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Exploring referral systems for injured patients in low-income countries: a case study from Cambodia

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Injury is a growing public health concern worldwide. Since severe injuries require urgent treatment, involving smooth, timely patient referral between facilities, strengthening of the referral system would reduce injury mortality. Smooth referral consists of identification of severe cases, organization of transportation, communication between facilities and prompt care at the receiving facility. This study examined these components of referral of injured patients in a representative sample of health centres (HCs) and referral hospitals (RHs) in Cambodia.

We analysed data from a survey carried out in 80 HCs and 17 RHs by interview or mailed questionnaire from December 2006 to April 2007. Collected information on referral included the presence of referral guidelines for injured patients, distance of referral, commonly used transportation and its cost, communication with receiving facilities, and fast-tracking at receiving facilities.

Formal referral systems were not functioning well in some areas (insufficient communication and underutilization of ambulances), and informal systems were frequently involved (patient transfer by taxi or referral by community volunteers, and treatment by traditional healers) but were not fully integrated into the referral network (traditional healers seldom referred patients to public facilities). The referral distance was long for most of the surveyed facilities and transportation costs were high when transferring from remote areas, even by ambulance.

This study identified the weaknesses and strengths of the emergency referral system in Cambodia. Streamlining referral mechanisms will require organization of each component of the referral mechanism by strengthening the existing system and mobilizing local resources, which would allow Cambodia to develop an efficient system at reasonable cost, though it may differ from Western models. Guidelines including these components along with training and supervision, and expansion of the system to cover other disease conditions, would strengthen the health care system as a whole in this country.

Keywords Referral system, injury, Cambodia, transportation, communication

KEY MESSAGES

- Existing referral mechanisms for injured patients in Cambodia were analysed to provide a framework on which to develop an appropriate referral system.
- Formal referral systems were not fully functioning. Informal systems such as patient transfer by taxi or by community volunteers, and treatment by traditional healers were frequently involved; however, they were not fully integrated into the referral network.
- Streamlining referral mechanisms requires organization of each component by strengthening existing systems and mobilizing local resources, including informal systems.
- Full utilization of local resources should enable us to develop an innovative system suitable for this country at reasonable cost, which may differ from Western models of emergency referral systems.

Introduction

Rapid economic growth and widening economic inequalities have been associated with increased injuries, both unintentional and intentional, such as road traffic injuries and interpersonal violence, in low- and middle-income countries (LMICs), necessitating establishment of emergency trauma care systems (Krug *et al.* 2002; Mock *et al.* 2004; Peden *et al.* 2004; Ameratunga *et al.* 2006). Emergency health care needs for injuries as well as non-communicable diseases in LMICs have been underemphasized (Sethi *et al.* 2000; Razzak and Kellermann 2002; Joshipura *et al.* 2004), reflecting global health policy focusing on communicable diseases and maternal and child health (Smith and Haile-Mariam 2005). In contrast, there have been many successful attempts to strengthen the emergency obstetric care (EmOC) system including organization of transportation for referral (Koblinsky *et al.* 1999; Krasovec 2004; Paxton *et al.* 2005), and improvement of the quality of child emergency care by introducing standardized care such as Integrated Management of Childhood Illness (IMCI) (Bryce *et al.* 2005; Victora *et al.* 2005; Molyneux *et al.* 2006). The Essential Trauma Care (EsTC) Project has only recently started to set reasonable and affordable standards for trauma care in LMICs by defining essential services and resources (Mock *et al.* 2004).

Traumatic injuries require urgent treatment necessitating smooth, timely referral between facilities. The effective function of the referral system requires improvement in three components, as Hensher *et al.* (2006) indicated: system design; smooth transfer of patients and information; and referral discipline to minimize inappropriate use of higher level care (bypassing a level or self-referral). Of these components, in a given condition (system design), emergency referral places more emphasis on smooth transfer than referral discipline, and minimizing delay sometimes overrides the efficient use of resources. For example, bypassing and self-referral may be acceptable in emergency cases. Erroneous decision-making in patient referral should be biased toward the safer option: over-triage (inappropriate use of higher level care) is accepted to reduce under-triage (severe cases inappropriately kept at a lower level).

