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Characteristics and Outcomes of Women Utilizing EMS for Pregnancy-Related Complaints in India: A Prospective Observational Study

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Abstract

Objectives Characterize the demographics, management, and outcomes of obstetric patients transported by emergency medical services (EMS).

Design Prospective observational study.

Setting Five Indian states utilizing a centralized EMS agency that transported 3.1 million pregnant women in 2014.

Participants This study enrolled a convenience sample of 1684 women in third trimester of pregnancy calling with a “pregnancy-related” complaint for free-of-charge ambulance transport. Calls were deemed “pregnancy related” if categorized by EMS dispatchers as “pregnancy”, “childbirth”, “miscarriage”, or “labor pains”. Interfacility transfers, patients absent upon ambulance arrival, and patients refusing care were excluded.

Main outcome measures Emergency medical technician (EMT) interventions, method of delivery, and death

Results The median age enrolled was 23 years (IQR 21-25). Women were primarily from rural/tribal areas (1550/1684 (92.0%)) and lower economic strata (1177/1684 (69.9%)). Time from initial call to hospital arrival was longer for rural/tribal compared to urban patients (66 min (IQR 51-84) vs 56 min (IQR 42-73), respectively, p<0.0001). EMTs assisted delivery in 44 women, delivering the placenta in 33/44 (75%), performing transabdominal uterine massage in 29/33 (87.9%), and administering oxytocin in none (0%). There were 1411 recorded deliveries. Most women delivered at a hospital (1212/1411 (85.9%)), however 126/1411 (8.9%) delivered at home following hospital discharge. Response rates at 48 hours, 7 days, and 42 days were 95.0%, 94.4%, and 94.4%, respectively. Four women died, all within 48 hours. The cesarean section rate was 8.2% (116/1411). On multivariate regression analysis, women transported to private hospitals versus government primary health centers were less likely to deliver by cesarean section (odds ratio 0.14 (0.05 to 0.43))

Conclusions
Pregnant women from vulnerable Indian populations frequently use free-of-charge EMS for impending delivery, making it integral to the health care system. Future research and health system planning should focus on strengthening and expanding EMS as a component of EmONC.

What this paper adds

What is already known on this topic

Increased facility-based childbirths with a skilled birth attendant is key to decreasing delivery complications and maternal mortality.

Timely transport for women in labor to emergency obstetric care remains a major barrier in many developing nations.

What this study adds

In India, pregnant women, including those of low socioeconomic status and rural areas, are commonly using a free of charge EMS system to deliver at facilities.

EMTs regularly assist in prehospital deliveries and perform basic assessment and management.

EMS in India is able to consistently transport women within the internationally recommended two hours to emergency obstetric care, even from rural settings.

Strengths and limitations of this study

- This study is a novel, prospective assessment of obstetric patients calling for emergency medical services across 5 states in India.
- Data was collected real-time and 42-day follow up rates were excellent (94.1%)
- Generalizability may be limited as it was a convenience sample during daytime hours.
- Limited data on in-hospital management was collected.

Introduction

As the global health community's priorities transition from the United Nation's Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs), improving access to quality maternal care remains a top priority.(1)(2) SDG 3.1 specifies a new global maternal mortality ratio (MMR) target of less than 70 per 100,000 live births by 2030. To accomplish this goal, the World Health Organization's (WHO) Global Strategy for Women's, Children's, and Adolescents' Health (2016-2030) identifies facility-based childbirth with a skilled birth attendant and comprehensive emergency obstetric care as essential, evidenced-based interventions. The impact of these interventions, however, is critically limited by inequities in access to care.(3)(4) Yet to date, programs aimed at improving access by decreasing barriers to transport, often fail to reach the most vulnerable populations and have been unable to demonstrate a consistent reduction in maternal deaths.(5)

In India, the Janani Express Yojana (JEY) transport program was created to improve access to timely obstetric care. To do so, JEY worked with the Janani Suraksha Yojana (JSY) program, which incentivizes women by providing conditional cash transfers to deliver at facilities. In the state of Madhya Pradesh, the JEY program achieved moderate penetration with 35% of pregnant patients utilizing their transport services. However, patients encountered frequent delays when transported by JEY vehicles.(6) Their two-hour average transport time was comparable to patients that utilized public transport, with over 50% of patients taking longer than four hours to arrive at a facility.(6) GVK Emergency Management and Research Institute (GVK EMRI) is a public-private partnership that also provides free ambulance transport along with prehospital stabilization care, and can be easily accessed using a toll-free phone number (108). In some states, they provide a separate parallel service (102) for routine pregnancy-related transport, including delivery. Call management, dispatch, and on-line medical direction are provided by a centralized, state-level, emergency call center that supports a fleet of ambulances, strategically distributed to optimize response times. Obstetric emergencies are the most common reason to call GVK EMRI for assistance, with an estimated 3.1 million transports for pregnancy-related complaints in 2014.(7)

Despite the extensive use of ambulance transport services for obstetric indications in India, the critical role of prehospital care providers in managing obstetric patients often goes under-recognized by national and international agencies. For example, prehospital care providers are not mentioned in the Every Women Every Child Global Strategy 2.0.(3) Emergency medical services (EMS) systems and prehospital care providers have the potential to significantly improve the outcomes of obstetric patients through timely prehospital medical interventions and transport to facility-based care.(8) Yet, to date, limited research exists describing their obstetric patients, the care provided, or patient outcomes.(9)(10) Our study seeks to characterize the demographics, management, and outcomes of obstetric patients transported and treated by GVK EMRI.

