

# 11 Geographical Access, Transport and Referral Systems

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## Summary

- Poor access to emergency obstetric care is due to one of three delays: deciding to seek care, reaching a health facility and receiving appropriate treatment.
- Poor geographical access in itself is not the cause of the second delay, but the delay results from failure to bridge it with adequate referral interventions and systems.
- Geographical access can be defined using several dimensions, including distribution and density of services, distance and time.
- Poor physical access to health services contributes to urban–rural inequities in the utilization of services and in health outcomes. It also compounds the problem of availability of human resources for health in rural areas.
- Geographical access is mainly a problem of rural populations, especially the poor.
- The two-tiered model of primary health care and hospital-level care make referral and referral systems essential. Referral can be hampered and delays caused by a poorly functioning system.
- Solutions to overcome the problems of physical access include communication, transport, educational, financial, infrastructural and technological interventions.
- The effects and the effectiveness of many of these interventions are poorly understood and more evidence is needed to aid decision making, especially for low resource settings.

## Introduction

A major contributor to the high maternal and perinatal mortality and morbidity in developing countries is the poor access to life-saving obstetric care when complications arise. Such poor access may be due to a variety of causes: personal or cultural barriers, failure to reach facilities in time and inadequate care at health facilities. Three delays have been described in order to conceptualize the problems of obstetric care in the developing world (Thaddeus and Maine, 1994). The three delays are:

- Delay in deciding to seek care.
- Delay in reaching a health facility.
- Delay in getting appropriate treatment.

Delays in the decision to seek care usually occur at the household level and include problems related to recognition of the complication and its nature as a life-threatening condition or an emergency. The distances involved in reaching care, the costs of care and perceptions regarding the quality of care available, are also known to be key factors that affect women's decision making.

After the decision to seek care has been made, the second delay is concerned with the delay in arrival at the health facility. This delay is affected by the distribution and location of health facilities (and health professionals) that are equipped to deal with emergency obstetric and neonatal care, as well as the availability and costs of transportation and communication systems to reach facilities. The second delay is most common and severe in rural areas, where health professionals may not be available, transport and communication systems limited, and road conditions changeable, depending on the season.

The third delay occurs after the facility is reached. Here, delays in various aspects of care delivery can be due to poor procedures for triaging obstetric emergencies, staff shortages, staff attitudes and skills, a lack of functioning equipment or unreliable drug and blood supplies. Inadequate management structures and poor links between the primary, secondary and tertiary referral systems also cause delays in reaching an appropriate level of care.

The factors influencing all three delays are entwined and play a part in limiting women's access to health services. The second delay is directly linked to problems of geographical access. In many developing countries, utilization of health services is decreased by poor geographical access (Say and Raine, 2007; Gabrysch and Campbell, 2009) and the delay in reaching care is responsible for maternal and perinatal deaths in a significant proportion of cases globally (Ronsmans and Graham, 2006). This chapter focuses on issues relevant to geographical access in developing countries, discussing its definitions, impact of poor access on maternal and perinatal outcomes and interventions that have been attempted to improve access.

### Definition of Geographical Access

There is no agreed definition of geographical or physical access because the time taken to transport a woman to a facility will depend on distance, terrain, quality of roads, season of the year and type of transport. There are three possible ways to define the concept. The

first has been an attempt by UN agencies to define access to emergency obstetric care (EmOC) (UNICEF, 1997). The minimum desirable level of access to EmOC is defined as the availability of four basic and one comprehensive EmOC facility for every population of 500,000 people. The appropriateness of this definition depends on population density, and the relative proportions of rural to urban populations. In a sparsely populated rural area, if there was only one basic EmOC facility for 125,000 people, some would have to walk very far to reach it. By contrast, in most urban areas in developing countries, this criterion can be relaxed (provided the services available can still cope with utilization levels), because the high population density enhances geographical proximity. The use of the UN criteria may pose difficulties if applied to all population densities. In fact, at least three different criteria are needed, for low, average and high density populations. Another problem with the use of the UN indicators of EmOC access is that it fails to discriminate between high and low maternal mortality settings. For example, in a study comparing indicators for EmOC in Zambia and Sri Lanka, both countries exceeded the recommended benchmarks and had similar EmOC facility density, yet performed very differently in terms of maternal health outcomes (Gabrysch *et al.*, 2011b).