Referral mechanisms for injured patients in LMICs have not been well investigated. A few studies investigating the prompt transfer of injured patients revealed a deficiency in the ambulance system or communication devices but did not examine the referral mechanism as a whole (Forjuoh *et al.* 1999; Sethi *et al.* 2000; Nakahara *et al.* 2007; Razaak *et al.* 2008). Other studies into the details of patients' referral, some of which included emergency cases but did not necessarily focus on injured patients, investigated the referral discipline and care-seeking behaviours such as bypassing or self-referral (Kloos 1990; Nordberg *et al.* 1996; Ohara *et al.* 1998; Atkinson *et al.* 1999; Low *et al.* 2001; Siddiqi *et al.* 2001; Macintyre *et al.* 2003; Bossyns *et al.* 2006).

Although most of the previous studies used patients' individual data to analyse factors associated with behaviour and barriers to service use, many of the factors influencing the referral are facility-specific: e.g. referral guidelines, communication (practices and systems), and transportation (availability and cost). In addition, such factors are easily subject to policy changes and are relevant to streamlining of the emergency referral system. In addition, previous studies surveyed limited areas and could not illustrate the situation nationwide.

Therefore this study examined the referral system by collecting facility-specific information from a nationally representative sample of health facilities in Cambodia, as part of a nationwide evaluation of the trauma care system. We previously reported facility capacities for trauma care based on the Guidelines for EsTC (Nakahara *et al.* 2009); this paper reports on the inter-facility referral components.

Context

Cambodia is a low-income country with a per capita gross national income of US$540 (in 2007) and a population of 14.4 million (2007) (World Bank 2008). Cambodia consists of 24 provinces, and provinces are divided into operational districts, the basic units of its health care system distinct from the administrative districts. Each operational district, covering 100 000 to 200 000 people, has a network of health centres (HCs) and usually a referral hospital (RH) which receives patients referred from HCs. At the time of the study, there were 76 operational districts, 975 HCs and 68 RHs in total. Village health volunteers (VHVs) are involved as first responders at the community level with varying degrees of involvement (referring patients to HCs, completing referral slips and record keeping) and training by region; some HCs have a motor-bi/tricycle ambulance for referral (Daily 2005).

Trauma referral systems extend from the communities to definitive care at the hospitals (Figure 1). Life-threatening cases should be promptly transferred from HCs to higher-level facilities, possibly bypassing mid-level facilities. For such decisions to be made properly, written guidelines are crucial but