Methods

We conducted a prospective observational study of patients calling 108 for pregnancy-related complaints across five states in India – Andhra Pradesh, Assam, Gujarat, Karnataka, and Meghalaya. Launched in 2005, GVK EMRI covers the entirety of 17 states and union territories, providing free-of-charge ambulance transport and emergency care to over 750 million people in India (Figure 1). The vast majority of ambulances are staffed by a driver and a single emergency medical technician (EMT). EMTs are trained to provide basic emergency obstetric care and resuscitation. They are empowered to administer life-saving medications such as oxytocin and magnesium, under the oversight of real-time, physician-guided medical direction and via standard care protocols (Supplement 1). Following initial assessment and treatment, ambulances transport patients to the nearest hospital, unless otherwise requested by the patient or her family.

We enrolled a convenience sample of patients for a defined six-week period from February 17 through April 10, 2014. Patients were enrolled Monday through Saturday, during daytime hours for six hours per day. Any woman in her third trimester of pregnancy who called 108 for a pregnancy-related complaint was eligible for enrollment. A call was considered "pregnancy-related" if it was categorized by the EMS dispatch officer as a call for "pregnancy", "childbirth", "miscarriage", or "labor pains". Exclusion criteria included calls for interfacility transfers, patients who were absent upon EMT arrival, and patients who refused care services. At initial enrollment, trained research assistants used a standardized questionnaire to collect data in real-time by phone from the EMTs caring for patients. Data included patient demographics, prior and current obstetric history, and physical exam findings. After EMTs completed patient transport, research assistants re-contacted EMTs by phone to collect additional information such as EMT interventions at the scene and en route. At the time of initial enrollment, two phone numbers were obtained, the patient's and a friend's or relative's, to limit the number lost in follow-up.

Patients who did not deliver prior to hospital arrival or en route were followed up by phone at 48 hours and 7 days. If they did not deliver by 7 days, they were excluded from further analysis. All patients who delivered, prior to EMT arrival through 7 days after the dispatch call, were followed up by phone at 48 hours, 7 days, and 42 days postpartum. Patients were verbally consented by EMTs for treatment, data collection, and follow-up at the time of enrollment. The study was approved by the Institutional Review Board at Stanford University (IRB#18185) and the Ethics and Research Committee at GVK EMRI. Per GVK EMRI's standard operating procedures participants provided verbal consent for care, transport, and follow-up at the time of enrollment. The study was funded jointly by Stanford University and GVK EMRI.

The study's primary outcomes were EMT interventions, location of delivery, cesarean section, and death. Demographics, obstetric history, and care characteristics were compared using chi-square analysis for categorical variables (or Fischer's exact test

when appropriate) and Wilcoxon two sample test for continuous variables to identify univariate predictors of cesarean section. Multivariate logistic regression analysis was used to determine predictors of cesarean section based upon significance in the univariate analysis. A p-value less than 0.05 was considered significant. All data analysis was conducted via SAS Enterprise Guide for Windows, version 4.3 (SAS Institute Inc., Cary, USA). Odds ratios (OR) and 95% confidence intervals (CI) are reported for all model variables.

Results

We enrolled 1684 women, approximately 1.7% of all pregnancy-related calls to 108 across the five states during the study period (Table 1). The median age of women in this study was 23 years (IQR 21-25), with few women less than 18 (0.01%) or older than 34 (1.8%). Women were largely from rural or tribal areas (92.1%) and overall transport times were significantly longer from both tribal and rural areas compared to urban areas ($p < 0.0001$) (Table 2). However, only 5.5% of transports took greater than two hours, with none lasting longer than three hours.

Almost half of all women had attended at least four antenatal care visits, as recommended by the WHO. By self-report, few current or prior pregnancies were complicated by anemia or hypertension. While almost all women presented with contractions (96.7%), only 29.3% of women had rupture of membranes prior to EMT arrival (Table 3). EMTs consistently measured basic vitals, and properly positioned mothers in the left lateral position en route. Twenty-four women presented with signs of severe preeclampsia, defined as systolic blood pressure >160 mmHg or diastolic blood pressure > 110 mmHg, or eclampsia, defined by an EMT witnessed seizure. Only one of these women (4.5%) received magnesium as indicated by standard GVK EMRI protocol.

Of enrollees, 1411 mothers delivered during the study period, including 80 delivering in the prehospital setting, of which 36 delivered prior to arrival of the EMT and an additional 44 delivered on scene or during transport to the hospital (Table 3). Of these 44 EMT-assisted deliveries, EMTs regularly delivered the placenta and provided transabdominal uterine massage. In only 1.3% of all prehospital deliveries, including both deliveries prior to EMT arrival and EMT assisted, did the EMT administer oxytocin. In that case, it was given to a woman with postpartum hemorrhage. However, there were no incidents of documented severe postpartum hemorrhage, defined by one liter or more of estimate blood loss.

Response rates at 48 hours, 7 days, and 42 days were 95.0%, 94.4%, and of delivered mothers 94.1% respectively. In total, only four women died during this study, and all died within 48 hours after arrival at the hospital. One of these women presented with eclampsia, but the final etiology of their deaths is unknown. Eighty-seven women were lost to follow-up prior to delivery (5.2%), 83 additional women who did deliver were subsequently lost to follow-up (4.9%) and 186 did not deliver by 7 days (11%). Most

women delivered at a hospital (85.9%), and those were overwhelmingly at government hospitals (82.9%). There were 154 deliveries (10.9%) that occurred at home, and 81.8% of these occurred after being discharged from the hospital to which EMTs had originally transported women.

