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Concerning mobilising transport for accessing maternal health care and how impactful strategies are in low resourced settings: A scoping review

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ABSTRACT

There is very limited research examining the impact of transport mobilisation strategies across different geographical domains. This scoping review explores information holes on strategies for mobilising transport to maternal healthcare, and how strategies potentially impact women's care-seeking behaviours in Low Income Countries (LICs) and Lower Middle-Income Countries LMICS. The scoping review employs a multi-database search approach retaining 59 articles after full article review. Three themes were identified; efficient coordination between several institutions; paying attention to key proximal and distal factors as well as strengthening sustainable local solutions to interventions. However, initiatives would generally thrive through (i) Integrating health promotion into organised maternal healthcare programs equipped with requisite infrastructure; (ii) improving capacity, autonomy and participation within and across social/ community structures and (iii) maternal health care regionalisation addressing barriers due to physical and socio-economic geographies through the use of approved/secure facilities (iv) addressing cases of endemic poverty (v) subscribing to socio-cultural, and religious identifications in transport mobilisation. There is a significant variation in scope, context, legislative regulation, and relevance across environmental-societal dynamics making transferability of transport mobilisation strategies problematic. Strategies for mobilising transport for maternal care ought to be approached within the spatio-temporal confines of this variation. Successful interventions must integrate place-specific approaches, holistically integrating Women/Maternal Health policing, financing schemes and geographically aware transport mobilisation strategies.

KEYWORDS

Geographical access, global health, coordinated health care systems, coordinated fund, proximal and distal factors, localised interventions

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1. Introduction

Transportation systems, and related communication infrastructures, are recurrently recognised as key barriers/facilitators to accessing maternal healthcare services (Atuoye et al., 2015; Munguambe et al., 2016). Improved access to and increased utilisation of maternal healthcare services has been the panacea to poor maternal and child health outcomes especially in Low and Middle Income Countries (LMIC) (Hanson et al., 2017; Haruna et al., 2019; Tsawe & Susuman, 2014).

Two main factors have been consistently identified as contributors to low uptake of maternal health care services: (i) ignorance on when to seek health-care, leading to delays in seeking care (ii) difficulties with transportation, leading to delays in reaching health-care facilities (Ensor et al., 2014). Whereas long distances to health facilities is arguably one major contributor to why women fail to reach skilled care for delivery, particularly in LMICs (Dantas et al., 2020; Gabrysch et al., 2011; Ntoimo et al., 2019) versus the availability of transport to reach care is another important factor in the access to care discourse (Makacha et al., 2020).

Adverse maternal and child-health outcomes can be prevented or at least reduced with improved transportation systems to health facilities. Therefore, the role of transport mobilisation in improving maternal health outcomes cannot be overemphasized, considering that transport is a major contributor to improving access to care (Muzyamba et al., 2017). Knowledge of contextually relevant transport mobilisation strategies serve to strengthen evidence-based intervention strategies linked to improving access to maternal care. Thus, understanding how such strategies may potentially motivate women to seek care, becomes essential to the success of engagement initiatives (McCarron et al., 2019). If considerable resources are to be devoted to mobilising transport for accessing quality care, then it is important to identify interventions that have been known to work in different socio-geographical settings and the extent to which these can be customised for similar settings. However, knowing what works best in public health practices aimed at improving maternal health outcomes is to a greater extent complicated by the seemingly huge diversity in the geographical contexts in which these interventions are deployed (Pfadenhauer et al., 2017).

Whilst there has been an upsurge of maternal health programmes seeking to promote mobilisation of communities to organise solutions to maternal health transports, (*WHO Recommendation on Community-Organised Transport Schemes*, 2015), there is a paucity of research examining the range, contextual relevance and/or transferability, impact, as well as adequacy of adopted strategies for improving access to care (Elmusharaf et al., 2015), with extraordinarily little documentation of how transport is mobilised for maternity beyond community transport schemes, at least in one combined effort. The extent to which strategies would potentially modify healthcare seeking behaviours in LMICs is also understudied (Miltenburg et al., 2019).

This study seeks to excavate what is known as well as knowledge gaps on strategies for mobilising transport to maternal healthcare, how strategies potentially impact women's care-seeking behaviours across different socio-geographical settings. The study also seeks to triangulate the potentials around how identified strategies could influence women's maternity care-seeking behaviours in LMICs.

2. Methodology

The design of this scoping review follows the six-stage York framework for conducting scoping reviews (Arksey & O'Malley, 2005), which involves: (i) identifying key research questions; (ii) identifying relevant studies that can potentially answer the research questions; (iii) study selection; (iv) charting the data; (v) collating, summarising and reporting the results; and (vi) consultation to enhance study findings. Using emerging synthesis methodology, we employ a multi-database search approach to minimise the risk of introducing database bias, while at the same time maximising the yield of relevant studies. This approach provides a systematic and reproducible approach to synthesising varied literature on a subject area under investigation and accommodates both quantitative and qualitative studies, as well as theoretical work, grey literature, and policy evaluations (Bramer et al., 2018).

