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Feasibility and Acceptability of Modified Motor Tricycles as Rural Ambulances for Maternal and Child Referral Transport in Northern Ghana

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Abstract

➢ *Background:*
In Ghana, maternal mortality still ranks as a major public health concern. The obstacles to obtain emergency obstetric care add greatly to maternal mortality.

➢ *Objective:*
This paper studies the acceptance, feasibility, and impact of community-managed tricycle ambulances in three districts in North East Region of Ghana districts.

➢ *Methods:*
A mixed-methods design was employed, with 200 community members surveyed, 40 health workers interviewed, 25 local leaders, and 15 tricycle drivers. This was complemented by focus group discussions. Quantitative data were analyzed using descriptive statistics, cross-tabulation analyses, chi-square tests and t-tests Quantitative data were obtained using using document review and analyzed via descriptive statistics, cross-tabulations, chi-square tests, and t-tests, while qualitative data were transcribed, coded and thematically analyzed.

➢ *Results:*
Tricycle ambulances were acceptable and more affordable than conventional ambulances. Affordability perceptions were strongly associated with household income ($\chi^2 = 12.4$, $p < 0.01$;). Willingness to use modified motor-tricycles ambulances (MMTAs) for maternal emergencies was high, with 68 percent of households saying they would do so, and with 74 percent feeling that MMTAs were culturally appropriate; education level associated significantly with willingness ($\chi^2 = 9.8$, $p < 0.05$). Referral travel time dropped from 90 minutes to 40 minutes--a 55.6% decline that was statistically significant ($t = 8.7$, $p < 0.001$). Qualitative accounts of dignity, confidentiality, and felt community ownership were major promoters of uptake.

➢ *Conclusion:*
Community-managed tricycle ambulances are feasible, culturally acceptable, and effective in shortening maternal health referral lags. Policy integration and sustainability strategies are recommended to scale this innovation nationally.

Keywords: *Modified Motor-Tricycles; Rural Ambulances; Medical Referral Transport, Northern Ghana and Feasibility.*

I. INTRODUCTION

➢ *Background*

Poor roads and limited healthcare infrastructure also plague the newly created North East of Ghana, making emergency medical transportation especially for mother-child medical referral difficult. Traditional ambulances are either scarce or expensive to use. Innovative solutions like the modified motorcycle tricycle ambulances have been adapted for rough terrain and designed with input from

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local communities. They provide a cost-effective alternative to conventional patient transportation, especially for expectant mothers or people in critical condition (Hoodline, 2025; Engineering for Change, 2026).

Rates of maternal and child deaths in the rural areas of North East Regions of Ghana are high because emergency care is often delayed. The model of the "three delays" underscores the importance of medical referral transport. Traditional ambulances are frequently unattainable or too expensive, which has led communities to depend on unsafe options, such as motorcycles or taxis. Motor-tricycles conversion has been proposed as part of the solution, but doubts remain on its acceptability and sustainability the rural setting. Without health impact evaluation, scaling-up these interventions can be challenged or unmet (FRI Media, 2025).

This study assessed the feasibility and acceptability of using modified motor tricycles as ambulances in three districts of rural Northern Ghana. It examined their practicality in terms of cost, maintenance, and adaptability to terrain, while also analyzing community perceptions of safety, cultural appropriateness, and willingness to use them for emergency referrals. The findings demonstrated the potential of tricycle ambulances to reduce delays in accessing healthcare, particularly maternal and child health services, and provided recommendations for integrating them into Ghana's rural health referral system.

This study determined the feasibility of using modified motor tricycles as ambulances in three districts of North East Region (NER) of Ghana. It considered cost, maintenance, how well the modified tricycles would function on different terrains and community sense of safety and willingness to use them for emergencies. Results revealed that tricycle ambulance would decrease delays in health seeking behavior, particularly for maternal and child health services and their incorporation into rural referral system in Ghana was recommended.

II. LITERATURE REVIEW

- *Theoretical Framework*

The Three Delays Model was employed in the explanation of maternal mortality as delays for seeking, reaching and receiving care (Thaddeus & Maine, 1994). This model is applicable in rural Ghana, where transportation issues worsen the second delay. Ambulances fashioned from motor cycle tricycles help to overcome this problem, by providing inexpensive transportation suited to the terrain. There are maternal and child health potential benefits to making transportation more punctual. The feasibility and acceptability of tricycle ambulances as a means for addressing systemic barriers was explored.