The next possible definition might use distance as a criterion. Several studies have used the distance of 5 km to determine whether rural women are more, or less, likely to use obstetric services (van den Broek *et al.*, 2003; Gage and Guirle Calixte, 2006; Yanagisawa and Wakai, 2008). The choice of 5 km is not explained in the papers, but there are two probable reasons for the arbitrary selection of this distance: (i) distance is described in multiples of 5 km in most papers; and (ii) many rural women in labour will walk to the facility, or be carried on a stretcher or hammock by people who are walking. They or their carriers are unlikely to attempt a distance of more than 5 km. The problem with using distance as a measure of geographical access is that it may not take into account other physical factors. Mountainous terrain or flood-prone areas can make some

areas difficult to reach during certain times of the year, so a health facility that is 'nearby' during the dry or warm season may become inaccessible during monsoons or during winter, irrespective of its distance. The availability of transportation is another factor that changes the value of distance as a good indicator of geographical access. A health facility 20 km away may be easier to reach than one which is closer if, for example, the further facility is located in a busy market town, well connected by transport, or poorly maintained roads slow transit time.

A third method of defining geographical access is to describe it by the time by which a woman should reach an EmOC facility. The estimated average time from onset of complications to death for the leading causes of maternal mortality ranges from between 2 h (in postpartum haemorrhage) and 6 days (in the case of infections). The implication is that it is not safe for women to be more than 2 h away from EmOC, since death can result from postpartum haemorrhage within this period (Maine, 1991). The updated guidelines for monitoring EmOC add that women should be within 2–3 h travel time to a facility that can offer life-saving treatment (WHO *et al.*, 2009). However, travel time is not necessarily a static measure and it is possible that a facility could be 2 h away during the day, but not at night, because of the way transportation systems are organized. A facility may be 2 h away, but not used because personal safety of travellers could be compromised by using that specific route.

In summary, although there are limitations to all definitions, geographical access is probably best defined by the time taken to reach a facility rather than by distance. The period of highest risk for pregnant women is around the time of delivery and this is when they should be within 2 h of life-saving care. For practical purposes, good geographical access in the context of care for the pregnant mother and her baby can be defined as the ability to reach an EmOC facility within 2 h after 37 weeks gestation and up to the first 3 days after delivery. This definition focuses on the period of greatest danger to pregnant women, the unborn baby and newborns, and

avoids the need to make access available within 2 h throughout pregnancy, which is generally an unrealistic aim.

## Impact of Poor Geographical Access

### Urban to rural differentials in outcomes

At the national level, the most obvious result of poor geographical access is the difference in outcomes between urban and rural women. In low income countries, rural women usually have worse outcomes and this is partly due to poor access to high quality EmOC (Ronsmans *et al.*, 2003; Hunger *et al.*, 2007). Whereas it can be difficult to separate the effects of distance alone, from poverty, education and other factors, it has been demonstrated that geographical access can act independently to reduce utilization of services (Hounton *et al.*, 2008; Malqvist *et al.*, 2010). Many developing country governments simply do not have the resources to make facilities as readily available in rural areas as they are in urban settings. Compounding the problem, there is little demand from rural women for equal access to EmOC since most of them have received less education than their urban counterparts.

### Utilization of antenatal care

Utilization of antenatal services is reduced by increased distance to the health facility, as evidenced by a number of studies. In Kwale district, Kenya, women living further than 5 km from a dispensary were less likely to attend for antenatal care (OR 0.29; 95% CI 0.22–0.39) (Brown *et al.*, 2008). In Haiti, the availability of a health centre within 5 km significantly increased the odds of receiving antenatal care in a timely manner and of attending for care on four or more occasions (Gage and Guirle Calixte, 2006).

Women are able to travel further for antenatal visits than they can during labour. In Matebeland North Province, Zimbabwe, 63% of the clients who were within 10 km of health facilities (2 h walk) considered that

they had adequate access to antenatal care (Sikosana, 1994). In Malawi, despite living an average of 5 km from the health centre, over 90% of women attended antenatal clinics with a mean of five visits (van den Broek *et al.*, 2003). A study in Nepal noted that antenatal services were well utilized despite problems of geographical access, but mothers were less likely to access good quality delivery or postnatal care (Tuladhar *et al.*, 2009). Clearly however, the mere establishment of antenatal services is insufficient to increase their utilization and other factors are important, including women's satisfaction, autonomy and gender role in the decision to seek care (Bilenko *et al.*, 2007; Simkhada *et al.*, 2008).

#### Utilization of health facilities for labour and delivery

Poor geographical access has its greatest influence on the potential of women to reach a health facility during labour. Once a woman is in labour, there is a limit to how far she can travel if she has to walk, or be carried by others. The situation is compounded if there are complications or if the woman needs emergency care.