We retained studies reporting (i) a strategy for mobilising transport (ii) recommendation/s to improving transport mobilisation (iii) transport-induced maternal healthcare seeking behaviour changes. Databases were searched and reviewed by three independent reviewers using a combination of keywords. Table 1 summarises the combinations used to search for relevant literature.

Table 1: *Combinations of keywords used to search for relevant literature*

Transport	Access	Maternal Health Care
transport	Access	Antenatal
	Distance	Neonatal
	Travel Time	Obstetric
	Geographical Access	Maternal
	health services	Postpartum care
	Physical Access	Hospital Care
	Personal Barriers	Maternal Mortality
	Cultural Barriers	Maternal Morbidity
	Seasonality	Perinatal Morbidity
	Geographical proximity	Perinatal Mortality
	Three delay frameworks	CEmOC
	Improved Access	Emergency Obstetric Care
		EMOC
		child health
		Maternal health
		New-born health
		Obstetric complications
		Pregnancy
		Institutional Delivery

We iteratively redefined search terms and undertook more sensitive searches in the databases, without placing strict limitations on search terms and identification criteria of relevant studies at the outset. The process was iterative, requiring the researchers to engage at each stage in a reflexive way and, where necessary, repeat steps to ensure that the literature was covered in a comprehensive way, following enhancements proposed by (Levac et al., 2010). This iterative process stopped when all reviewers were satisfied that there was some level of saturation in the content returned by the searches.

Due to time and budget constraints, we limited our search to only articles written in English language and relating to human subjects. We excluded articles written in other languages as the cost and time involved in translating material was inhibitive within the confines of the current funding budget. Searches were conducted on the title, abstract and full text of the research works, expanding the search to related keywords. We included all articles with any of the search terms without limiting coverage of the review in terms of publication status, geographical setting, and/or intervention time span. Deliberately not limiting inclusion in terms of time was motivated by the fact that interventions can be potentially modified to reflect time variations, and still draw useful evidence informing current and future interventions (Titler, 2008). We did not impose

geographical limitations on the searches to portray and assess literature on the subject in an unbiased way, making sure that the review's findings are robust and geographically representative.

Table 2 summarises database searches (including grey literature searches), dates for the final searches together with total number of articles returned in the final search. Documenting databases searched against dates for final searches is important, especially if there is a likelihood of updating the searches in future studies. We conducted a check on the bibliographies of studies included through the database searches - especially systematic and literature reviews - to ensure that all studies meeting the inclusion criteria had been included in the scoping exercise. This process identified an extra seven articles, and these are included in the indexing databases.

Table 2: *Summary on final database searches*

Database	Final search	Articles	Comments
Medline via EBSCOHOST	8 October 2019	183	
Web of Science Core Collection	2 November 2019	64	
CINAHL	9 October 2019	5	
Google Scholar	9 November 2019	418	90% Scopus and Web of Science (Martin-Martin et al., 2018)
WHO Global Health Library	14 December 2019	3	Grey literature
ResearchGate	7 December 2019	1	Grey literature
JPMA Supplement	7 December 2019	1	Grey literature
World Bank	7 December 2019	1	Grey literature

Synthesis of the existing knowledge was done to identify studies reporting strategies for mobilising transport to accessing maternal care generally, acceptability of strategies as well as how identified transport mobilisation strategies may potentially modify maternal health care seeking behaviours in LMICs.

Literature relevant to this scoping review was identified through a relevance screening criterion that included the following: (i) Whether the title/abstract described a research study or review on strategies for mobilising transport, or recommendations on strategies that can be employed for mobilising transport to accessing care, (ii) Whether the intervention described in the title/abstract refers to maternal health, specifically antenatal and/or postnatal childbearing women, their spouses, children, or anyone acting to further the health of children and their babies, and (iii) Whether the title/abstract included a behaviour change as a result of a transport intervention for maternal care. Studies that reported any or all the relevant screening criteria were included in this study. Data extraction and analyses were performed by four independent investigators, with internal review of findings from two other researchers.

The reporting of findings in this scoping review follows a fused approach incorporating both the PRISMA extension for scoping reviews statement and checklist (Tricco et al., 2018) and the PRISMA Statement for Systematic Reviews and Meta-Analyses (Moher et al., 2009). This approach ensures that the scoping review follows a transparent, replicable, and iterative process while digging deeper into the science on the subject.

Results

Setting

Figure 1 shows the general spread of included articles with key characteristics of study settings and times of investigation.