The overall rate of cesarean section was 8.2%. The states of Karnataka and Meghalaya each had only one woman deliver by cesarean section, and therefore, these states were not included in univariate and multivariate regression analysis predicting cesarean section. State, hospital type (private versus government), hospital level (e.g. primary versus tertiary), and first pregnancy were significantly correlated with cesarean section on univariate analysis ($p < 0.001$).

Multivariate logistic regression analysis identified several factors that significantly impacted the likelihood of cesarean section ($n = 791$; c-statistic 0.75) (Table 4). Women who were initially transported to a tertiary care center, such as a medical college, were significantly less likely to deliver by cesarean section than those initially taken to primary care centers (odds ratio 0.18 (95% confidence interval 0.08 to 0.41)). Similarly, women initially transported to a private hospital rather than a government primary care center were significantly less likely to deliver by cesarean section (0.14 (0.05 to 0.43)). In contrast, women with a history of a previous cesarean section or who were nulliparous were more likely to deliver by cesarean section (3.28 (1.37 to 7.82) and 3.38(1.89-6.05), respectively).

Discussion

This is the first prospective study to evaluate the characteristics and outcomes of obstetric patients transported by the world's largest EMS organization, GVK EMRI. Our study enrolled patients from one third of the states in which GVK EMRI operates, providing evidence of vast the potential of a centralized EMS to reach vulnerable women during the third trimester and childbirth.

Providing Timely Care for Vulnerable Populations

Leveraging existing EMS resources, such as dispatch center, ambulances, and care providers, increases the capacity to reach vulnerable women during childbirth and decreases time to facility-based obstetric care. Our findings demonstrate that women from vulnerable populations were able to access emergency obstetric services by phone, either directly or through a friend or relative. Of the women transported, less than 40% had a secondary level education, and 70% were dependent on the low-income government health insurance program (white ration card). Using self-identified caste as a proxy of social status, we also found that almost 80% of patients were from lower social strata. Moreover, with a median call-to-facility arrival time of 65 minutes (IQR 50-84), this overwhelmingly rural population was connected quickly to facility-base care. This is in accordance with the World Health Organization (WHO) and the United Nations Population Fund (UNFPA) recommendations that laboring women have access to EmONC facilities within two hours. Longer times have been associated with worse

outcomes including higher maternal mortality.(11)(12) However, one population was not well represented in our sample: women less than 18 years old. Only one patient (0.01%) enrolled in our study was less than 18. This is much lower than expected given that 2.5% of all women enrolled, and 22% of women nationally, report having their first pregnancy before age 18.(13) The reason for this unexpectedly low percentage may be that women less than 18 years have restricted autonomy and/or lower health literacy than older women. Further investigation is needed.

Providing Appropriate Care for Prehospital Deliveries

In advance of assessing and treating pregnant patients, over 99% of GVK EMRI's EMTs have undergone Basic Life Support in Obstetrics (BLSO®) training in addition to their initial EMT B training (ranging from 6 weeks previously to 10 weeks (450 hours) currently). Appropriate practices such as obtaining maternal vital signs and placing the patient in the left lateral decubitus position were performed in almost all patients. Of our study patients, EMTs assisted in the delivery of 44 (3.1%) patients. Of these, the placenta was delivered in 75% of patients and most patients received transabdominal uterine massage. Active management of the third stage of labor (AMSTL) is within GVK EMRI's EMTs' scope of practice and is highlighted in their emergency care protocols. Despite this, not a single patient received oxytocin following delivery, the key component of AMSTL.(14) In fact, for the cohort of prehospital deliveries, 95% of EMTs reported that administration was not indicated. The rationale for this misconception, despite access to standard protocols and contact with call center physicians for real-time medical direction, is likely multi-factorial. Possible explanations include a lack of provider comfort with oxytocin administration and the overall protocol, or an environment where physicians may not be supportive of EMTs providing oxytocin. Further, there are additional opportunities to improve the quality of emergency obstetric and newborn care (EmONC) beyond AMSTL. Only one patient with postpartum hemorrhage received oxytocin, and no patients with eclampsia or severe preeclampsia received magnesium. GVK EMRI has already begun responding to these quality gaps by conducting EmONC refresher programs for practicing EMTs. Further focused efforts at the institutional, development partner, and government levels will likely be needed. Potential solutions include multi-agency, multi-specialty quality improvement efforts that bring together key stakeholders from healthcare facilities, government, and prehospital providers. Together, these groups can collectively problem solve and elucidate regional standards of care, including scope of practice for EMTs, continuing medical education, and standardized certification.

