the NAS. A NAS is only one component of an approach to improving health care within a country and must be done in collaboration with other activities aimed to improve health care.

It is important that the NAS ambulances be located near hospitals and HFs where possible and when the data from the epidemiological mapping indicates this is justified. However care must be taken with this arrangement for numerous reasons. The hospital or HF may start to take the ambulance crews to work in their facility due to understaffing which will affect the operational functionality of the NAS. Hospitals and HFs may start to make requests for drugs or supplies from the ambulances if they are lacking such resources. Ambulance staff may feel they have to "do as they are told" by senior doctors at these facilities due to cultural or political norms or out of respect for the position of authority they hold. As stated in the previous paragraph these types of situations will not only interfere with the operation of the NAS but also may sour the relationships between the hospitals and HFs and the NAS.

The locations of the ambulance stations, as already stated, will depend upon the information gathered by the Epidemiological mapping process. Examples of where stations may need to be located as are follows;

- Peak periods on major roads and highways (stand point)

- Black spots – a location where incidents occur frequently
- At major sports events (stand points)
- Seasonally effected areas – areas prone to major flooding, landslides, hurricanes etc.

Finding patients' locations

As previously discussed it may be an option to hire local people for the ambulance crews who would have the local knowledge of locations, roads, landmarks etc. to ease in the location of a patient during a response. This however will not always be possible and so other means must be investigated.

- On some major roads and highways there are number or mileage posts which indicate the mile or kilometre on that road and thus will give an approximation of the location.
- Maps will be a useful tool for the NAS. They will enable the crews to find locations but also the call centre staff can use them to get the crew started and heading in the right direction if they are unsure.
- Although Global Positioning Systems (GPS) may be an option, their introduction is not recommended in the initial phases of set up and expansion of a NAS. Experience shows that the more electronic devices, software and complex expensive components are used the greater the chance of failure and major cost. GPSs should only come into discussions once a NAS has been established and expanded nationwide and even then on the list of priorities and budgeting it should fall far below such items as vehicles, staff, supplies etc.

Other activities

As mentioned in the Health Care section of this guide ambulance crews could be involved in other activities such as youth and community programmes. At the differing types of stations mentioned above such programmes could be completed by the crews'in-between responses. Health care education, screening, basic first aid etc. could be done when they are not attending to emergencies however as mentioned previously the NAS must be very careful that these types of activities will not interfere with the operation of the NAS as an emergency service or damage the relationships between the hospitals and HFs and the NAS.

The NAS may be used as a referral system in certain circumstances. These circumstances must be clearly defined and documented so as not to leave any doubt as to what qualifies and what does not. Such circumstances may be maternal emergencies when the initial HF is not equipped to deal with such an emergency. It may also include such circumstances as transferring critical patients needing surgery or transplants between hospitals.

The NAS can play a role in infection control as well and this links back to such components as community programmes and health education. These components and the knowledge and understanding they will instil in the communities will only aid the process of infection control.

Operational continuity

In this guide there has been mention of third parties, such as St Johns Ambulance, being contracted to supplement the NAS. This addition is important for continuity within the NAS and operational coverage. Linking in to the Legal section of this guide it is vital that contractually and legally this partnership is sound. Also it is important that such external partners are scrutinised to the same

level of the NAS itself and that they are at the appropriate level of skills, knowledge and equipment and are certified to a recognised and preapproved standard.

It is advised that Memoranda of Understanding (MoU) are signed with several third party ambulance providers. This will be a type of contingency plan to allow for a larger pool of providers when there is a need but it will also encourage those providing an ambulance service within the country to strive to achieve a nationally recognised and certified standard.

Testing

When a NAS is first set up there will be a learning curve within the service as to what works and what doesn't and how the service operates. This learning will be for the day to day operations of the service however it does not include large scale emergencies and national disasters.

Inevitably every country will unfortunately have to deal with large scale emergencies, possible a train/bus crash or terrorist attack, and natural disasters such as earthquakes or landslides. As discussed in the Stakeholders: Governmental and Non-Governmental section of this guide there must collaboration between the different emergency services such as the police, fire service and military. Planning and structuring responses to such emergencies is a must however, planned responses and enacting those responses can have very different outcomes in times of high stress, high casualty situations.

Live testing of responses and interactions between different services to large scale emergencies must be considered by a NAS in its design phase. It would however be foolish to enact such a test in the initial stages of a NAS set up when the service is not functioning to its full capacity. Looking to the future testing must eventually become common place within the NAS and the corresponding emergency services.