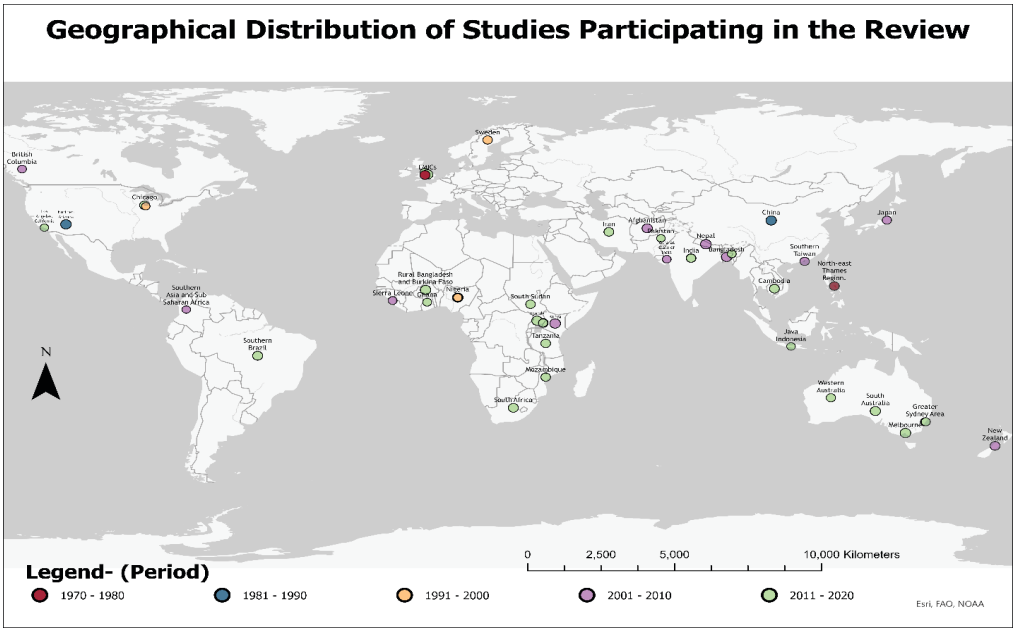

Figure 1: Study area map with key characteristics of final participating research articles

Search summary

The literature search and subsequent abstract and full article review yielded 59 articles which participated in the full article review. Figure 2 summarises the literature selection flow process. 40 of the reviewed studies (67.7%) that passed to the full article review stage emphasized strategies for mobilising transport in LMICs.

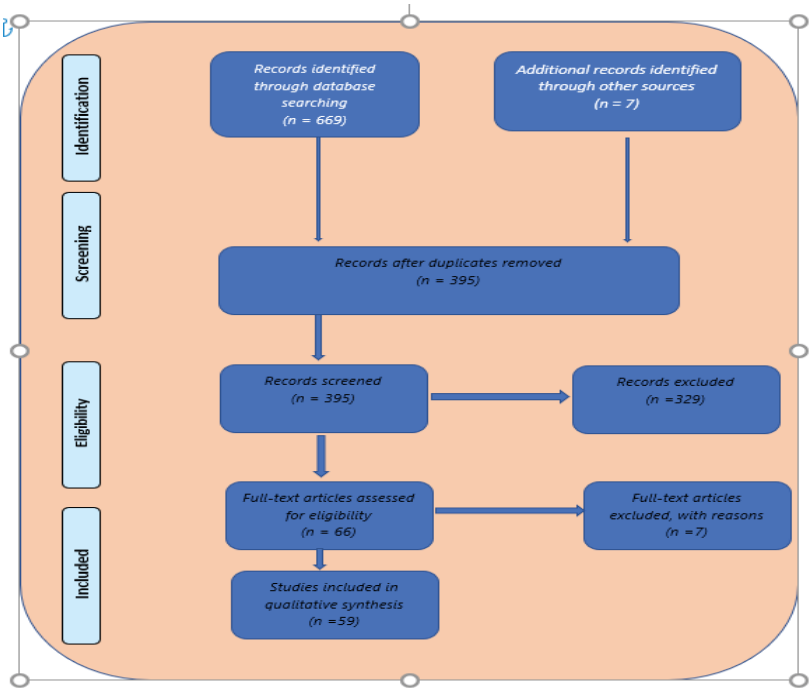

Figure 2: ***Scoping Review Literature Selection Flow Process (Format adapted from: Moher et al., 2009)*** [Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal. pmed1000097]

Key themes emerging from the literature synthesis

Three themes were identified: Efficient coordination between several institutions; paying attention to key proximal and distal factors as well as strengthening sustainable local solutions to interventions.

Efficient coordination between key community institutions and health-care systems

Coordination mechanisms require innovative interventions that uniquely address identified barriers in the transport mobilisation ecosystem. To facilitate implementation of transport mobilisation strategies, interventions should aim at making publicly known as appropriate, the design and dissemination of area-specific transport mobilisation strategies, with the involvement of key stakeholders such as the full range of relevant ministries, non-governmental

organisations assisting in communicating logistical arrangement to local communities.

i) Integrating health promotion approaches into maternal and new-born health programs

Community mobilisation through health education and advocacy, targeted at increasing community awareness is a tool for galvanizing communities into action to take charge of their local health problems (Dogra et al., 2015; Olaniran et al., 1997). Special (vertical) health campaigns employing mobile transport options can be an effective means of mobilising transport to care. There is need for a communicated and fully regulated policy to address rural transport problems to improve maternal health care transport mobilisation strategies (Atuoye et al., 2015). In Nepal for example, women could not figure out that there was provision of transport incentives; they only knew that there was a cash payment but did not know the specific purpose of the payment. Through health promotion strategies, interventions can be communicated to women accessing care, hence complementing efforts in transport mobilisation (Bhusal et al., 2011).