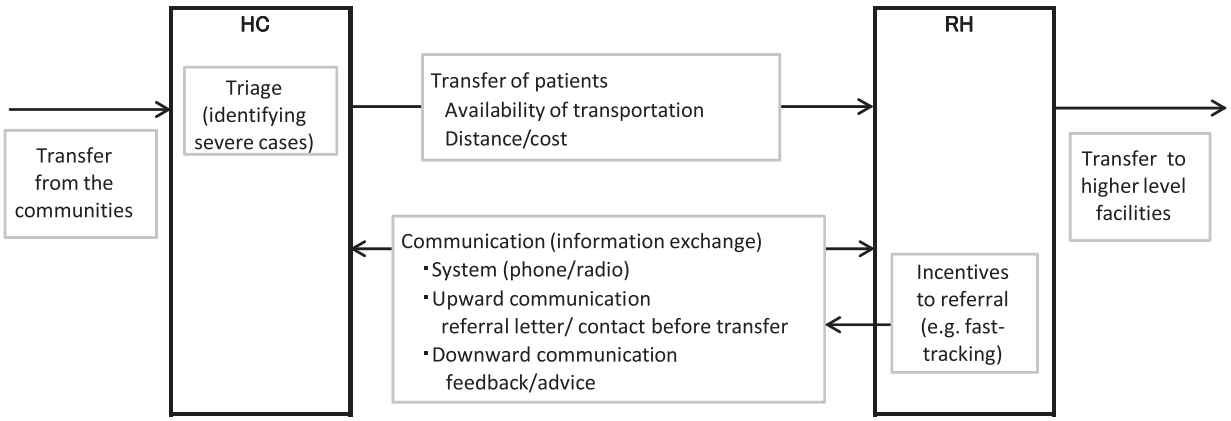

Figure 1 Refferal flow from the communities to definitive care

are rarely prepared in LMICs (Nkyekyer 2000; Sethi *et al.* 2000; Razzak and Kellermann 2002; Joshipura 2008). Unavailability of transportation is a widespread barrier to emergency referral (Razzak and Kellermann 2002; Kobusingye *et al.* 2005; Levine *et al.* 2007; Razzak *et al.* 2008). The majority of emergency trauma (Forjuoh *et al.* 1999; Sethi *et al.* 2000), obstetric (Thaddeus and Maine 1994; Nkyekyer 2000), medical (Pandian *et al.* 2006) or general emergency patients (Razzak *et al.* 2001; Levine *et al.* 2007) reach health facilities by private vehicles, taxi, non-motorized vehicles or even on foot.

Longer distances to hospital increase travel and opportunity costs (Kloos 1990; Thaddeus and Maine 1994; Hardeman *et al.* 2004), and prolong the time for patients to reach the hospital (Pandian *et al.* 2006). Transport costs account for a considerable proportion of the total cost and can directly delay urgent referral in LMICs (Fofana *et al.* 1997; Ensor and Cooper 2004; Peterson *et al.* 2004; McIntyre *et al.* 2006). A study in Uganda reported that relatives have to obtain money by selling assets or borrowing before starting patient transfer (Peterson *et al.* 2004). Financing such costs, along with treatment and indirect costs, can push poor people into the poverty trap (Whitehead *et al.* 2001; Mock *et al.* 2003; Hardeman *et al.* 2004; Van Damme *et al.* 2004; Kobusingye *et al.* 2005; Jacobs and Price 2006). In Cambodia, community financing schemes known as Health Equity Funds have been introduced in some areas to support the poor, but are diverse in operational organization (Noirhomme *et al.* 2007), and may or may not cover transport costs (Hardeman *et al.* 2004; Jacobs and Price 2006).

Lack of communication can also deter referral (Kalter *et al.* 2003) and reduce the quality of trauma care (Jat *et al.* 2004). The supply of referral and feedback letters is inconsistent or even rare in LMICs (Nordberg *et al.* 1996; Ohara *et al.* 1998; Atkinson *et al.* 1999; Siddiqi *et al.* 2001) including Cambodia (Daily 2005). Communication technology is becoming less problematic in LMICs because of rapid expansion of the cell phone network (Krasovec 2004; Daily 2005).

Methods

Study design

We conducted a cross-sectional facility survey from December 2006 to April 2007, selecting nationally representative samples of HCs and RHs. We excluded two urban neighbouring provinces, Phnom Penh and Kandal, where people have easy access to tertiary care hospitals, since our focus is the referral functions in rural settings where HCs and RHs play a major role. Details of the study design are described elsewhere (Nakahara *et al.* 2009). This study was approved by the Cambodia National Ethical Committee for Health Research and the Cambodia Ministry of Health.

We used stratified two-stage cluster systematic random sampling with probability proportional to size. The sampling units of the first and second stages were operational districts and HCs, respectively. In the first stage, we stratified provinces by population density (1998 census) into low (1–19/km^2), lower-middle (20–49/km^2), upper-middle (50–99/km^2) and high (100+/km^2) population density strata. We selected operational districts with an equal sampling fraction in each stratum using a systematic random sampling technique with probability proportional to the number of HCs in each operational district. In the second stage, HCs in the selected operational districts were stratified into one of three categories based on access to main roads and vehicle availability, and from each stratum HCs were randomly selected with an equal sampling fraction. In total, 85 HCs and 17 RHs were selected.

Data collection

We collected information using a pre-tested structured questionnaire by interviewing the staff of HCs and RHs or sending a questionnaire to them. Of the 85 selected HCs, a research assistant contacted and interviewed directors of 70 HCs by phone, and visited five HCs for face-to-face interviews. The questionnaire was sent by mail to 10 HCs in remote areas where visiting and phoning was difficult because of poor accessibility. To minimize bias arising from the different methods, the questionnaire indicated precisely the questions asked by the interviewer (we trained her to precisely read the questions), and the same questionnaire was sent to the 10 remote HCs. We collected information on RHs with a questionnaire sent by mail to their directors asking them to instruct a person in charge of trauma care to answer it.