In Nepal, a distance of more than 1 h to the maternity hospital was significantly associated with an increased risk of home delivery by almost eight-fold (Wagle *et al.*, 2004). In many varied, low income settings, poor geographical access has consistently been found to be associated with decreased use of health facilities for labour and delivery (Stekelenburg *et al.*, 2004; Gage, 2007; Say and Raine, 2007; Yanagisawa and Wakai, 2008; Gabrysch and Campbell, 2009; Gabrysch *et al.*, 2011a). In the countries described in these studies, the percentages of women delivering at home ranged from between 50% and 84%. By contrast, unplanned home deliveries in high or middle income countries are very few at less than 1% (de Almeida *et al.*, 2005; Scott and Esen, 2005; Homer *et al.*, 2011). In the Netherlands, the arrival of a woman in labour at the facility is considered delayed if travel time is longer than 20 min (Ravelli *et al.*, 2011).

The risks of complications occurring during childbirth make access during this time crucial. However, as interventions can be costly, it is even more important than with antenatal care to ensure that socio-economic factors and quality of services are addressed at the same time. Several studies in various settings including Nepal, Guatemala and Vietnam have demonstrated that improving proximity to biomedical services is unlikely to have a dramatic impact on utilization in the absence of additional changes addressing quality, social, cultural and economic factors (Glei *et al.*, 2003; Duong *et al.*, 2004; Tuladhar *et al.*, 2005).

#### Maternal and perinatal outcomes

Poor access to maternity care can lead to higher morbidity and mortality. Obstetric fistula – development of an abnormal passage between the bowel or urinary tract and the birth canal – is the classic complication which arises from delayed treatment of obstructed labour. Although clinical factors such as young age, primigravidity and short stature are the leading associated factors for obstetric fistula, a long distance to travel has also been shown to be a significant contributory factor (Muleta, 2004; Melah *et al.*, 2007). Women have also been shown to be at higher risk of maternal death due to poor geographical access in South Africa, West Africa, Burkina Faso and Zimbabwe (Fawcus *et al.*, 1996; Ronsmans *et al.*, 2003; Moodley, 2004; Bell *et al.*, 2008). In Pakistan, an analysis of 104 consecutive maternal deaths showed that 74% of women experienced the second delay, and the most frequently stated reason for this was long distance, which was mentioned in 39.7% cases (Shah *et al.*, 2009).

Perinatal outcomes are also affected by poor geographical access, although this has not been studied as much as maternal outcomes. Mothers living furthest away from a health facility had an increased risk of neonatal mortality in northern Vietnam (OR 1.96, 95% CI 1.40–2.75) (Malqvist *et al.*, 2010). The perinatal outcome most susceptible to delay in treatment is stillbirth. Obstetric emergencies

can have catastrophic consequences for the unborn fetus within a short period of time. Although a serious postpartum haemorrhage can lead to death of a woman in less than 2 h, the unborn fetus may succumb much earlier (Maine, 1991; AbouZahr, 1998). If women are seen rapidly during an emergency obstetric event, and effective action taken, such as expediting delivery, intrauterine deaths could be averted or the baby delivered in a better condition. It is thus no surprise that sub-Saharan Africa has the highest intrapartum-related neonatal mortality and stillbirth rates, with a stillbirth rate of 32.2 per thousand in 2006 (Stanton *et al.*, 2006; Lawn *et al.*, 2009), with one of the main contributing factors being poor geographical access.

### Impact on health providers

Most of the papers published on geographical access concentrate on the pregnant women and their babies. In remote facilities, health workers suffer from intellectual and social isolation, fear of mishandling complications and may fail, or be unable to transfer women with complications on time. Although research evidence from developing countries is limited, transferable lessons can be drawn from other remote and rural settings. In British Columbia, Canada, health providers identified elements of personal risk they perceived resulted from offering intrapartum care in communities without access to backup services such as Caesarean section. Maternity care was felt to be unique because things could change quickly. Emotional tensions were felt and social risks such as negative attitudes from community members feared (Kornelsen and Grzybowski, 2008). These social risks may be one reason why it is difficult to recruit or retain health providers in rural areas.

### Contextual Factors

#### Population distribution

In many low income settings, most people live in rural areas, which is mainly where the

problem of geographical access occurs. In urban areas, even in poor countries, most women can reach a facility within 1 h, so the problems of access tend to be related to decision making and getting appropriate treatment, rather than of a geographical or physical nature – although there may be some exceptions, such as heavy traffic in congested cities. The proportion of people living in rural areas is decreasing in developing countries, and in some parts of the world this transition is occurring rapidly. Sub-Saharan Africa is experiencing the slowest rate of this transition (UN Population Division, 2008), which means the problem of geographical access will persist there for a long time.