Example test running a drill of all services working together: A large bus and multiple vehicles are involved in a crash. Use old non-functioning scrap vehicles and use actors or local people to play the parts of the injured and dead. Fire service, police and NAS respond. Act out the interactions between the services and the roles that they would play and what they would do. It is very important to remember the test should be considered a "real" exercise and everyone should take it as such. A test will cost time, money and resources so it must be serious, planned, structured and controlled. The aim of the tests are to prepare the services for when such events happen and the more seriously the tests are taken and drilled the better the services will respond when such an event actually does happen.

Legal considerations

Like any other health care service the NAS must be held to the highest standards however there is always the potential for the unexpected to happen and that is why the NAS must ensure it complies with all laws and legal restrictions that apply to it. Some of these have been discussed to varying degrees in this guide;

- National Drug Authority legislation

- Certification and nationally recognised courses for medical crews
- Licences, insurances, taxes etc.
- Human Resources – hiring, termination, wages, harassment, sexual discrimination etc.
- Outsourcing of components – contracting and operation

The NAS must operate within the law and be seen to have integrity in its operation.

Emergency or "Blue light" driving and vehicles are discussed in the TMS section of this guide. There are legal issues surrounding emergency or "Blue light" vehicles that need to be addressed.In many countries it is a legal obligation to allow an emergency service vehicle right of way on any road while using their blue lights to enable them to operate as fast and effectively as possible saving lives. Although it is recognised that if this is not already written into law it would require much work to bring to fruition however it is worth considering for the future to help enable the NAS operate to its best ability. Looking to the future a NAS must have at its disposal any and all resources and systems which enable it to operate to its most effective and efficient level.

Outsourcing

Outsourcing has been mentioned several times during this guide for different components of the NAS. If any component of the NAS is to be outsourced to a third party there are several considerations to take into account when making that decision;

- Is it financially more cost effective (in the long term)
- Does it mitigate the risk to government
- Is it a logical move for skills, knowledge and expertise gain
- Will it improve the operation of the NAS versus doing the component in-house
- Is there capability to manage the third party within the NAS
- Does it make sense operationally to give control of a component to an external party

If it is decided that a component of the NAS will be outsourced it is vital that the different sections of the process are done correctly. From scoping the component to Expressions of Interest (EoIs) all the way through to contracting must be completed with care, precision and professionalism. It is vitally important that both operationally and legally the process is air tight otherwise if operational or legal issues arise in the future between the third party and the NAS it could affect the day to day operation of the service and potentially cause loss of life.

Vehicles

The vehicles of any NAS form the physical and operational backbone of the service. The correct type and specification of vehicle will have a huge impact on the operational effectiveness of a NAS. There are many experts with many years of experience and technical and engineering knowledge on the design and internal layout of ambulances but this section will briefly discuss specifications and the

internal and external layout and design of NAS vehicles as an introduction to the subject and to highlight common errors and misperceptions.

Types

A NAS by definition must be flexible and adaptable to its situation in order to fulfil its mandate of delivering an emergency health care service. When designing a NAS service the vehicles that make up the NAS must be appropriate for the conditions and situations they will operate in. This process is often over simplified and one type of vehicle is selected for National Ambulance Service, four wheel drive vehicles that are usually small trucks, vans or pick-ups.

During the design phase of any NAS, various types of vehicles for differing situations and conditions must be considered. Below is a short outline of potential vehicles and their uses;