Programs focusing on training health personnel on public relations may restore confidence in maternal health-care systems. Care workers (mostly female) in government facilities are often unhospitable discouraging pregnant women from seeking care from those facilities, rather mobilising transport to other more friendly facilities (mostly private) where attendants are usually male (Essendi et al., 2011). Community education and mobilisation programs may help increase awareness of systems of transports which can be used (Kawuwa et al., 2007; Olaniran et al., 1997). Appointing " resource mobilisation focal persons" and utilization of skilled personnel to implement transport mobilisation interventions improve mobilisation efforts for facility deliveries. Safe motherhood interventions should intensify behaviour change-communication efforts through educating communities to recognize pregnancy-danger signs for which a prompt action must be taken to save life (Killewo et al., 2006).

Furthermore, involving Traditional Birth Attendants (TBAs) in referral processes impacts positively in systems seeking to formalize birthing processes through national policies. TBAs are potentially active promoters of essential new-born care, as they facilitate alternative birthing processes which involve

mobilising transport to access care for complicated pregnancies (Killewo et al., 2006; Kironji et al., 2018; Namazzi et al., 2013).

ii) Improving the decision-making capacity, autonomy and participation by individuals, families, and communities

According to Munguambe et al. (2016) and Nuamah et al. (2019), advancing maternal education plays a role in improving access to maternal health in Ghana and Mozambique through motivating women to seek hospital care, as such acting as an agent for mobilising transport to maternal care. Mobilising transport for accessing maternal health care is further enhanced if women are engaged in decision-making processes. Women's autonomy in decision making, especially on deciding to look for transport to reach the health facility is key to transport mobilisation efforts as seen in the positive correlation between women autonomy and rates of facility delivery (Alam et al., 2016; Kawuwa et al., 2007; Munguambe et al., 2016; Panciera et al., 2016). In a study conducted in rural Bangladesh and Burkina Faso (Alam et al., 2016) improving literacy rates especially for women of childbearing age was associated with care seeking behaviour change. Besides household-level decision-makers, matrons, community health workers, neighbours and village chief or headman (Essendi et al., 2011) were seen to be key players in referral processes for pregnant women and hence in defining strategies for mobilising transport. Decision-making processes may be delayed and particularly complex if an emergency requiring transport mobilisation occurs in the absence of key decision makers (Essendi et al., 2011; Munguambe et al., 2016).

Family and community support for pregnant women to reach health facilities modifies decision making processes, reflecting preferences on strategies to transport mobilisation (Barker et al., 2007; Echoka et al., 2014). Mobilising family support will generally go a long way in supplementing efforts at mobilising transport resources to care, especially in patriarchal societies. Addressing pre-hospital challenges faced by pregnant women influences decision making and, hence, addresses delays in accessing care, contributing to successful strategies for mobilising transport to care (Echoka et al., 2014). On the other hand, promoting dialogue between women and services providers, providing incentive schemes that finance transport costs to health facilities by pregnant women, as well as incentives to health workers attending deliveries, will potentially contribute to boosting transport mobilisation strategies (Barker et al., 2007).

iii) Using organised transports and Equipping health systems with requisite infrastructure

Improving coverage of effective interventions (e.g. increasing availability of intrapartum and postpartum care; intermittent prevention and treatment of diseases such as malaria during pregnancy), are other strategies that works to improve transport mobilisation efforts (Erim et al., 2012). In most LMICs socially and economically marginalized populations face both physical and financial barriers to accessing formal health services calling for the need to redirect efforts to reducing maternal health access disparities tackling barriers operating at different levels of society (Essendi et al., 2011).

Improving antenatal detection on the other hand, would allow safer, less resource intense transfers of infants to different levels of care (Gupta et al., 2014). Availing focused and coordinated information on antenatal detection and emergency transports for pregnant women increases levels of motivation in systems of transport mobilisation. This follows the recognition that ad hoc arrangements are unreliable and often unsafe (Hosseini et al., 2014; Ratnavel, 2013; Sumners et al., 1980; Wilson et al., 2013). A study in Pakistan showed how partnering with a local taxi service improved reliability and affordability of transport for ANC visits (Wilson et al., 2013) . Providing appointment reminders on ANC care visits as well as making follow-up home visits assists young women in maintaining antenatal contact thereby enhancing transport mobilisation for maternal health care (Reibel et al., 2015).