Improving Facility-Based Deliveries

In this study, women recognized the appropriate time frame to come to a facility for a delivery. The vast majority of women (93%) delivered within approximately 48 hours of the original dispatch call. A significant number of patients transported to hospitals who were subsequently discharged delivered within the next two days at home, constituting 7.2% of all deliveries. Perhaps most striking is that 82% of these post-discharge home deliveries occurred the day of transport. This may be an opportunity for facility-based

quality improvement regarding the detection of early labor and patient discharge education, or system-based interventions such as maternity waiting homes.(15)

The overall cesarean section rate of 8.2% was below the national average of 12.1% in India,(16) and the traditionally recommended rate by the WHO of 10-15%.(17) Prior reports have suggested that delivery in private facilities is associated with increased rates of cesarean delivery in India and other South Asian countries.(18) However, this did not hold true in rural India, where public facilities were found to have higher rates of cesarean delivery.(19) Our study is consistent with this latter finding. Cesarean section rates in private hospitals were 3.5% compared to 10.9% in public hospitals, with the highest rate in rural public hospitals (11.2%). Further, the increased likelihood of delivering by cesarean section if transported to a primary care center may be indicative of multiple different clinical scenarios. Future studies should examine interfacility transfers for obstetric emergencies to determine the need for obstetric emergency-specific referral protocols.

Limitations

Any conclusions regarding maternal mortality are limited as there were few maternal deaths in our sample. The estimated MMR for our study population is at least 280, but may be as high as 291, if all infants that died the day of birth are assumed to be stillborn. Without taking into account the known deep disparity between urban and rural MMR's,(20) the expected MMR would be 152,(21) weighted by a state's proportion of our sample size but not inclusive of Meghalaya, which has no available recent MMR. The generalizability of our findings is limited by a lack of data collection beyond daytime hours and the predominance of three of the five states in our sample. Lastly, two factors may limit the accuracy of our cesarean section rates: patients lost to follow-up and missing data. While our response rates were strong, we still lost 168 patients in follow-up and for 139 women we did not have the mode of delivery recorded. These women may have had different rates of cesarean section and/or complications, including death.

Conclusions

Pregnant women from vulnerable Indian populations – geographically isolated, low socioeconomic status – frequently use a free-of-charge ambulance service for impending delivery. EMTs regularly deliver women in the field and consistently perform basic assessment and management of pregnant patients, reaching women within the internationally recommended two hours of EmOC. Together, the ability to reach vulnerable populations, provide care, and connect women makes EMS an integral part of the health care system. We have identified several areas in need of quality improvement including AMSTL and the management of PPH, eclampsia and severe preeclampsia. Future research and health system planning should focus on how to strengthen and expand EMS as a critical component of emergency obstetric care services.

MS, EP, GR and SM contributed to the study design, implementation, data analysis, and manuscript production. EM, AE and LL contributed to study design and manuscript production. JN and CB contributed to data analysis and manuscript production. MS and SM accept full responsibility for the work and conduct of the study, had access to the data, and controlled the decision to publish. MS affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained. Special thanks to Anne Tecklenberg Strehlow for her assistance editing and Aruna Gimkala, Marada Lakshmana Rao, Royal Uddin Ahmed, Rupjoy Maibangsa, Rajini Danthala, Divya Patel, Steffy Christian, Chandrashekhraswami Kendadmath, Sahyadri Venkateshappa, Shylaja Muniyappa, and Isberth Tham for collecting data and ensuring data quality.

Full dataset available by request from the corresponding author at strehlow@stanford.edu. Consent was not obtained but the presented data are anonymised and risk of identification is low.

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that (1) no authors have support from any outside companies or organizations for the submitted work; (2) no authors have any relationships with any companies or organizations that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) no authors have any non-financial interests that may be relevant to the submitted work.

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Table 1. Characteristics of Women Transported by Emergency Medical Systems for Pregnancy-Related Complaints

Characteristics*			N (%)
All patients			1684
Age	Median (IQR)		23 (21-25)
	< 18 years		1 (0.1%)
	18-21 years		525 (31.2%)
	22-25 years		739 (43.9%)
	26-34 years		388 (23.0%)
	> 34 years		31 (1.8%)
Geographic location	Rural		1333 (79.2%)
	Urban		134 (8.0%)
	Tribal		217 (12.9%)
Economic status	Pink card		479 (28.4%)
	White card		1177 (69.9%)
Social status	Other Caste		343 (20.4%)
	Below Caste		608 (36.1%)
	Scheduled Caste		297 (17.6%)
	Scheduled Tribe		430 (25.5%)
Education	None		637 (37.8%)
	Primary		429 (25.5%)
	Secondary		428 (25.4%)
	Intermediate		90 (5.3%)
	Graduate		40 (2.4%)
Obstetric history			
Anemia			125 (7.4%)
Hypertension			42 (2.5%)
Antenatal care visits		0	108 (6.4%)
		1	142 (8.4%)
		2	235 (14.0%)
		3	384 (22.8%)
		4+	778 (46.2%)
Seen by physician during visit			1309 (77.7%)
Parity	Nulliparous		725 (43.1%)
	Multiparous		959 (56.9%)
Age at first pregnancy **	< 18 years		24 (2.5%)
	18-21 years		578 (60.3%)
	22-25 years		312 (32.5%)
	26-34 years		40 (4.2%)
	> 34 years		1 (0.1%)

Prior cesarean section**	Yes	89 (9.3%)
	No	865 (90.2%)
Years since prior pregnancy**	< 2 years	435 (45.4%)
	24-35 months	240 (25.0%)
	> 3 years	277 (28.9%)

*Values may not add up to 100% as most categories have missing data. All missing data was less than 6%.
**Of multiparous mothers only (N=959)

Table 2. Response and Transport Times for Women Transported by Emergency Medical Systems for Pregnancy-Related Complaints