- Four wheeled vehicles (two wheel drive): Various forms of two wheel drive vehicles, if they be vans or cars are suitable for urban setting where the more expensive four wheeled vehicles are not necessary. Of course if the catchment area of an urban ambulance service also includes areas with poor infrastructure, peri-urban areas and rural areas then a mix of both two wheel and four wheel vehicles may be necessary. Cars in most cases cannot be used as ambulances for transporting patients however they can be used to transport medical staff, senior staff (during larger scale incidents/emergencies) and equipment during incidents that warrant the additional support.
- Four wheeled vehicles (four wheel drive): Four wheel drive vehicles will be needed in areas of poor infrastructure and difficult terrain (mountainous/sand etc.), for the most part rural areas. They may also be needed in areas prone to flooding for ease of small river and/or floodplain crossing. These vehicles may also be in large form such as vans, pick-ups and trucks but also cars for the reasons stated above.
- Motorcycles: Motorcycle use is on the increase within NASs due to their flexibility and ability to respond quickly to an incident. They are widely used in urban areas as “first responders”, attending to those in need of medical care while four wheeled ambulances negotiate heavy traffic and small streets that plague most large urban areas. Their ability to move within built up, traffic congested areas makes them an important addition to any urban ambulance service. Motorcycle ambulances can be adapted to hold medical equipment and supplies including such items as small oxygen tanks and limited drugs. In the case of major incidents, such as a terrorist attack, communications may fail or purposely be shut down and this is when motorcycle ambulances can take on an additional role as “runners”. “Runners” are regularly used as communication messengers between command centres, senior staff, hospitals and incident locations, a practice which is replicated in other services such as the police.
- Bicycles: Bicycles are also being increasingly used by urban ambulance services across the world. Their ability to negotiate urban terrain such as narrow streets, pedestrian areas and even shopping centres give them an edge over four wheeled vehicles and even over motorcycle ambulances. Bicycles, like motorcycle ambulances, are often used in urban areas as “first responders” to deliver life-saving care while waiting for four wheeled ambulances. They can be fitted with similar equipment to the motorcycle ambulance taking weight and safety into consideration. Similarly to motorcycle ambulances, bicycle ambulances can also take on a role as “runners” during major incidents.

Other types; depending on the geographical area and the terrain other types of vehicles may have to be considered which are specialised. These may include small or large boats for coastal areas or areas with large river and lake networks. In extreme cases such as large swamp/marsh areas even small hovercrafts may have to be considered. It is however strongly advised that any of these specialised types of vehicles are only invested in once a NAS is set up and running effectively. These forms of transport could be very expensive and a risky venture for a NAS in its early stages of development.

Specifications

Specification of the type of vehicle to be used for an ambulance in the different environments it will operate in is discussed briefly in the "Transport Management System" section of this guide.

One technical specification for an ambulance would be the carrying capacity and seating configuration. Seating is briefly discussed in the next portion of this section. In terms of the carrying capacity of an ambulance, the obvious and generic option is a single stretcher however having double stretcher ambulances should be considered. It is a rational assumption that ambulances will be responding to RTCs and other incidents that might involve multiple patients. As has been proven in many countries during such incidents with multiple patients, from RTCs involving buses/coaches to terrorist bombings or natural disasters, the capacity of the ambulance services has been stretched and patient transportation has suffered. Double stretcher ambulances are an option that could contribute to an improvement in patient transportation and should be seriously considered. It would be unrealistic for an entire ambulance fleet to consist of double stretcher ambulances. However a proportion of the fleet could consist of double stretcher ambulances for when tragic accidents involving multiple patients occur.

Internal and External design/layout

The following portion of this section will briefly deal with the internal and external layout of four wheeled ambulance vehicles (2-wheel and 4-wheel drive). The layout of an ambulance will of course be determined by its intended operational use however there are some factors in common that will apply to the large majority of ambulances in a NAS.

Ambulances are, by their very nature, statistically more likely to be involved in a Road Traffic Crash (RTC) then average road users. As an emergency response vehicle they will be involved in faster and more defensive driving practices than the average road user during their response and transportation to a hospital. Considering this fact it is advised that safety and the external structural integrity of an ambulance always be a part of the vehicle considerations and specifications.

It is a dangerous misconception to assume that to accommodate all the equipment and crew, an ambulance needs to be a large, oversized vehicle. In many countries, like the USA, there is an active move to reduce the size of ambulances for many reasons including fuel consumption and safety. Larger vehicles of course mean higher fuel consumption and in turn increased fuel costs to an ambulance service. The safety of the ambulance crew is also a primary concern. Large vehicles mean the crew has to move around inside the vehicle to attend to patients while moving. This is a

potential cause of harm to a crew member who risk being thrown around the back of the vehicle. While administering care in an ambulance, the crew should remain seated and have a safety belt on, where possible, to reduce the risk of injury during transit.