The collected information on patient transfer included the number of injured patients received and referred to a higher-level facility in the past 3 months, as recorded in the

logbook; main causes of injuries in the communities (multiple answers allowed up to three); the distance to the higher-level facility; availability of ambulance (multiple answers allowed); the common mode of transportation for patient referral (up to three); the estimated cost of transportation for each indicated mode; the frequency of staff accompanying the referred patients (no, rare, sometimes or always); and pre-transfer care. The information on referral communication included availability of a phone or radio (multiple answers allowed), utilization of a referral letter, the benefit to patients of carrying a referral letter at the receiving facility and the frequency (no, rare, sometimes or always) of communications (contacting before referral, feedback from higher-level facilities after referral, and advice from higher-level facilities). The information about the communities included preferred facilities for injured patients (up to three), activities of volunteer groups, the training given to them and referral from traditional healers. Other information included existence of written referral guidelines for injured patients at HCs and whether RHs fast-tracked patients with a referral letter. We also collected information on the mode of transport and referral guidelines of emergency obstetric patients.

Data analyses

Of the 85 HCs, we excluded from the analyses five with a distance of 500 metres or less to the referral hospital because important factors that were a barrier to referral (distance, transportation and its cost) were non-existent. Continuous variables, all of which had markedly skewed distributions, were described using the median and inter-quartile range (IQR). We calculated Spearman's rho to determine the association between categorical variables.

Analyses on the mode of transport and cost from HC to RH include 192 data sets (larger than the number of HCs because of the multiple answers) from 77 HCs (three HCs did not provide cost information). We indicated median distance and cost by mode of transport, and also performed multiple linear regression analysis to determine the association between cost and mode of transportation adjusting for distance, after excluding free transportation. Cost and distance with skewed distributions were log-transformed to address violation of the normality assumption in linear regression. We analysed the data using SPSS ver. 12.

Results

Facility characteristics

In the 80 HCs surveyed (one HC did not provide the number of staff and main causes of injuries and two did not provide the number of injured patients), physicians were not available in 76 (96%) but medical assistants, nurses or midwives were available in 15 (19%), 78 (99%) and 72 (91%), respectively. In the 17 RHs surveyed, physicians and general surgeons were available in 16 and 14, respectively, but none of them had a neurosurgeon. Distance from HC to RH ranged from 2 to 135 km with a median (IQR) of 25 (13–46.5) km; that from RH to a higher-level facility ranged from 40 to 665 km with a median (IQR) of 115 (50–150) km. The number of injured patients who visited the HCs and RHs in the past 3 months had medians (IQR) of 6 (1–15) and 63 (25–89), respectively; the number of injured patients referred to higher-level facilities from the HCs and RHs in the past 3 months had medians (IQR) of 0 (0–3) and 7.5 (3–12). Road traffic injuries were the leading cause of injuries (69 HCs and 16 RHs indicated road traffic injuries as a main cause of injuries), followed by violence (47 HCs and 13 RHs).

Transfer of patients to RHs

Of the HCs surveyed, 78 (98%) answered that the nearest RH had an ambulance, whereas 17 (21%) of them also used a taxi to transfer emergency trauma patients; four (5%) HCs had their own motor-bi/tricycle ambulance; two (3%) HCs answered that no ambulance was available. All RHs had an ambulance but one of them restricted its use to emergency transportation of obstetric cases. The commonly used modes of transportation to carry injured patients from HCs to RHs were indicated as taxi, ambulance, motorcycle and private car in 61 (76%), 45 (56%), 44 (55%) and 21 (26%) of the HCs, respectively; motor tricycle including motor-bi/tricycle ambulance was a common mode in 13 (16%). For transferring emergency obstetric patients, of the 79 HCs (one did not provide information on emergency obstetric care) only 18 (23%) indicated motorcycle as a common mode, whereas 59 (75%) and 46 (58%) indicated taxi and ambulance, respectively. Of the HCs that provided information on first aid to severely injured patients before transfer, 79 out of 80 (99%) were ready to give intravenous fluid and 72 out of 78 (92%) were ready for splinting (92%), 46 out of 77 (60%) could provide fixation with a backboard, but oxygen could be administered only in 6 out of 75 (8%). Only 34 (43%) of the HCs had a written protocol for care and transfer of injured patients, whereas 94% had a written protocol for obstetric emergencies.