### Infrastructure of health services in developing countries

In developing countries, administrative authority is usually devolved by central government to regions (or provinces), then to districts. The district is the smallest administrative sub-division of authority, with powers to implement government programmes in education, agriculture, health etc. In sub-Saharan Africa, a district will range in population between 75,000 and 500,000 people, although they may have higher populations in regions of South Asia.

Implementation of health programmes uses the district administrative infrastructure. The primary health-care model has been adopted by most developing countries, to allow the majority of the population to access preventative services. In any district, there are several primary health-care facilities which refer patients to the district hospital, resulting broadly in a two-tiered model of obstetric care. The model of obstetric care recommended by WHO comprises the basic and the comprehensive EmOC levels, partly based on the type of facilities on the ground in the district. The primary health centres serve as, or can be upgraded to basic facilities, whilst the district hospital is the comprehensive level (see Phoya *et al.*, Chapter 10 this volume). Recommendations by WHO for implementation and monitoring of maternal and

newborn health programmes is based on the district model (WHO, 1996b, 2006; WHO *et al.*, 2009).

The district model is well entrenched, and for better or worse, efforts to improve geographical access will have to be based on its structure. It is a compromise between providing primary health care to a lot of people and making sophisticated care available to the estimated 15% of women who develop complications. The problem is that even in rural areas of high population density, the primary health centres which serve as basic EmOC units may be more than 2 h away (by walking) from many women's homes. In many countries, the district health team does not assume any responsibility for the movement of women from homes to the primary health centre, beyond providing childbirth preparedness advice during antenatal care.

### The referral system

The two-tiered model of obstetric care, which results from poverty of resources and considerations of efficient functioning of the health system, makes referral between tiers necessary. The process of referral is the responsibility of the district health team.

Expedient referral, although dependent on many other factors within the health system, is often made difficult by poor geographical access between the basic and comprehensive levels. The principal requirements of a referral system have been summarized recently, and formalized communications and transport arrangements is one of them (Murray and Pearson, 2006). Until recently, communication between basic and comprehensive EmOC facilities was through either poorly maintained telephone landlines, or unreliable radio systems. The advent of mobile telephones is already bringing about a revolution for communication for referral in developing countries, especially as coverage is progressing rapidly (Krasovec, 2004).

The minimum transport requirement in any district is a motor car ambulance dedicated to obstetric and neonatal emergencies only, but it is rare to find a district with such a

facility in low income settings. After a woman has successfully reached a basic EmOC facility, she may find herself trapped there, at the mercy of a health system that is unable to transfer her in a timely manner. In some countries, this has given rise to by-passing, in which women with means avoid the lower level facilities and go direct to the district hospital as self-referrals (Jahn *et al.*, 1998; Low *et al.*, 2001).

### Interventions that Overcome Barriers to Geographical Access

This section will describe interventions that have been attempted or have been implemented in order to improve geographical access, or reduce its harmful impact. There have been very few randomized controlled trials done with distance or geographical access as the sole parameter under study – for obvious reasons, such a study would be technically difficult and pose ethical challenges. Most studies are descriptive, or are of composite interventions in which access was one of several.

### Communication

Communication is vital in managing complications of pregnancy, and is even more important in areas of poor geographical access. Unfortunately, these are the same areas that experience poor communication facilities, although the situation is already changing rapidly with mobile phone technology.

Communication needs to be addressed at the community level and at health facilities, to:

- Summon transport or call for help.
- Seek advice and initiate first aid or stabilization.
- Arrange prompt referral and allow the receiving facility to prepare for the emergency.
- Allow reassuring communication between a woman far from home and her family (Holmes and Kennedy, 2010).

In most developing countries, the mainstay technologies for communication were fixed

landline telephones and two-way radio. Communication was only available to the woman after she reached a primary facility, for the purpose of referral. Landline facilities do not reach every facility, and their overhead cables are subject to weather storms, falling trees and theft.

There have been more reports about the use of two-way radio, since it allows the primary facility, referral facility and ambulance to communicate (Musoke, 2002; Krasovec, 2004; Santos *et al.*, 2006; UNFPA, 2011). In these reports, use of two-way radio decreased referral times significantly, in the case of Mali from up to a day to just a few hours (UNFPA, 2011).