Stretchers

- Stretcher location: the location of the stretcher within an ambulance and the medical crew's location in relation to the stretcher are vitally important for correct care. Although space limitations within the vehicle used as an ambulance will play a role in dictating the layout of the interior, a common and dangerous error is positioning the medical crew member parallel to the stretcher as illustrated in *Diagram 1* below. This position, although close to the patient, does not allow for airway management. Airway managementis the medical practice of maintaining or restoring an open pathway between a patient's lungs and the outside world. Airway management is a primary consideration in emergency medical care and first aid. The attending crew member's seat should be situated at the top of the stretcher at the patients head as illustrated in *Diagram 2* below to enable quick and easy airway management for the patient. Correct airway management is a major concern in emergency care and should be considered in the specification and selection of ambulance vehicles when possible.
- Stretcher type: this is briefly discussed in the "Medical equipment including drugs" section of this guide.

Diagram 1

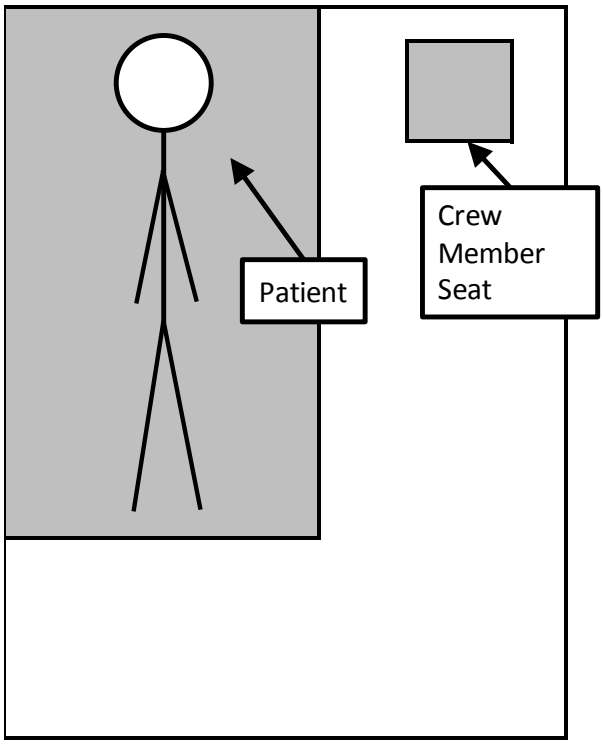
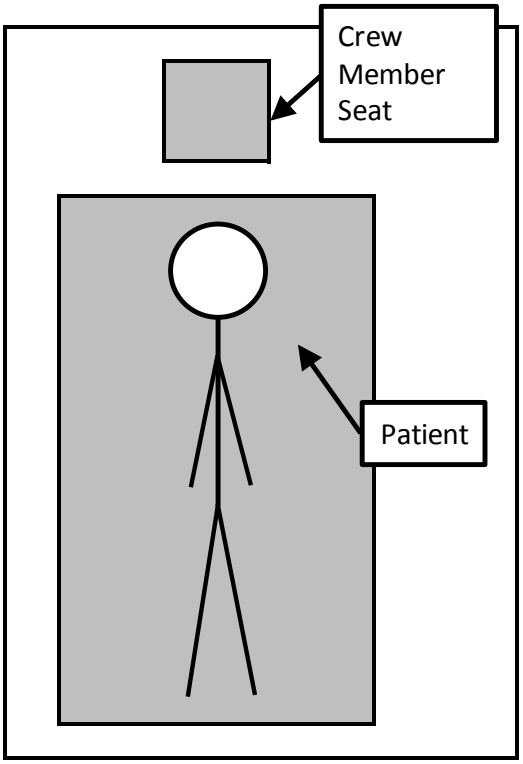


Diagram 2



Layout

Often the interior patient section of an ambulance can be overcrowded with unnecessary equipment and devices. The most technologically up-to-date equipment is seen as a must in order to have an effective ambulance, which is not always the case. The more advanced and complicated the equipment the more chance there is that when it does have a fault it will not be able to be repaired or replaced due to cost. The easier it is to repair and replace the equipment in a NAS the better it is for the operation of the NAS both in terms of efficiency and effectiveness. The following examples are common areas where design layout must be carefully considered;