Mode of transport, distance and cost

Table 1 shows the distance and cost of commonly used transportation for patient referral from HCs to RHs. Motorized vehicles, with the exception of free ambulances, were used for longer distances. Taxis showed the highest cost, followed by ambulances. Table 2 shows the results of multivariate linear regression analysis with cost being the dependent variable. The cost markedly increased with greater distance. After adjusting for the distance, the cost of transport by taxi was about 1.4 times ($e^{0.35}$) higher than that by ambulance; that by motor-bi/tricycle was about half ($e^{-0.76}$) that by ambulance.

Communication between HC and RH

Cell phones or radios were available for communication in 98% of the HCs (Table 3). The majority of the HCs (60%) had ever contacted the RH before patient transfer, if not always, whereas the majority of RHs did not contact the higher-level facility before patient transfer. However, only 21% of the HCs always contacted the RH at the time of patient transfer. Only one RH indicated that referring HCs were always in contact before transfer and 13 indicated they sometimes were in contact; three indicated that referring HCs always provided referral letters and

Table 1 Mode of transport from HC to RH, distance and cost

	Distance (km)		Cost (US$)	
	Median	IQR	Median	IQR
Ambulance	20	15–35	12.5	7.5–15
Free ambulance	12	6–19	0.0	0–0
Motor-bi/tricycle	19	11.5–32.5	5	2.5–7.5
Taxi	25	15–47	20	10–37.5
Private car	27	8.5–51	10	6.25–25
Other[a]	13	11–25	2.75	4.25–12
K–W chi square[b]	11.3		81.1	
d–f	5		5	
P	0.046		<0.001	

Note: in total, 192 datasets from 77 HCs were analysed. Data without information on the transportation cost were excluded.

[a]This category includes bus, bicycle, on foot, animal and boat.

[b]Kruskal–Wallis test was used.

Table 2 Correlates of transportation costs: multiple linear regression model[a]

	B[b]	(95% CI)	β
Distance (log)	0.81	(0.69, 0.93)*	0.63
Mode of transport[c]			
Ambulance	Reference		
Taxi	0.35	(0.02, 0.68)*	0.14
Private car	0.05	(−0.38, 0.47)	0.01
Motor-bi/tricycle	−0.76	(−1.10, −0.43)*	−0.30
Other	−0.24	(−0.71, 0.24)	−0.05
Constant	−0.11	(−0.57, 0.35)	–
Adjusted R^2	0.64		
F	61.8		
P	<0.001		

Note: in total, 175 datasets from 77 HCs were analysed. Free transportation was excluded from the analysis: 15 ambulance and 2 others. CI = confidence interval.

*$P < 0.05$.

[a]The dependent variable (cost) is log-transformed.

[b]The regression model is indicated in a formula as:

$\mathrm{Ln}(Y) = -0.11 + 0.81 \times \mathrm{Ln}(X_{distance}) + 0.35X_{taxi} + 0.05X_{private} - 0.76X_{moto} - 0.24X_{other}$, where Y is the cost.

In the case of taxis, $X_{taxi} = 1$, $X_{private} = 0$, $X_{moto} = 0$ and $X_{other} = 0$; therefore,

$\mathrm{Ln}(Y_{taxi}) = -0.11 + 0.81 \times \mathrm{Ln}(X_{distance}) + 0.35 = \mathrm{Ln}(e^{-0.11} \times X_{distance}^{0.81} \times e^{0.35})$

$Y_{taxi} = e^{-0.11} \times X_{distance}^{0.81} \times e^{0.35} = e^{-0.11} \times X_{distance}^{0.81} \times 1.42$

[c]Free transportations were excluded from the analysis: 15 ambulance and 2 others (a bicycle and animal).