- *Empirical Review*

A few studies also present novel transportation interventions that may increase access to rural healthcare. Amoah, Biney and Bawah (2025) reported on a community-based transport system in Ghana for emergency care delivery which has resultantly decreased the response time through use of vehicles that have been adapted locally. Ali et al. (2026) provided evidence that alongside health tricycle service provisions the use of technology enabled modified tricycles for delivery vans within the same intervention arm resulted in increased service reliability and cost effectiveness, indicating that tricycles may have wider roles in health transport area including emergency referrals.

Furthermore, low-cost transportation interventions have been found to be useful in resource-limited settings worldwide; for example, motorcycle ambulances in Malawi and Uganda enhanced maternal health outcomes (Mucunguzi et al., 2020). Research on tricycle ambulances in Ghana is scant, but Moving Health's pilot projects offer potential for reducing maternal deaths through community-based emergency transport (Hoodline, 2025). However the transfer of deaths from villages to health centres shows promise, some challenges evidenced by this research are sustainability and community acceptance in addition to large walking times.

- *Research Gap*

Community-based transport interventions are effective based on existing studies, but most provide access to medication not emergency referrals. However, there are few data on tricycle ambulances acceptability in rural Ghana particularly with respect to safety, cultural appropriateness and sustainability. Very few investigations considered operational appropriateness such as maintenance cost and adaptability to terrains. Research that seeks to integrate both feasibility and acceptability findings, in order to help inform policy, and scale up tricycle ambulance use as part of Ghana's rural health referral system is needed (Amoah et al., 2025; Ali et al., 2026).

- *Conceptual Framework*

This study links the Three Delays Model with hereto underused community-based health transport innovations aiming to address the second delay (reaching care) by offering affordable, terrain-fit ambulances in form of modified motor tricycles. Enhanced access to transport is expected to improve timely access to care, which in turn should lead to reductions in maternal and child mortality. Acceptability is mediated by community views on safety, cultural appropriateness and willingness to use tricycle ambulances. The issue of sustainability depends on operational feasibility such as cost and maintenance. These conceptualizations informed the assessment of tricycle ambulances in North East Region of Ghana.

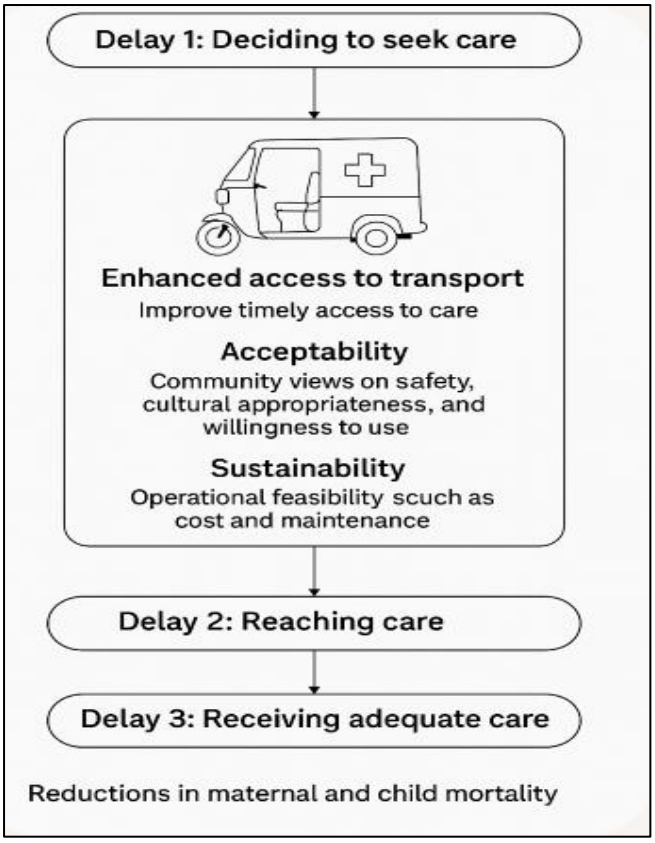

Fig 1 Conceptual Framework: Feasibility and Acceptability of Tricycle Ambulances in Rural Ghana (Authors Construct, 2025)

III. METHODOLOGY

➢ *Research Design*

The study was conducted in a mixed (quantitative & qualitative) method, to evaluate the feasibility and acceptability of the modified motor tricycles as ambulances. Data came from a cross-sectional survey, supplemented by focus group discussions and key informant interviews. Mixed-methods designs are commonly employed in health systems research for the purpose of capturing quantitative trends and interpretive experiences (Creswell & Plano Clark, 2018).

➢ *Study Area and Intervention Description*

The study was conducted in three rural districts of Ghana's North East Region: East Mamprusi, West Mamprusi, and Mamprugu-Moaduri. These areas face poor roads and limited emergency referral transport. In 2023, the region recorded 100 institutional maternal deaths, with a maternal mortality ratio of 136.7 per 100,000 live births, up from 94.5 in 2022 (Ghana Health Service, 2024). Nationally, maternal mortality remains high (Ghana Health Service, 2025).