The rapid expansion of mobile phone usage, its low cost and widespread availability will soon make other forms of communication redundant. The growth of mobile phone ownership is quite high in the developing world because the market has not yet been saturated. For the year 2010, in Asia and the Pacific there were 70 subscriptions per 100 people, in Africa the figure was nearly 30 per 100 people (International Communication Union, 2010). Health services in many countries have also started supplying handsets and mobile numbers to facilities. This combination of extended use by the public and by the health services will allow women to communicate with facilities from home. It will also enable primary centres to contact the referral facilities and for health facilities to keep track of ambulances. Innovative uses for

mobile technologies in health (mHealth) are increasing all the time – with consultations, sharing of case notes with referral facilities, feedback and follow-up reported (WHO, 2011). A potential role in referral for mobile telephones is to allow electronic funds to be confirmed with, or transferred to, drivers of private cars in the absence of cash. Women can also be sent funds by relatives for transport and user fees. Communications technology has opened opportunities for new partnerships between public and private providers of health at global level (see <http://www.mhealthalliance.org>) and within countries (Box 11.1).

### Transport

In urban areas, public and private transport is usually available and sufficiently affordable by women seeking health care. City authorities and municipalities usually have ambulance services, although in sub-Saharan Africa they are usually oversubscribed (Nkyekyer, 2000; Thomson, 2005) and private taxis are widely used as they are cheaper and quicker. Obstetric flying squads, which send ambulances with health personnel to attend and transport women with complications, have been used in a few developing countries such as Pakistan but have not been scaled up, probably due to a mixture of difficulties in linking with communications systems and shortages

#### Box 11.1. Emergency referral in India: a public-private partnership.

GVK EMRI (Emergency Management and Research Institute: <http://www.emri.in>) is a not-for-profit professional organization operating in a public-private partnership mode to supply emergency referral services in India. It handles medical (as well as police and fire emergencies) through their '108 Emergency service' line. This is a free service, which utilizes the expanding telephone and communications systems in India. The group has a fleet of nearly 3000 ambulances across the states of Andhra Pradesh, Gujarat, Uttarakhand, Goa, Tamil Nadu, Karnataka, Assam, Meghalaya, Madhya Pradesh, Himachal Pradesh and Chhattisgarh, responding to an estimated 30 million emergencies annually in both rural and urban environments. The organization has arrangements with over 6800 hospitals, which provide initial stabilization of patients, free of cost for the first 24 h.

The 108 Emergency Response operates round the clock through a call centre and a toll-free number accessible from land or mobile telephone lines. Medical advisers are on hand at the call centre to provide expert advice. Calls for emergency transfer of pregnant women make up a significant proportion of their work.

of human resources (Andina and Fikree, 1995). In the urban setting, poverty and belief systems (see Mumtaz and Levay, Chapter 12 this volume) rather than physical access may be predominant barriers.

It is in the rural areas that transport interventions are crucial. There have been several recent reviews on the subject (Krasovec, 2004; Babinard and Roberts, 2006; Holmes and Kennedy, 2010; Hussein *et al.*, 2011). The range of physical transport options includes: pick-up trucks; taxis; buses; reconditioned vehicles; tractors; motorcycles; tricycles; bicycles; bicycles/tractors/tricycles with trailers; motorboats; canoes; wheelbarrows; animal-drawn carts; home-made stretchers; rickshaws; aircraft and trains.

Non-motorized options do not have the potential to transport a woman needing emergency care in good time. There are very few reports on non-motorized means of transport, but there have been publications on bicycles and tricycles (Plate 6) (Lungu *et al.*, 2001; Schmid *et al.*, 2001; Bossyns *et al.*, 2005). This mode of transport has not become more widely used because of its limitations. There is a limit to the distance that a rider can carry a woman, probably no more than 20 km. The rough terrain may make use of the bicycles/tricycles difficult or impossible, and the wear and tear on them as a result can be considerable. In extreme weather conditions, such as heat or rain, they may be very uncomfortable both for the rider and passenger. And lastly, the family cannot accompany the woman.

Motorcycle ambulances (Plate 6) have been tried in a few settings and the experience of Malawi has been reported (Hofman *et al.*, 2008). In that study, motorcycle ambulances were placed at three remote rural health centres and their effectiveness was compared with that of a four-wheel-drive car ambulance at the district hospital. The median referral delay in the centres using the motorcycle ambulances was reduced by 2–4.5 h (35–76%). The purchase price of a motorcycle was 19 times cheaper than a car ambulance, and annual operating costs 24 times cheaper. Currently, on land the motorcycle ambulance is the only way that large numbers of women can be moved at a relatively affordable cost from primary facilities to district hospitals.

Health ministries have been slow to try them in sub-Saharan countries however. Even though they are more comfortable than tricycles, they are seen as 'backward' by some administrators.