Table 3 Communication between different levels

	Health centre ($N = 80$)	Referral hospital ($N = 17$)[a]
Communication methods[b] (n)		
Cell phone	68	11
Radio	35	7
Fixed-line phone	0	4
Other	0	2
No	2	2
Contact before patient transfer (n)		
No not at all	32	12
Yes	48	5
(If yes, how to contact)		
(By phone)	33	4
(By radio)	15	0
(Other)	0	1
Referral letter to higher level (n)		
Formal form	78	14
Other	1	1
No	1	2
Feedback from higher level (n)		
No	24	11
Yes rarely	3	3
Yes sometimes	37	3
Yes always	16	0
Advice from higher level (n)		
No	48	4
Yes rarely	12	2
Yes sometimes	14	4
Yes always	6	6

[a]One referral hospital did not answer the question about advice.

[b]Multiple answers allowed.

11 indicated they sometimes did (not shown in Tables). In both HCs and RHs, when the staff wrote a referral letter at the time of referral, this was mostly in formal forms, in 98% and 82%, respectively. The majority of HCs (70%) had ever received feedback from the RH whereas the RH had rarely received feedback from higher-level hospitals. Among HCs that had ever received feedback, the commonly used method was a formal form in 43% and verbal communication in 50% (not shown in Table). Among these HCs, the frequency of contact before transfer and that of feedback were significantly correlated (rho = 0.45, $P < 0.001$). Those with a referral letter were fast-tracked past the queues of non-referred patients and received a discount in user fees in 11 RHs. The majority of HCs could not readily receive advice from RHs when they had difficulty in managing patients (60% of them had never received such advice), whereas the majority of RHs could gain information from higher-level hospitals.

Referral from the community

According to the HC staff, preferred facilities for severely injured patients were indicated as HCs, RHs, traditional healers and private clinics/hospitals in 73 (91%), 70 (88%), 37 (46%) and 34 (43%), respectively (multiple responses allowed). The commonly used modes of transportation to carry injured patients from the scene to the preferred facility were indicated as taxi, motorcycle, private car and ambulance in 55 (69%),

50 (63%), 25 (31%) and 22 (28%), respectively. VHVs were trained for trauma first aid only in 16 (20%); other community members were trained for trauma first aid only in 13 (16%). VHVs usually brought injured patients to HCs: 69 (86%) answered that VHVs always/sometimes accompany injured patients to HCs. But VHVs did not always provide written forms: 35 (44%) answered that VHVs never sent a referral form whereas 38 (48%) answered they always/sometimes did. Traditional healers rarely referred injured patients to HCs: 57 (71%) answered they never referred injured patients to HCs, 16 (20%) answered they rarely did, and 7 (9%) answered they sometimes did. Traditional healers' use of a referral form was quite rare: 21 out of 22 HCs that had received patients from traditional healers had never received referral forms.

Discussion

This study, using nationally representative samples of health facilities, indicated that formal and informal referral systems exist in Cambodia. Formal systems were not fully functioning (e.g. underutilization of ambulances), and informal systems (e.g. community volunteers and traditional healers) were frequently involved but were not fully integrated into the referral network.

Referral from the community

Since a patient's referral route starts at the scene of injury, streamlining the referral system should start in the community by mobilizing local resources. As shown in this study, VHVs were not fully mobilized and traditional healers were practically outside the referral network, despite their potential as first responders. Training of community people as first responder groups is promising (Mock *et al.* 2002; Husm *et al.* 2003), and integration of traditional healers into the network may benefit the community because of a preference for them and their accessibility (Nakahara *et al.* 2008). There are some attempts in Cambodia to formally involve VHVs and traditional healers in the referral network, but this has not yet succeeded (Daily 2005).

Transportation

Frequent use of non-ambulance vehicles to carry patients suggests insufficient functioning of the formal ambulance system. Establishment of a formal ambulance system, although it is the long-term goal, is not realistic in the short term because of limited resources (Mock *et al.* 2002). Rather, an innovative system needs to be devised, mobilizing local resources, as an interim system while awaiting implementation of the final scheme, or even as a formal system different from Western models (Van Rooyen *et al.* 1999). Examples of such attempts include pilot projects in African countries (Krasovec 2004; Kobusingye *et al.* 2005; Murray and Pearson 2006). For example, in Nigeria, commercial vehicle drivers and private vehicle owners were voluntarily enlisted to respond to emergency obstetric cases with the establishment of community funds to support transportation costs (Essien *et al.* 1997; Shehu *et al.* 1997). In similar projects in Tanzania, various transportation choices including a boat system were adopted (Schmid *et al.* 2001), while in Ghana, commercial drivers were trained in first aid of injured people (Mock *et al.* 2002).