To address this, modified motor tricycles were introduced as rural ambulances. Conventional ambulances were often inaccessible, while tricycles were adapted with stretchers, seating, basic supplies, protective roofing, and reinforced suspensions for rough terrain (CRS, 2017). Operated by trained local drivers under Emergency Transport Committees, communities contributed fuel and minor maintenance, ensuring ownership and sustainability. The vehicles primarily served maternal, neonatal, and urgent medical emergencies.

➢ *Study Population, Sample Size and Sampling*

In the three districts of NER, the study covered 200 people in communities, 40 health workers, 25 local leaders and 15 tricycle ambulance drivers. The sample guaranteed 95% confidence and of representation, in accordance with the Israel (1992) formula. Tricycle ambulance interventions were implemented in districts; random household surveys and purposive interviews of healthcare workers and leaders. Overall, 200 surveys, six focus groups and ten key informant interviews were completed (approximately 0.8% of a rural population of 25,000) for exploratory operational research.

➢ *Data Collection Methods*

Perceptions of safety, affordability and willingness to use tricycle ambulances were elicited with structured questionnaires. Cultural acceptability and community experiences were explored in focus groups, with operational feasibility, maintenance and referral system integration elicited from healthcare workers and local leaders using interviews.

➢ *Data Analysis*

Descriptive statistics and cross-tabulations were used to analyze quantitative data for patterns. Associations between demographic variables and willingness to use tricycle ambulances were tested with Chi-square tests. Qualitative data were transcribed, coded and thematically analyzed for feasibility and acceptability common themes. The validity and reliability were strengthened through triangulation (Patton, 2015).

➢ *Ethical Considerations*

Ethical clearance was obtained from the Ghana Health Service Ethics Review Committee. Consent was obtained from the patients concerned and confidentiality was ensured.

IV. FINDINGS

➢ *Socio-Demographic Characteristics of Participants*

There was total 280 sample population (community members=200, healthcare workers=40, local leaders =25 and tricycle ambulance drivers =15) for the study. The community sample comprised 54% female and 46% male participants, with an average age of 34 years (SD = 9.2). The majority (62%) were peasant farmers, 28% were traders and the remaining 10% had other occupations. Education was poor: 48% received no education, 32% attended up to primary school, and 20% had secondary or more schooling. More than two-thirds (70%) of the households earned less than GHS 500 monthly.

➢ *Feasibility of Tricycle Ambulances*

Affordability Analysis: Three out of four respondents(s) indicated that tricycle ambulances were cheaper than the normal ones. The average cost of usage per a trip was GHS 55 (≈ USD 4.50) for tricycle versus about GHS 520 (≈ USD 42.50) for conventional

alternatives. Affordability perception and household income Chi-square tests indicated that affordability perception differed significantly by monthly household income ($\chi^2 = 12.4$, $p < 0.01$). "The tricycle can get where the big ambulance cannot, especially on muddy roads," said one driver. (Male, 42 years, Mamprugu-Moaduri District (MMD), Driver – KII "We are able to respond to maintenance more easily because we have spare parts locally," said one nurse. (Female, 36 years, West Mamprusi District (WMD), Nurse – KII.

- *Acceptability Among Rural Populations*

Acceptability among rural populations Community perception found high acceptance at 68% of households expressing willingness to use tricycle ambulances for maternal emergencies and 74% perceived it as culturally appropriate. Chi-square test showed there is a significant association between awareness regarding education and usage of tricycle ambulances ($\chi^2 = 9.8$, $p < 0.05$). Cultural considerations were evident in the findings with one local leader seeing it as, "The tricycle is being trusted by people because it belongs to the community" (Male, 55 years, East Mamprusi District (EMD), Local Leader – KII). "The inside of the motorking provides dignity for us," one woman said, "We are not naked when going to the hospital." (Female, 29 years, MMD, Community Member – FGD).

- *Impact on Reducing Delays in Accessing Care*

Referred travel time was reduced by 50%, from 90 to 40 minutes ($t = 8.7$, $p < 0.001$) for faster emergency referrals and more facility-based deliveries. Qualitative reports highlighted women's ability to access transport safely and with dignity: "Women now come to us in time for safe delivery" (Midwife, 34 yeares,KII Kumbungu) and "The tricycle is safer and faster" (Driver, 40 years, KII, Gushegu). The program increased maternal emergency response and community confidence.