Characteristic	Incident Location			
	All	Urban	Rural/Tribal	*p* value
Response time (min)				
Call to dispatch	3 (2-4)	3 (2-4)	3 (2-4)	0.55
Dispatch to scene	24 (16-35)	17 (11-28)	25 (16-35)	<0.0001
Time on scene	7(5-10)	9 (5-12)	7 (5-10)	0.076
Scene to hospital	26 (17-40)	22 (12-35)	26 (18-40)	0.005
Total time: call to hospital	65 (50-84)	56 (42-73)	66 (51-84)	<0.0001
Distance (km)	15 (9-23)	12 (6 -17)	15 (9-23)	<0.0001

* All values are median (IQR)

Table 3. Presentation and EMT Management of Women Transported by Emergency Medical Services for Pregnancy-Related Complaints

Patient Presentation and Management	N (%)
All patients	1684
Presentation	
Contractions	1628 (96.7%)
Rupture of membranes	493 (29.3%)
Severe preeclampsia	22 (1.3%)
Eclampsia	2 (0.1%)
EMT Actions	
Pulse, blood pressure, and respiratory rate measured	1633 (97.0%)
Placed in left lateral decubitus position	1610 (95.6%)
Deliveries Assisted by an EMT	44
Active management of third stage of labor*	
Placental delivery	33 (75%)
Oxytocin	0 (0%)
Uterine massage**	29 (87.9%)

*Of EMT assisted deliveries (N=44)
**Of patients whose placenta was delivered (N=33)

Table 4. Predictors of Cesearan Section, Multivariate Analysis

Characteristics	Odds Ratio (95% CI)
State	
Gujarat	ref
Andhra Pradesh	1.65 (0.86-3.17)
Assam	3.03 (1.54-5.93)
Age	1.13 (1.05-1.21)
Low economic status	0.95 (0.48-1.88)
Receiving hospital type	
Primary, government	ref
Secondary, government	0.45 (0.27-0.77)
Tertiary, government	0.18 (0.08-0.41)
Private	0.14 (0.05-0.43)
Other	0.21 (0.06-0.75)
Cesearean section history	
Multiparous, no prior	ref
Nulliparous	3.38 (1.89-6.05)
Multiparous, prior cesearean section	3.28 (1.37-7.82)
Twin gestation	1.88 (0.38-9.39)
Premature gestation	1.83 (0.96-3.5)

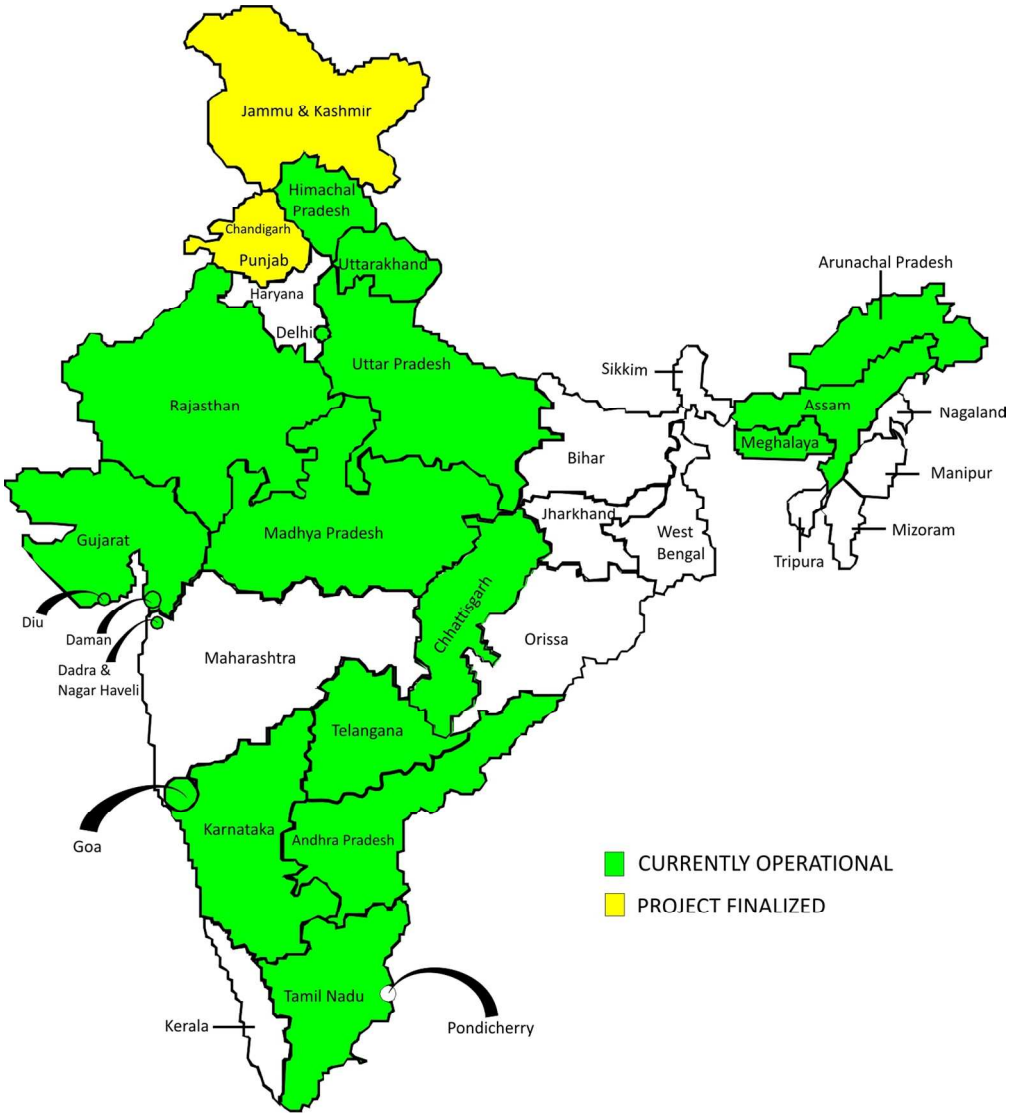


Figure 1: Map of India Showing Location of GVK EMRI Emergency Medical Services
199x220mm (200 x 200 DPI)