In many of these projects, community people themselves identified problems and solutions using existing resources. These participatory problem-solving processes could empower communities and strengthen the ownership and sustainability of projects. In addition, community people with local knowledge can make a choice of the appropriate mode of transportation within the local context of geography, economics, preference and culture; and they can modify the system following situational changes that may occur over time (Schmid *et al.* 2001). The present study also indicated the possible influence of preference on transport choice: motorcycles, commonly used by trauma patients, were less preferred by obstetric patients.

One RH restricted the use of its ambulance to emergency obstetric cases, but it is more efficient to expand the existing system to cover other conditions rather than establishing new, separate systems for different conditions (Razzak and Kellermann 2002; Joshipura *et al.* 2004; Kobusingye *et al.* 2005; Smith and Haile-Mariam 2005; Murray and Pearson 2006; Nakahara *et al.* 2008). An emergency obstetric transport system based on commercial vehicles in Nigeria was also used for the benefit of male and paediatric patients (Shehu *et al.* 1997).

Mode of transportation, distance and road conditions determine transfer time, which matters most for urgent severe cases. A median distance of 25 km between HC and RH would necessitate 20–30 minutes by car or 40–50 minutes by motor-bi/tricycle, on paved roads such as national roads; and 50–60 minutes or 90–100 minutes, respectively, on non-paved bumpy local roads, to which most HCs in rural areas have access. Improvement of local road conditions has to await economic development. Although RHs usually have ready access to a paved national road, when severe cases are transferred to Phnom Penh or even abroad, it takes a long time because of the great distance, e.g. from Ratanakili RH to Phnom Penh (600 km) it takes around 10 hours by car via national roads. To minimize such transfers requires improvement of care at RHs and the establishment of regional trauma centres.

Transportation costs, even of a public ambulance service, can deter care-seeking and cause a poverty trap, especially in remote areas. As shown in our results, ambulances covering longer distances charged patients to recover the cost of fuel and maintenance whereas free ambulances only covered short distances; the pay-ambulance cost less than a taxi but more than a motor-bi/tricycle. When injured patients are referred to a national hospital in Phnom Penh from remote areas, the travel cost for the long distance, even by ambulance, would easily exceed their monthly income (International Monetary Fund 2003; Cambodia Development Resource Institute 2007).

Risk-sharing schemes in the communities to cover transportation costs as well as treatment costs could reduce the referral delay and economic burden among the poor. Community-based risk-sharing schemes, especially for obstetric emergencies, have been tested in many countries (Essien *et al.* 1997; Fofana *et al.* 1997; Pearson and Shoo 2005; Hossain and Ross 2006; Rana *et al.* 2007; Richard *et al.* 2007). Health Equity Funds that cover travel costs are promising in achieving more equitable access to medical care among the poor (Jacobs and Price 2006;

Noirhomme *et al.* 2007). However, they have not yet spread across the whole country and some funds do not actually cover travel costs.

Communication

This survey also revealed insufficient communication between facilities, although referred patients are almost always given a formal form when receiving a referral letter. Previous studies also indicated inconsistent provision of referral and feedback letters in Cambodia and other LMICs (Nordberg *et al.* 1996; Ohara *et al.* 1998; Atkinson *et al.* 1999; Daily 2005). The lack of benefit in having a referral letter, such as fast-tracking and a discounted fee at the receiving hospitals, and a lack of feedback, may discourage referring staff from supplying a letter (Nordberg *et al.* 1996). Although the majority of the surveyed RHs offered such benefits, they might not have functioned satisfactorily or been well known, or patients may not have sought a letter from unfriendly HC staff, a possibility which is beyond the scope of this study and requires further investigation.

Communication before transfer was inconsistent, although most of the facilities were equipped with a cell phone or radio, reflecting rapid expansion of the cell phone network worldwide (Krasovec 2004). It is likely that personal relations dictated the consistency of communication rather than a problem with communication devices. The bidirectional nature of communication was evident: HCs frequently contacting an RH before patient transfer were likely to receive feedback. The frequency of communication between HCs and RHs was higher than that between RHs and higher-level facilities, probably reflecting a situation where HC staff have regular meetings with RH staff whereas RH staff seldom meet staff of national hospitals. HC staff training at RHs or RH staff training at national hospitals may strengthen personal relations between the facilities as well as improve knowledge and skills.