Car ambulances, private cars and taxis would be the most effective method of transferring women, but the problem is availability and affordability. Public sector ambulances stationed at district hospitals are extremely busy and not dedicated to obstetric emergencies only. Vehicles often get put into service for other non-emergency messenger services once available. The positive reports on the impact of using car ambulances are few. In Sri Lanka, the government equipped every district hospital with between three and five ambulances, which greatly reduced the delay in transporting women (Pathmanathan *et al.*, 2003). In Sierra Leone, a collaboration between the Prevention of Maternal Mortality Network and the Ministry of Health studied the use of a four-wheel-drive vehicle at the referral hospital (Samai and Sengeh, 1997). Referrals for serious obstetric complications increased from 0.9 to 2.6 per month and average referral time was just over 3 h.

Due to the cost of running a public sector ambulance service in rural areas, women and their families have to depend on private transport using either their own funds or financing schemes. Holmes and Kennedy (2010) presented a detailed description of the initiatives in a wide variety of developing country settings and concluded that community-based schemes have demonstrated some potential to overcome financial barriers to reaching EmOC. These included emergency loan funds, insurance and pre-payment schemes. Challenges included the generation of sufficient funds, particularly in small communities, and sustainability. Government programmes have introduced, sometimes in partnership with non-government organizations or the private sector, cost-sharing initiatives: vouchers and entitlement cards, and cash transfers and reimbursements (see Witter and Ensor, Chapter 7 this volume). Attention to management, transparency, and regulations to ensure rationalization is recommended to ensure the success of the initiatives.

The most feasible transport arrangements for many low income settings would be a motorcycle ambulance at all primary centres attending to pregnant women, complemented by a car ambulance at the referral centre. The motorcycle ambulance would perform two tasks: collecting women from the community to the primary facility, and then transferring them to a referral facility when the need arose. The car ambulance would then be reserved for collecting women from primary facilities more than 30 km away or for situations in which the woman might deliver in transit.

### Childbirth and emergency preparedness

Pregnant women are now routinely offered birth and complication readiness advice, usually in the third trimester, regardless of where they live. However, this is much more relevant to women living in areas of poor geographical access. Birth preparedness and complication readiness is meant to improve the access to skilled providers and consists of the following: knowledge of labour symptoms; knowledge of danger signs; plan for where to give birth; plan for a birth attendant; plan for transportation; and plan for saving money (Moran *et al.*, 2006). These interventions aim to overcome the delays in decision making while simultaneously addressing planning to improve geographical access.

However, the results of providing this advice have been mixed. In Koupela district, Burkina Faso, a survey of 180 women who had given birth was done after a district-based service delivery system had been implemented by JHPIEGO, an international non-profit health organization. Of these women, 46.1% had a plan for transportation, and 83.3% had a plan to save money. Women with these plans were more likely to give birth with a skilled provider ( $p=0.07$  and  $p=0.03$ , respectively). Controlling for education, parity, age, average distance to the health facility and number of antenatal visits, planning to save money was associated with giving birth with the assistance of a skilled provider ( $p=0.05$ ). Most women saved money for delivery but

had less concrete plans for delivery care (Moran *et al.*, 2006). In Ile-Ife, Nigeria, 400 women attending the antenatal clinic were asked about their birth preparedness and complication readiness plans. By the study criteria, 61% had made adequate preparations for delivery while only 4.8% were ready for complications (Onayade *et al.*, 2010).

Other studies have failed to demonstrate the effectiveness of birth preparedness, which did not change key maternal health indicators such as skilled attendance and use of EmOC, although it positively influenced knowledge and some intermediate health outcomes such as household practices and use of other health services in Siraha district, Nepal (McPherson *et al.*, 2006). At Kenyatta Hospital in Kenya, education and counselling on different aspects of birth and complications was not consistently provided during antenatal care. A survey found that knowledge of danger signs in pregnancy was low (Mutiso *et al.*, 2008).

It is not clear from most of the studies how far the women were on average from the facilities, what the actual plans for transportation were, and the modes of transport for those who were delivered by a skilled attendant.