Attention must also be paid to training, clinical governance, disseminating best practices, setting standards, ring fencing funding and supporting parents (Ratnavel, 2013). Mobilising emergency transport, especially for obstetric emergencies is generally not common in poor resource settings, with pregnant women relying mainly on pre-arrangements with service providers in transport mobilisation (Eckstein et al., 2015). Mobilising transport for maternal care mainly relies on fully established systems in place with the management of document flows in hospital facilities and through referral systems, playing a crucial role in the implementation of transport mobilisation programs. (Hosseini et al., 2014).

Combinations of resources have an impact on transport mobilisation strategies e.g. availing hospital-linked transport options for institutional childbirth including sourcing appropriate intermediate technology transport (Kaye et al., 2014) i.e. bicycle, animals, or motorcycles as well as equipping health facilities participating in health delivery (Kawuwa et al., 2007; Peabody

et al., 1992) greatly impact transport mobilisation strategies with hospital level characteristics as well as rural-urban disparities adding to the mix.

In a study conducted in the Greater Sydney area in Australia it was found that road transport is the most common mode of transport in accessing care (Kaye et al., 2014), therefore strategies for mobilising transport should emphasize or channel resources to such common modes of transport.

Consideration should also be given to the hospital facility network in the mobilisation of transport services as women generally prefers options with higher access and transferability rates. Automated processes in the management of women records greatly assists in efficient service discharge and transport mobilisation, ultimately improving both communication and people commitment to using transport infrastructures. At the same time, educational resources should prioritise general critical care of the pregnant woman rather than specific obstetric procedures (Devkota et al., 2018; Kaye et al., 2014).

Another strategy which can potentially impact positively on systems of mobilising transport to care is increasing volumes of vehicular transport coupled with the paying of consistent attention to road infrastructural development (Atuoye et al., 2015). In India (Mavalankar et al., 2009), infrastructural and supply bottlenecks coupled with substantially-decreased political will and social awareness have been alluded to act negatively in transport mobilisation efforts as they lead to under-use of the public-health system delivery care resources. Furthermore, status of health care facilities and other systems of care is crucial in extending levels of trust in mothers who use the linked transport systems (Chung et al., 2009). Therefore, improving poorly equipped health facilities should be emphasized for health facilities participating in health care delivery to boost transport mobilisation to such facilities (Essendi et al., 2011).

Endemic poverty is a detriment to transport mobilisation. Maternal resilience in community strategies becomes apparent if communities live in endemic poverty. While significant improvements in health delivery infrastructure is a key requirement, these need to be augmented by a paced systematic effort investing in scaling up capacity for integrated maternal health services as well as addressing the underlying poverty issues, which turns to distract efforts in the spheres of transport mobilisation (Carvalho et al., 2013).

Paying attention to key proximal and distal factors

iv) Minimising distance, travel times and intervention times in care seeking

Decisions to transport women to care mainly consider distance to be travelled (especially in referral transports), time to cover that distance and specialised personnel on the transport being key considerations (Woodring & Tidei-Duin, 1994). Long distances to a facility and associated costs have largely either restricted or delayed women reaching the health facilities where ground transport is the main means of transport (Blake et al., 1975; Elliott et al., 1992; Mugo et al., 2018; Patterson et al., 2011; Sumners et al., 1980; Woodring & Tidei-Duin, 1994). Transport to cities can become a major access, health, and safety issue especially for rural and remote communities.

The seemingly inevitable disconnect between healthcare and transport systems further complicates already complex and challenging journeys. This reduces the likelihood of women responding positively to transport mobilisation strategies. Travel times to the nearest source of care must be carefully considered if successful mobilisation strategies are to find life. Therefore, referring pregnant women to local health facilities is a key enabler in transport mobilisation (Echoka et al., 2014; Elliott et al., 1992). Median distances travelled to antenatal and postnatal check-ups were reported as between 2km and 4km for complication management (Keya et al., 2014). In the Thames Region, it was observed that seriously ill new-born infants may be transported safely to referral centre within 50 miles (Blake et al., 1975). Factoring these distances in planning for transport would increase trust in transport systems by pregnant mothers. A qualitative study conducted in South Australia (Jan et al., 2000), found non-significant effects of 'travel time' and cost , even though the study population placed a high premium on the quality of hospital care. This finding further emphasises the varied geographical nature of perceptions.

Working in close consultation with health care providers in transport mobilisation schemes has also been cited in other settings as clearly beneficial with health care providers mainly considering distance/time factors in mobilising transport to care (Quinn et al., 2015). Ground ambulance systems are consistently chosen even if out of hospital time is prolonged (Quinn et al., 2015). A study conducted in India (Vadrevu & Kanjilal, 2016) found that maternal health facilities are not equitably accessible to the populations that are disadvantaged and living in remote pockets of the study region. Provision

of a referral transport system along with a resilient infrastructure of roads is critical to improve access to care. Therefore, it is crucial to consider distance to be travelled and/or accessibility in mobilising transport for maternal care (Vadrevu & Kanjilal, 2016). Panciera et al. (2016) further suggests that there is need to strengthen referral and emergency transport systems to reduce travel time to cities, or at least establish or relocate EmOC facilities closer to where the poor reside. In a study conducted in rural Bangladesh and Burkina Faso (Alam et al., 2016), travel time was associated with significant care seeking behaviour changes with a higher likelihood of modifying transport mobilisation efforts.