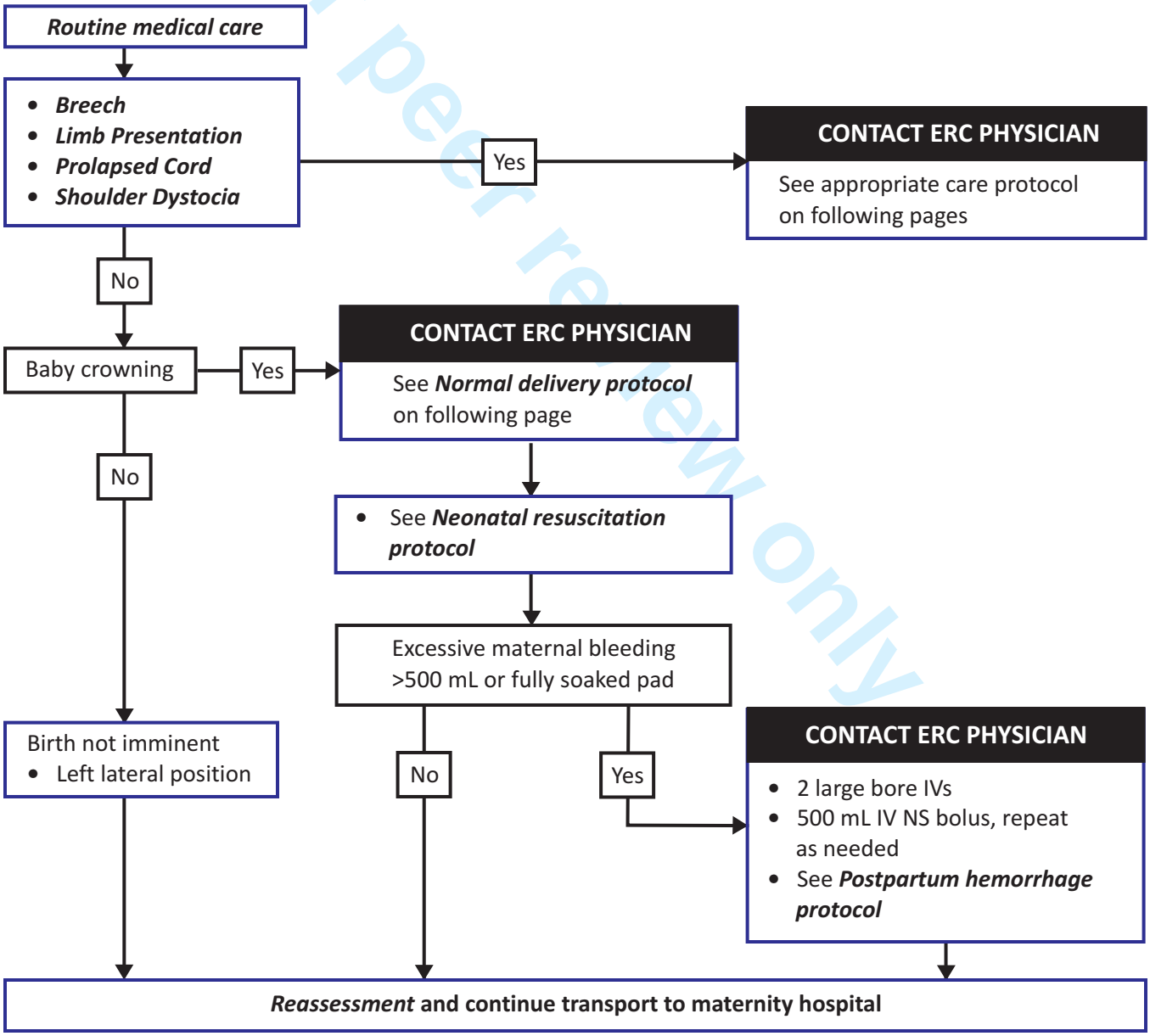
CHILDBIRTH (Uncomplicated/Complicated)

Key points

- Symptoms: Abdominal/back pain, vaginal bleeding/gush of fluid, minutes between contractions
- History of current pregnancy: Antepartum care, estimated gestational age, complications
- OB history: Number of pregnancies and c-sections, prior complications during pregnancy
- Physical exam: Inspecting external vaginal area for crowning/presenting part if patient feels like she wants to push or if she feels there is something protruding from her vagina
- *DO NOT* pull/push baby