Better communication at the time of referral may facilitate smooth referral and quality of care. Upward information transfer can reduce treatment delays allowing fast-tracking and smooth exchange of patients' information; in particular, communication before patient transfer can allow the receiving facility time for preparation to receive the patient (Mock *et al.* 2004). Downward information transfer can also contribute to system improvement. Feedback informs the staff of referring facilities of the results and appropriateness of their management, which could facilitate their learning (Ohara *et al.* 1998). Communication before transfer allows the referring facilities to obtain advice for stabilizing the patient. HC staff received such advice from a higher level less frequently than RH staff. This may be because of poor resources at HCs (Nakahara *et al.* 2009), and without minimum essential resources even for basic care, such advice would be useless.

Guidelines

At the HC level, written referral guidelines for injured patients were not well prepared whereas most of the facilities had EmOC guidelines. As IMCI projects have indicated, guidelines with appropriate training can improve the performance of health staff (Bryce *et al.* 2005; Molyneux *et al.* 2006). Simplified algorithms for trauma treatment and referral decision-making would improve trauma care quality at the HC level by filling the gap unaddressed by the existing guidelines. Guidelines for EsTC do not include such an algorithm (Mock *et al.* 2004). The Acute Care Module of Integrated Management of Adolescent and Adult Illness (IMAI), although focusing on HIV/AIDS care, covers emergency care for most adult illnesses with algorithms (World Health Organization 2005), but does not address trauma care.

Limitations

Several limitations of this study should be noted. First, we did not examine the actual patient flow. Therefore we did not have information on frequencies of transfer by each mode or of communications. The data provided rough estimates that depended on the respondents' subjective judgments and on relative comparisons between modes. Estimated average transportation costs, if not accurate, may not differ considerably from the actual cost given the fixed distance between facilities. The regression analysis showed a strong association between cost and distance, supporting this inference.

Second, since this study used telephone interviews, face-to-face interviews or mailed questionnaires, we could not obtain detailed information on some aspects. For example, we could not examine the contents of the written protocols or referral letters. We believe we minimized bias resulting from the various methods of collecting data from HCs by assuring that the questions asked were the same. Furthermore, since the response rate was 100%, we could avoid bias due to the non-response that mailing methods tend to produce. We cannot deny the possibility of desirability bias particularly with respect to communication at the time of referral, in which a referral letter is stipulated in the current guidelines set by the Ministry of Health. However, such bias did not distort the results since responses from HCs and RHs were consistent regarding the frequency of communications.

Third, this study did not include private clinics, which also should be integrated into the referral network. Since private facilities often pay higher incentives for patient referral and are keen to have better communication with referring facilities than public facilities, they attract referral from traditional healers or even from HCs. Therefore, further studies are needed to draw the whole picture of the emergency referral system in Cambodia by shedding light on referral between private facilities and public facilities or traditional healers.

Policy implications

Streamlining referral of injured patients in Cambodia as well as in other LMICs without a well-functioning, formal system requires prior organization of each component of the referral mechanisms by strengthening the existing system and mobilizing local resources. This will allow such countries to develop a proper system at reasonable cost, although the system may differ from Western models. Improvement of care at each level of health facility, including establishment of regional trauma centres, is also necessary. These measures would minimize referral delay by promptly arranging referral and reducing referral distance.

To this end, it is preferable to have standard guidelines, such as IMCI guidelines, describing the mobilization of local

resources to organize referral mechanisms. These would help LMICs to develop context-specific guidelines and strengthen their referral system along with appropriate training. Such guidelines would fill the gap that the previously published international guidelines did not fully address. The Guidelines for EsTC briefly touch on referral mechanisms and the IMCI guidelines regard transportation and communication as contextual factors that the programme cannot manage (Victora *et al.* 2005).

A vertical intervention to strengthen the referral system and target injured patients can be expanded to cover other conditions. In addition, each vertical intervention on emergency care has its weaknesses and strengths. Therefore, we can integrate existing systems to provide more general and efficient emergency care systems, which would strengthen the health care system as a whole.

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