Timely referrals to emergency obstetric care services is another factor which works to propagate effective transport mobilisation strategies (Dogra et al., 2015; Essendi et al., 2011). Times spent waiting for transport and the time spent traveling to health facilities using different modes of transport play a huge role on decisions to use specific transport systems. Understanding waiting time characteristics in transport mobilisation is key to successful mobilisation efforts. Time for transport, convenient opening times for the hospital facilities play a pivotal role in transport mobilisation strategies.

*v) **Addressing physical and socio-economic geographic barriers***

The geographies which form the immediate environments of pregnant women (both physical and socio-economic geography including cultural contexts) play a pivotal role in modifying health seeking behaviours (Martinelli et al., 2016). Access to maternal care is believed to be modified by availability, affordability and acceptability of transport systems in place, a function of the socio-geographical character of the place of residence of the woman (Bhandari et al., 2014; Martinelli et al., 2016). (Wilson et al., 2013) emphasizes that transport mobilisation strategies vary substantially between low-income settings and high-income settings.

Transport system affordability and acceptability is a function of the earning potential of the women seeking care (Martinelli et al., 2016). (Britt et al., 2006) found that at the individual level, social characterisation including age, affects the number of women using transport systems for accessing care. These findings point to possible variations in response to intervention doses both across age groups and across different cultural settings. Reducing financial and physical barriers for the varied transport options has been known to improve transport mobilisation efforts in both the urban and rural environments as women's affinity to disposable incomes increases.

Terrain and meteorological aspects related to transport e.g., weather conditions and state of roads affects mainly emergency transport mobilisation. Proper exploration of local topographical challenges prior to investment helps inform on the most effective means of transport for ANC (Wilson et al., 2013). In China, addressing geographic and economic inequality, particularly for the poor ethnic minority has been found to benefit transport mobilisation efforts in maternity care seeking (Song et al., 2016). Key features within the woman's setting (times and distances to be travelled, geological and climatic characteristics, types of transport systems and availability of local assistance) influenced the timeliness of the decision to seek care (Patterson et al., 2011).

vi) Reducing cost and increasing efficiency of transport and communication systems

Women generally prefer low cost or subsidized transport options and mobilising such low-cost transport options is generally an effective measure in low resourced settings. In Tanzania, over 50% of patients interviewed said they would not have been able to access treatment without the transport costs being covered for them (Siddle et al., 2013), a position which speaks to the need for subsidizing costs when mobilising transport in communities. The introduction of voucher schemes to improve access by marginalized communities (Killewo et al., 2006) was also found to be an effective measure in mobilising transport resources. Organisational interventions including funds generation for transports at community scales reduces neonatal deaths through improved transportation systems to health facilities (Hussein et al., 2012).

Unavailability of funds to pay for health services makes the decision-making process to seek care at the health facility, and consequently options to transport mobilisation more complex. Some women reported used low cost transport options like non-motorised rickshaws or vans to reach health facilities (Keya et al., 2014). Travel cost, extra cost of services, unwelcoming health facility environments including staff shortage, delayed and inadequate drug supplies were common problems in health systems impeding transport mobilisation (Devkota et al., 2018). Attending to the inadequacies of transport systems to formal care is therefore crucial in mobilising transport and will go a long way in improving transport mobilisation strategies as it boosts confidences in the systems of care (Essendi et al., 2011).

The number and complexity of interventions performed by the transport teams in getting a patient to the hospital plays a pivotal role in the choice for

transport by pregnant women (Chen et al., 2005). Effective and prompt transport systems are better preferred in accessing care as generally they result in lower maternal mortalities. Radio communications for summoning vehicles to obstetric emergencies is another potentially winning strategy t that can be used to alert transport providers of the need for their services in specified locations. In Mali and Sierra Leone, radios were provided to summon vehicles during obstetric emergencies (Fournier, Dumont, Tourigny, Dunkley, & Dramé, 2009). Health authorities should prioritise funding for inter-facility transports in the transport mobilisation scheme, especially those equipped with communication facilities (Schoon, 2013).

Improving local solutions in the intervention matrix

vii) Using local financing options for institutional childbirth from community support systems

Availing pooled emergency funds for institutional child delivery especially from community support systems is a key enabler to transport mobilisation efforts. In China, for example, the use of rural cooperative medical schemes, community supported emergency funds for obstetric emergencies and the provision of reliable, effective, and affordable transports were identified as necessary measures to mobilize transport resources to care (source). In Uganda, incentive schemes e.g. transport vouchers had greater effects on influencing institutional deliveries, pointing to the potentials around the use of these interventions in transport mobilisation efforts (Massavon et al., 2017) . Incentive schemes can be sustainable if Ministries of Health integrates them in the health systems and policy planning.