- Storage: Quite often vast amounts of storage space are considered a must in an ambulance and many donated ambulances from other countries will come with excessive storage space. This is a misunderstanding of the true needs of the NAS medical crew. The level of training of the ambulance crew and their legal accessibility to drugs and equipment will determine the amount of storage space needed. Where possible only storage space for the medical equipment and supplies that the ambulance crew can use, should be in an ambulance. In some countries ambulance crews are trained to a level almost akin to doctors and thus have an ambulance which is effectively a mobile hospital. However, this may not be always the case and so the storage space needed should reflect this. Unnecessary unused storage space is simply taking up limited space within an ambulance.
- Lighting: This is a simple but necessary element that should be considered for an ambulance and is often over specified with complicated lighting systems. Again, a basic system is the best and having a lighting system with ease of access to bulbs, spare parts and replacement parts is a must. If such an essential system fails in an ambulance and cannot be repaired it could leave the ambulance unusable.
- Air-conditioning: Although it is accepted that in many countries heat will be an issue and the comfort of the patient as well as the ambulance crew must be considered, air-conditioning may not always be the answer. Air-conditioning brings with it added maintenance requirements and costly repairs and replacement parts. The cheaper, easier to repair and replace option, is to have fans in the ambulance. These will help ease the patient and the ambulance crew during periods of heat without causing unnecessary resource drain on the NAS.
- Additional Seating for passengers: Although it is recognised that additional seating for relatives or friends may be a cultural norm, there are practicalities which must be observed. The size and shape of an ambulance will determine if additional seating is possible. First and foremost the patient and the ambulance crew's safety, comfort and operational activities have to be considered. Also if a double stretcher style ambulance has been adopted, this will greatly reduce the available space in an ambulance for additional passengers. In any eventuality the ambulance is a life-saving emergency medical vehicle and not a passenger vehicle and should be designed as such.

There must be a balance between practicality and necessity versus the nonessential and superfluous.

Vehicle Donations

Most Ministries of Health across Africa have fleets of vehicles which include donated vehicles from one source or another. These acts of generosity must be highly commended. However in certain

cases the vehicles that are donated may not meet the specifications needed and are often second hand vehicles which ultimately may have a short and expensive operational life.

Vehicles which have been or are about to be donated to form part of a MoH fleet can be used to deliver a service until they reach the end of their operational life. Depending on their specification and condition they can be used to contribute to the initial set of a NAS to help reduce the large initial capital investment of purchasing vehicles.

Looking to the future there are several approaches that can be taken regarding vehicles offered for donation to the NAS;

- During discussion around the donation of vehicles, specifications must be brought into the decision-making process. The donated vehicles must be in line with a predetermined set of specifications, such as a variation of those discussed earlier in this section, to ensure the NAS gets the appropriate vehicles for its needs.
- Another approach is to ensure that during discussions, the vehicle donation does not come with restrictions on its use for the NAS only. This way, if the vehicle does not fall within the predetermined NAS specifications it can be accepted for use in another department elsewhere in the MoH or even in another ministry. This option may be more palatable than using valuable resources to keep an unsuitable vehicle operational, or simply accepting the donation and not putting it to use.
- The last and possibly the most difficult approach is to reject the donation with gratitude. Having a fleet of donated vehicles which cannot operate effectively as ambulances and costs the NAS precious resources to keep operational would be a tragic situation to be in. It would be a very difficult decision for anyone to make and must be made with due care and consideration however the greater good of an operationally effective NAS must be considered first and foremost.

National Ambulance Service examples

There are many examples of operational National Ambulance Services around the world all with varying operational set-ups. Below are some examples of NASs that relate to the African context or system being adapted for ambulance services. The author of this guide cannot advise on which of these operations is functioning and to what degree or recommend which should be studied. These are merely some examples of NASs and systems that may help steer those interested in setting up a NAS towards likeminded individuals, organisation or ministries.

Ghana:

Ghana has established a NAS and it has been in operation for a number of years. It is still expanding and growing and introducing new vehicles. The Ghana NAS has utilised external expertise, such as medical training, in its progression as NAS.

South Africa:

Emergency services in South Africa operate as a public/private partnership. Each province provides emergency ambulance services. The government system utilises volunteers as well as paid responders and this is supplemented by private-for-profit ambulance companies. Both of these services are further enhanced by voluntary ambulance services such as the South African Red Cross and St. Johns Ambulance. All of the services are required by law to meet the same standards with respect to staff qualifications.

United Arab Emirates (UAE):

The National Ambulance Service in the UAE is a private ambulance service. It is a company that also offers other medical services besides an ambulance service, such as first aid training, ambulance services for events and emergency health consultancy.

India:

GVK EMRI (Emergency Management and Research Institute) is a not for profit organisation operating in a Public Private Partnership (PPP) model. It is a 24 hours a day, 7 days a week service with a toll free contact number. This is the first service of its kind in India and reaches several million people in several areas of the country and is expanding.