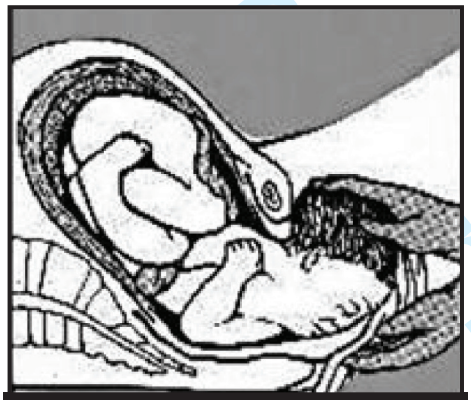
Serious signs and symptoms

- Part other than head presenting from vagina (arm, leg, umbilical cord)
- Excessive maternal bleeding
- Prolonged contractions (>6 contractions in 10 minutes or duration >2 minutes)
- Shortness of breath
- Altered mental status

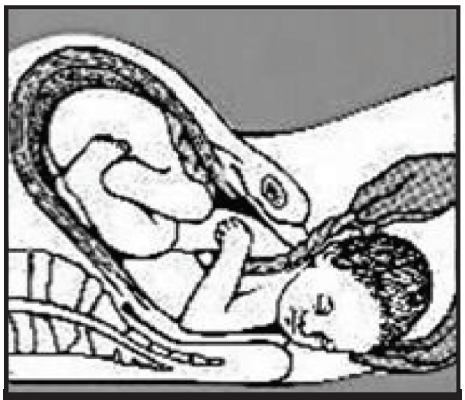


Normal Delivery

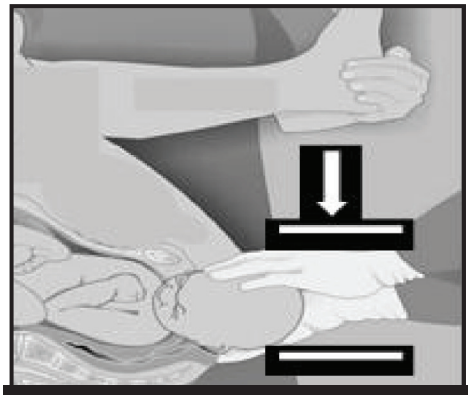
- Position patient
- Prepare OB kit
- As head delivers, suction with bulb syringe (only if not spontaneously breathing)
- Check for cord wrapped around neck
- If cord around neck, slip over shoulders/head of baby
  - If unable to unwrap cord, place umbilical clamps 5 cm apart and cut cord between clamps
- Support head, deliver body
- Place baby next to mother; dry baby and keep warm (see ***Neonatal resuscitation protocol***)
- See ***Post delivery care*** on last page



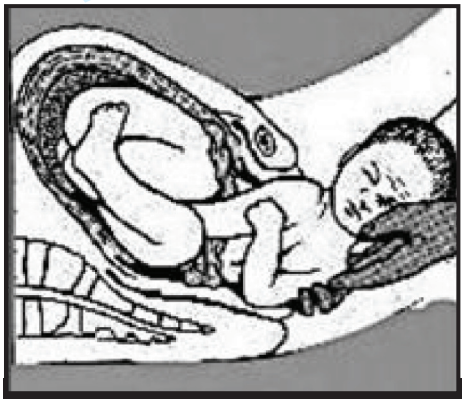
Step 1: Support head and let head turn to side to align with body



Step 2: Check for cord and slip over head if present



Step 3: Keeping hands parallel to floor, apply downward pressure to deliver shoulder



Step 4: Support body and place next to mother

Shoulder Dystocia

Definition

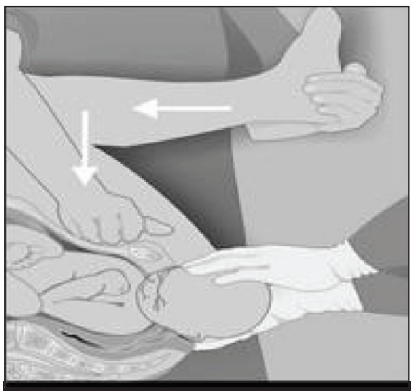
- Inability to deliver either shoulder within 60 seconds of delivery of head

Key points

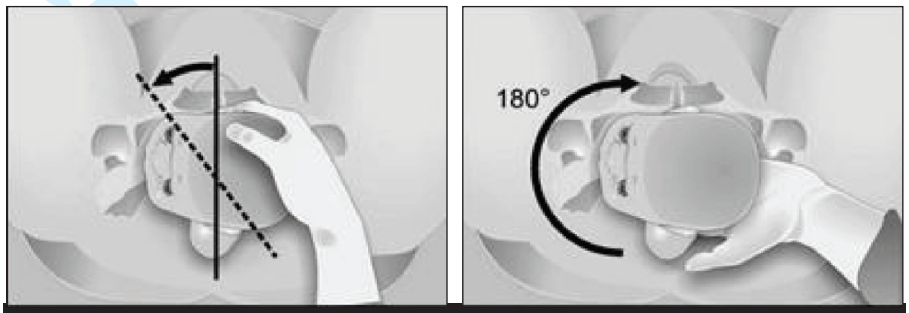
- Complications
  - Severe hypoxia, traumatic brachial plexus injuries and humerus/clavicle fractures
- *Turtle sign:* when fetal head moves back into the mother's perineum
- ***HELPERR (HeLP-R*** for BLSO provider denoted by *below) mnemonic can assist with recall of correct actions