The use of local voucher systems in exchange for transport helps in improving usage of health facilities. This has generally resulted in higher uptake of transport services and therefore could be used as an intervention technique to mobilize transport. Transport and service vouchers appear to be a viable strategy for rapidly increasing maternal care especially when coupled with options to learning by doing within community structures (Ekirapa-Kiracho et al., 2011).

viii) Use of locally approved secure facilities and transport systems

Locally approved secure facilities and transport systems have been found to be some of the greatest motivators of transport mobilisation. These include the use of community based multidisciplinary teams in transport mobilisation, use of female relatives to direct young women to pregnancy care (Atuoye et al.,

2015; Reibel et al., 2015), improving health security systems thereby reducing insecurities especially at night (Essendi et al., 2011; Reibel et al., 2015), as well as security provisions for skilled birth attendants (SBAs) (Bhandari et al., 2014) who interface directly with women and transport operators . (Lowe, 2017) demonstrated a common need for provision of adequate and well-trained staff with appropriate resources to care for women before, during and after pregnancy. Hospital institutions work to re-enforce ground efforts to improve mobilisation strategies, thereby reducing all-time delays to accessing care.

Challenges to securing transport for maternity and delivery are many. These include the absence of a reliable public transport system, particularly connecting the rural areas to towns where most hospitals are found. This is common in most developing countries. Where medical attention is a requirement *en route* to the health facility, or when transporting maternal patients over a long distance, the appropriateness of emergency transportation facilities should be judged by considering their impact on both new-borns and mothers. In Sweden, 77.3% of the transports were carried out by nonspecialized teams (Atuoye et al., 2015), a situation with the effect of reducing the acceptability of some transport options to care. Incorporating private transports to provide access to affordable and reliable transport services for pregnant and post-partum women has often countered inefficiencies brought about by public systems of transport with nonspecialised teams (Mugo et al., 2018).

ix) Using local leadership and community structures

Local government and community leaders can champion the cause for the provision of transport facilities in their localities. Findings indicate that locally existing resources such as motorcycle riders, also known as "boda boda" in Uganda can be used innovatively to reduce challenges caused by geographical inaccessibility and a poor transport network with resultant increases in the utilization of maternal health delivery services (Pariyo et al., 2011). However, care must be taken to mobilize the resources needed and to ensure that there is enforcement and proper regulation of laws that will ensure the safety of clients and the transport providers themselves (Pariyo et al., 2011). Emergencies should have policies in place to assure timely response to transport requests.

Health workers, especially lady health workers, act as 'gatekeepers' for child birthing services including mobilisation of transport resources to accessing care. This gate keeping role mainly extends to counselling and referral for skill birth attendance and travel arrangements for emergency obstetric care (if required)

(Khan et al., 2012). However, such gatekeeping arrangements and practices needs enhancement to include adequate information provision as well as informed 'decision' making and planned "action" by the pregnant women (Eckstein et al., 2015; Khan et al., 2012). Local traditional providers e.g. midwives in villages can potentially make important contributions by stabilising women and facilitating referrals thereby assisting in transport mobilisation efforts (D'Ambruoso, 2012). A study in Eastern Uganda (Namazzi et al., 2013) also confirmed that the use of community structures, especially district and community level stakeholders were high level supporters of making sure that access to maternal care is enhanced and as such would improve the mobilisation of transport resources. However, limited funds availability for maternity would act negatively in support of such efforts.

x) Subscribing to cultural, social, and religious identifications in the transport mobilisation matrix

Sociocultural and community beliefs or practices affect transport mobilisation strategies to different levels across cultural settings. These practices should be considered for inclusion in transport mobilisation models in culturally diverse populations. (Bertilone et al., 2017; Wilson et al., 2013). Whilst socio-cultural beliefs may be incorporated in transport mobilisation models, some religious beliefs may need to be carefully considered in the design of transport mobilisation strategies (Song et al., 2016). In China for example, women in Butuo following the Animism religion would refuse delivery in hospitals because of language barriers with many believing that childbirth should not be watched by strangers and that a home delivery was the safest option (Song et al., 2016). Provision of culturally acceptable services may reduce differences between different cultural groupings, hence improving access to timely and regular antenatal care (Kironji et al., 2018). Social networks and collaborations within and across families determine care options and can contribute to (or hinder) the mobilisation of resources necessary to access care (Scott et al., 2014).

Conclusion

A wide range of strategies are currently being employed across different socio-cultural and geographical settings to mobilize transport resources to maternal care. These strategies include: (i) Efficient coordination between several institutions (ii) paying attention to key proximal and distal factors (iii) improving local solutions in transport mobilisation schemes.

Findings suggests that there is however a geography to the scope of strategies, with significant variation in context and relevance across socio-cultural groupings and varying levels of legislative regulation in maternal transports. Therefore, the transferability of transport mobilisation strategies ought to be approached within the spatio-temporal confines of this variation. From a policy standpoint, there is a general lack of integrated place specific interventions incorporating maternal health domains, financing schemes and geographically aware transport mobilisation strategies. Efforts to borrow from systems of transport mobilisation across spatial settings should be viewed through a geographically partial scope. It is within these confines that systems emphasizing improving geographical access to maternal health care, should be approached. Faced with the demands of the sustainable development goals to reduce maternal morbidities, especially those resulting from inefficiencies in health care systems, a geographically precise health care delivery system is pertinent in meeting the goals and projected trajectories of the SDGs.