### Maternity waiting homes

A maternity waiting home (Plate 7) is a facility within easy reach of a hospital or health centre that provides EmOC. Women use the waiting homes at the end of their pregnancy, while awaiting labour. Once labour starts, women move to the health facility, so that they may be assisted by a skilled birth attendant (WHO, 1991). Maternity waiting homes evolved initially as a means of getting women living in remote areas closer to a health facility. Later, women at high risk, such as primigravidae, grand multiparae, women with a previous Caesarean section or a previous history of complications were encouraged to stay at the waiting homes. A review was conducted by the WHO in 1996 (WHO, 1996a). This showed that in different countries, the infrastructure of the waiting homes, the clientele accommodated

and the services offered varied greatly. That review concluded that waiting homes can be viewed as one possible option for areas with poor geographical access and should be considered as part of a comprehensive safe motherhood programme. There is insufficient evidence on which to base recommendations about the effectiveness of waiting homes and well-controlled trials are needed (van Lonkhuijzen *et al.*, 2009). Six retrospective population cohort studies have described the effectiveness of maternity waiting homes in decreasing maternal deaths and stillbirths (Millard *et al.*, 1991; Chandramohan *et al.*, 1994, 1995; Tumwine and Dungare, 1996; Spaans *et al.*, 1998; van Lonkhuijzen *et al.*, 2003). Three provided information on stillbirths (Millard *et al.*, 1991; Chandramohan *et al.*, 1995; Tumwine and Dungare, 1996). A recent meta analysis combined the findings of these three studies and found a significant reduction in the stillbirth rate (OR 0.52 95% CI 0.34, 0.80) (Hussein *et al.*, 2011).

The maternity waiting home is the only intervention which addresses both the first and second delay simultaneously. If women return to the waiting home after delivery for 2–3 days postnatally, neonatal problems can also be managed at the facility. It is potentially one of the more cost-effective solutions to poor geographical access, particularly in sub-Saharan Africa, but will need adequate assessment of effectiveness.

### Community-based interventions

Community-based interventions aim to prevent maternal and newborn illness and death,

and to improve neonatal outcomes. The expected outcome is to ameliorate the harmful effects of poor geographical access. The packages include some or all of the activities listed in Box 11.2.

There have been a number of systematic reviews of community-based interventions in the past 4 years. Some have looked at the effect of community-level interventions as a whole (including referral components, but with many others) to reduce maternal mortality. Five cluster randomized controlled trials (RCT) were included in one study (Kidney *et al.*, 2009), with two trials showing a combined reduction in maternal mortality reaching statistical significance (OR 0.62 95% CI 0.39, 0.98). Kidney and colleagues (2009) concluded that community-level interventions to improve perinatal care can bring about a reduction in maternal mortality. A larger systematic review, which looked at 18 studies covering a wide range of intervention packages (Lassi *et al.*, 2010), did not show any reduction of maternal mortality (RR 0.77, 95% CI 0.59–1.02). However, reductions in maternal morbidity (RR 0.75, 95% CI 0.61–0.92), neonatal mortality (RR 0.76, 95% CI 0.68–0.84), stillbirths (RR 0.84 95% CI 0.74–0.97) and perinatal mortality (RR 0.80, 95% CI 0.71–0.91) were noted. The conclusion of the review was that there is encouraging evidence of the value of integrating maternal and newborn care in community settings through a range of interventions which can be delivered through community health workers and health promotion groups.

A few systematic reviews have looked at the specific effect of interventions on referral. Sibley *et al.* (2009) revisited traditional

#### Box 11.2. Elements of community-based referral packages.

- Health education for women and their families, especially on danger signs.
- Birth preparedness and complication readiness.
- Transport arrangements.
- Generation of funds for transport.
- Referral advice.
- Training of community health workers and traditional birth attendants on first aid, danger signs, good practices and referral.
- Upgrading of local health facilities in EmOC.

birth attendant training for improving health behaviours and pregnancy outcomes. Results were mixed, with one study included in the review reporting lower perinatal deaths (adjusted OR 0.70, 95% CI 0.59–0.83) and stillbirths in the intervention group (adjusted OR 0.69, 95% CI 0.57, 0.83) (Jokhio *et al.*, 2005), while another study showed no differences in perinatal outcome. Similarly, in one study, referral rates were significantly higher in trained traditional birth attendants (adjusted OR 1.50, 95% CI 1.18–1.90,  $P < 0.001$ ) but another study reported no differences in the number of monthly referrals. The effectiveness of primary-level referral systems for emergency maternity care in developing countries has recently been systematically reviewed (Hussein *et al.*, 2011). Nineteen papers from 14 studies, which included RCTs, controlled before-after studies and interrupted time series were included. In several South Asian settings, the organization of communities to generate funds for transport, implemented as part of other community mobilization activities, reduced neonatal deaths significantly (OR 0.69, 95% CI 0.53, 0.90). Conclusions were limited by difficulties in isolating the effects of the multiple components and factors related to the design of some studies. The review recommended the continued inclusion of referral interventions within maternal and newborn health programmes as part of wider health system improvement, and suggested that practices in research, monitoring and evaluation of these interventions be improved.