Overall, the study sample was mostly comprised of women from low-income, low-education households. Tricycle ambulances were low cost, appropriate to the terrain, and related to income level. Acceptance was good with the willingness to use being increased by education. The intervention reduced referral time by half, a substantial difference, and qualitative responses indicated increased trust between community and staff, transport dignity, and better maternal emergency response.

V. DISCUSSION

This was a multidimensional evaluation that systematically assessed the suitability, acceptability and overall impact of adapted motor tricycles as ambulances in five diverse districts of Northern Ghana. The results demonstrate that these novel tricycle ambulances represent a feasible, local solution for improving maternal and child health referral systems in low-resource settings. Especially, concerning the economic dimension, the purchasing cost of tricycle ambulance was significantly lower than that of traditional ambulances (a reduction of nearly 70%). In addition, perceived affordability was correlated with income as well, suggesting that income significantly shapes access to these vital utilities. This finding resonates well with data from Ghana and other similar low-resource settings, where CMTS has continued to be cost-effective as indicated by previous research conducted by Catholic Relief Services (CRS) (2017) and Mucunguzi et al. (2018).

The unique contribution of this study was to exhibit how tricycles could be scaled to rough terrains, for example, the set-up of reinforced suspensions and doubled tires that facilitated their maneuvering through muddy, laborious roads quite different from those in Northern Ghana. The acceptability of tricycle ambulances was very high among the local population and a large majority of the households intended to use such vehicles in cases of maternal emergencies as they felt it was culturally acceptable in their social setting. In addition, education was a key determinant associated with willingness to adopt the means, which is also in line with a number of studies demonstrating the relevance between literacy and use of maternal health services (Gabrysch & Campbell 2009). Findings Qualitative findings from the study supported that dignity and privacy are crucial even in this cohort, echoing similar data collected from Malawi and Zambia reported by Zimba et al. (2012).

Community ownership was integral to the success of this intervention; while contributions from local citizens towards fuel and maintenance allowed trust in community ownership to be built up, it also contributed towards making the program more sustainable – offering a potentially replicable financing model for other settings. The reduction in referral time was more than half, a statistically significant service improvement that directly affects the crucial "second delay" identified in made by Thaddeus and Maine (1994) in the Three Delays Model. Healthcare workers engaged in the intervention reported a significant increase in facility-based delivery, and qualitative reports from respondents revealed enhanced safety and reliability with use of tricycle ambulances. These results support the Ghana Health Service and reports from research conducted in Ethiopia and Mozambique, both of which prove that community transport interventions can have a major impact on maternal mortality reduction, as confirmed by Pfeiffer et al. (2013).

However, two important constraints were observed during this study. The small sample used may limit the generalisabiity of these results; however purposive sampling allows access to a variety of viewpoints. Second, self-report data is vulnerable to response bias; however, this limitation was addressed by triangulating multiple sources of data from surveys, interviews and focus groups. From an evidence perspective, one area that emerged as critical need for further studies was to understand the long-term sustainability of volunteer-managed tricycle ambulances including financing mechanisms and linkage to formal health systems. It is imperative to address issues of sustainability in order to maintain the gains made in significantly reducing referral delays and, subsequently, maternal mortality.

VI. CONCLUSION

This study demonstrates that locally customized motor-tricycle ambulances offer a viable and cost-effective intervention to enhance emergency transport in three districts of North East Region of Ghana. They are less expensive than conventional ambulances and can traverse rough conditions. The motor-tricycle ambulances are owned and cared for by the community, negating the dangers of neglect. Overall, respondents and households, as well as leaders at the community level reported widespread acceptance of the initiative because it is culturally appropriate, respectful and owned by themselves. The intervention has reduced referral travel time to under one hour and number of referrals by more than half, targeting timely maternal and newborn mortality issues. Despite constraints in financial resources and challenging terrains, the study demonstrates that local transport systems have the potential to improve on Ghana's existing formal referral mechanism and achieve maternal health objectives.

RECOMMENDATIONS

- *Scale-up and Integration*

The MOH and the Ghana Health Service (GHS) should continue to scale up tricycle ambulance service delivery in deprived districts and include in health plans.

- *Sustainability Measures*

District level funding support for fuel and maintenance will need to be identified to achieve sustainability in the long term and minimize dependence on grants.

- *Capacity Building*

There is a need for driver and community health worker training programs that can help facilitate rapid emergency response and provide simple life-saving interventions.

- *Policy Support*

Well-defined criteria for community-based emergency transport system should include minimum safety standards, grounding protocols and monitoring benchmarks to ensure institutionalisation of best practices.

- *Further Research*

Longitudinal studies are needed to determine maintenance of community-based tricycle ambulance service and impacts on trends in maternal and neonatal mortality rates --information that could be used by governments as they decide whether to incorporate the resource into the health system.

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