Key issues identified in this study include level of efficiency and availability of transport systems; extent of support from key people and institutions around women transiting to care; level of autonomy in decision making; cultural contexts within the decision-making matrices; cost of transportation as well as safety considerations in transport mobilisation. Initiatives would generally thrive through (i) Integrating health promotion into organised maternal healthcare programs equipped with requisite infrastructure; (ii) improving capacity, autonomy and participation within and across social or community structures and (iii) maternal health care regionalisation which addresses barriers due to physical and socio-economic geographies; through the use of approved/secure facilities (iv) addressing cases of endemic poverty (v)subscribing to socio-cultural, and religious identifications in transport mobilisation.

Knowledge gaps included a need to explore/quantify the level of transferability of transport mobilisation interventions across different socio-cultural settings especially the extent to which interventions developed in high income settings are transferrable to low resourced settings, and a need to evaluate the readiness of pregnant women in different cultural settings to consume interventions. Limited evidence existed to suggest that use of geographic sensitive approaches had influenced maternal health policies in especially LMICs. Instead, application of GIS and/or Health geography to

maternal health was largely influenced by policy priorities in global maternal health, and more pronounced in High Income Settings.

From a policy standpoint, there is a general lack of strategies combining interventions packaged as an integrated service, with most strategies without regard to place specific connotations on extent of how they can be implemented across different social-cultural groupings. There are also little or no nationally unified standards established for the preparation and transportation of pregnant mothers leading to general strategy discordances in transport mobilisation efforts. Although some nationalities/agencies offer area-specific guidelines including flight nursing and trauma nursing protocols, most nationalities still lack guiding protocols on handling transit care transports and support staff other than the general etiquette informed by the nursing professions. The measurement and evaluation of transport mobilisation performance standards and effectiveness, therefore, remain highly subjective as evidence drawn in this paper cannot be benchmarked.

Transport mobilisation strategies are therefore, not freely generalized across different socio-cultural settings. However, we can do well by borrowing (with modifications) from configurations which have worked elsewhere. Interventions must be informed by what has been tested to work especially in similar settings, with an extended liability of filling the gaps due to socio-cultural and geographical variations. Thus, there is need for the deployment of geographically aware mHealth interventions for pregnancy underpinned by the fact that technology is not neutral, but context-specific – interventions must be adapted to the needs of people they seek to serve Exploring both community and individual level consumer preferences through facilitated participatory learning and action cycles is strongly recommended across different cultural settings if holistic approaches to the design and implementation of interventions are to gather momentum.

Abbreviations

ANC: Antenatal Care

CEmOC: Comprehensive Emergency Obstetric Care

EmOC: Emergency Obstetric Care

GIS: Geographical Information Systems

LMICs: Low- and Middle-Income Countries

PRISMA Statement: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

WHO: World Health Organisation.

Table S1
S2 Table. PRECISE Network

PRECISE Network	
In-country teams	
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Declarations and Supporting Information

Ethics approval and consent to participate

This scoping review is an exploratory study to understand context specific behaviours around transport interventions in a bid to design contextually relevant mobile health applications that addresses transport and saving challenges in a low resourced setting.

The study is part of an approved package of activities detailed in the RoadMApp protocol, and as such was approved by the ethics committees at Midlands State University and the Medical Research Council of Zimbabwe – File Number **A/2462**. Institutional Review Board (IRB) approval for either active or passive consenting processes or a waiver of consent to link data, and perform

analytic studies were sought from the Midlands State University, Zimbabwe, Faculty of Science and Technology IRB.

RoadMApp – Improving access to maternal care is a pre-post intervention which seeks to address delays in accessing care by linking pregnant women to locally available transport options and means of saving for maternity. This scoping review uses data available from online platforms. Most of the publications cited in this work are publicly available, and those with restricted access were accessed via the Midlands State University Library gateway.

Consent for publication

The authors grant the Publisher the sole and exclusive rights to publication of this work, which rights the Publisher hereby accepts.

Competing interests

The authors declare that none of the authors have any actual or potential conflict of interest and/or competing interests in relation to this publication

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Availability of data and materials

All the published sources of information used in this scoping review are available either publicly, or via the Midlands State University Library gateways.

Authors' contributions

LM, RM and PTM led the collation of results and charting of themes, made substantive contributions to writing the first complete version of the manuscript

and were involved together with all the other authors in the interpretation of the findings. LC, RM and MMA, revised the manuscript and copy-edited the final submission version. All the authors were involved in revising the manuscript critically for important intellectual content. All authors read and approved the final manuscript. PTM made substantive contributions in summarizing all the content in the manuscript.

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