### Geographical information systems

Geographical information systems (GIS) are an emerging technology in the analysis of health from a geographical or location context. They are potentially powerful assessment tools for the investigation of health-care access, health outcomes and the possible resulting health disparities (Graves, 2008). The technology captures geographical data and can analyse, manage and display relevant information for various purposes. The

technology has already been used in both developed and developing country settings to map diseases, infectious outbreaks, calculate distances from health centres, conduct surveys and aid in decision making (Kohli *et al.*, 1995; WHO and UNEP, 2011). In reproductive health, a GIS was used to integrate health facility and demographic health survey data to ascertain the value of distance to health services as a proxy variable for access to family planning services (Heard *et al.*, 2004). In maternal and perinatal health, one of the most significant uses of this technology would be to find out which women in a district suffer from the poorest geographical access, and where new facilities should be built. Mortality and morbidity data can be linked to the assessment to provide the best potential to save lives. GIS data could be used to inform the building or upgrading of facilities and infrastructure.

### Conclusion

Poor geographical access is a major determinant of maternal and perinatal mortality and morbidity. This is mainly a problem of rural areas in low income countries. Poor geographical access in itself is not the cause of the second delay, but the delay results from failure to bridge it with communications, transport and adequate referral systems. In high income countries pregnant women may live quite far from facilities but do not suffer unfavourable outcomes (Box 11.3). The economic potential of each country to deal with access and physical obstacles differs, so in resource poor settings, decision making regarding referral needs will be aided through the generation of reliable evidence describing the relationship between geographical access and pregnancy outcomes; and which rigorously assess the impact of interventions to improve access. New technologies should be exploited for their potential to resolve problems of communications and transport especially for the rural poor, but underlying the success of any referral intervention is its reliance on an efficiently functioning health system.

**Box 11.3.** Selected experiences from high income countries.

High income countries have largely solved the problem of geographical access. Good communication and excellent transport systems allow women to reach services within an acceptable time period. In countries such as Australia, the USA and Canada, and in Europe, pregnant women may live quite far from facilities in remote locations, but do not suffer unfavourable outcomes. There is little difference in maternal or perinatal outcomes between women living in urban or rural areas (Baird *et al.*, 1996; Schmidt *et al.*, 2002; Pilkington *et al.*, 2008; Hughes *et al.*, 2008; Homer *et al.*, 2011).

A report from California, USA on 2,620,096 births conducted between 1998 and 2002 showed that rural obstetric services had favourable neonatal and maternal safety profiles. Maternal death rates were not different (Hughes *et al.*, 2008). The good outcomes for rural women in isolated circumstances in the USA and Canada are the result of regionalization of perinatal care combined with efficient telecommunication and transport systems (Nesbitt, 1996; Larson *et al.*, 1997; Kornelsen and Grzybowski, 2005). However, even in these settings there are problems with providing rural services, such as the resources required to maintain the performance of a facility (Heaphy and Bernard, 2000), the viability of primary facilities which have high referral rates (Iglesias *et al.*, 2005) and the fact that subgroups of women may still actually experience poor outcomes due to poor geographical access (Hulme and Blegen, 1999).

In Europe, the use of hospital-based Obstetric Flying Squads shortens the time it takes for women to access emergency care. Travel time is measured in minutes rather than hours (Hauspy *et al.*, 2001; Pilkington *et al.*, 2008; Ravelli *et al.*, 2011). The flying squad members are staff of the nearest maternity unit. In the UK, one health authority assessed the potential benefits of using paramedics as primary responders for domiciliary obstetric and gynaecological emergencies. It was found that targets for response times were met and the mean response time for providing appropriate skilled help was halved compared to the previous arrangements. Medical staff depletion in the delivery unit was minimized (Hibbard *et al.*, 1993).

Reports of the use of maternity waiting homes in high income countries are few as they are largely unnecessary in those settings. Islands with small populations may have to transfer women to larger islands as in the Seychelles, or to the mainland, as in Scotland. In Australia, the use of a Cairns Base Hospital for late pregnancy care and delivery by women from the distant communities of Cape York has been described. The women were transferred at 36 weeks, which resulted in a mean stay of 24 days before birth (range 0–86 days). Referring at 36 weeks was concluded to be medically appropriate although there were some detrimental social, cultural and financial consequences (Arnold *et al.*, 2009).

Almost all industrialized countries have air transport facilities for geographically distant communities. Reports have described the successful air transport of women (Jony and Baskett, 2007) and neonates (Lang *et al.*, 2007). However, these experiences are hardly relevant to developing countries because of the costs involved.

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