Prehospital management options

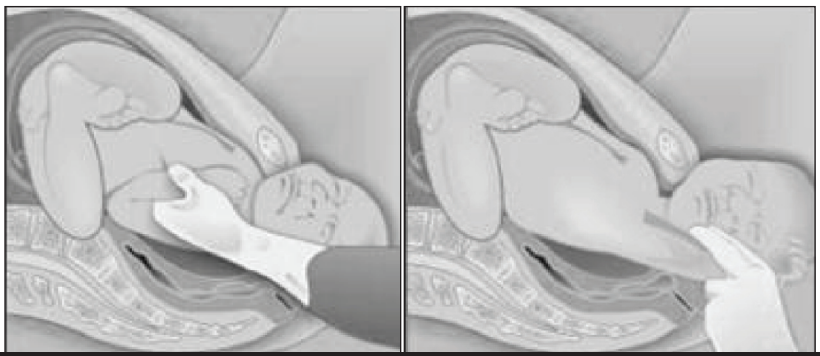
- H: Call for **H**elp*
- E: Consider **E**pisiotomy (only if additional space needed for hands to complete maneuvers below)
- L: Position **L**egs, pull knees to chest*
- P: Suprapubic **P**ressure (not fundal)*
- E: **E**nter vagina with hands to push on posterior aspect of anterior shoulder and other maneuvers
- R: **R**oll patient to knee to chest position, then deliver the posterior shoulder*
- R: **R**emove the arm, sweep posterior arm across chest



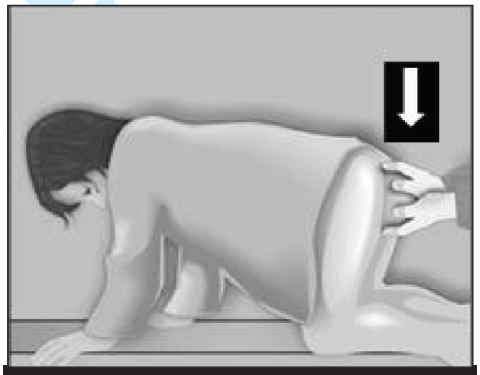
Legs: Pull knees up
Pressure: Push down in suprapubic area (not fundal)



Enter maneuvers:
1) Push anterior shoulder forward
2) Pressure: Push anterior shoulder backward and posterior shoulder forward



Remove posterior arm by bending at elbow and sweeping across chest and out



Roll on to knee chest position and deliver posterior shoulder first by gentle downward pressure on fetal head

Breech Presentation

Definition

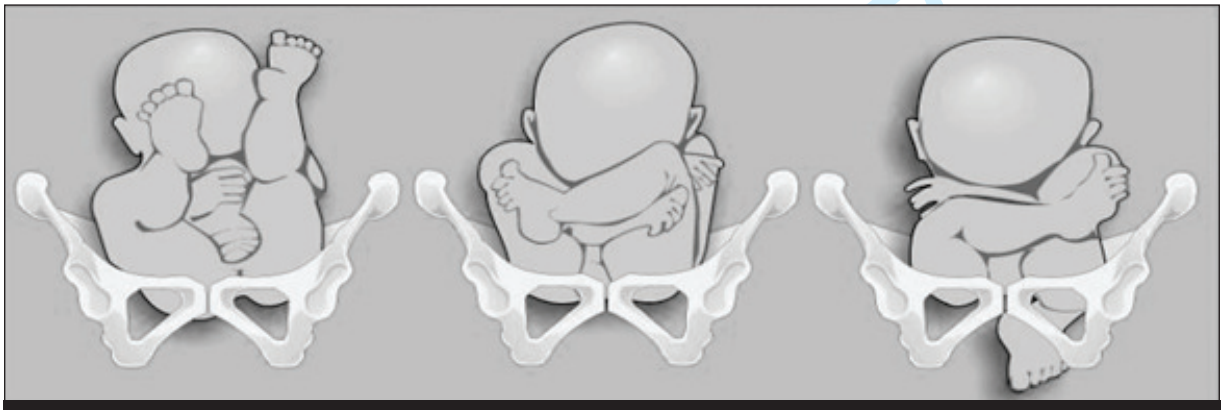
- When buttocks (or legs) deliver first

Key points

- Transport immediately
- *AVOID* delivery in ambulance if possible. Tell patient not to push.

Prehospital management options

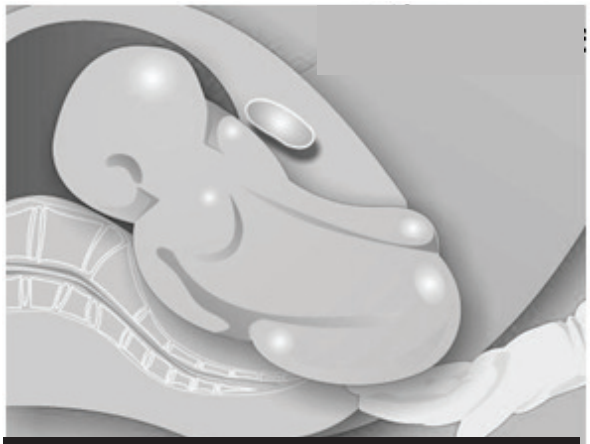
- Determine if buttocks or limb is presenting first
  - If limb (leg or arm) is presenting first, see ***Limb presentation*** section on the following page
- Delivery of breech presentation
  - Step 1
    - Support baby and allow delivery to proceed passively until base of umbilical cord is seen
    - *DO NOT* pull baby
  - Step 2
    - Grab the bony pelvis and femurs and apply gentle traction
    - *DO NOT* grab the abdomen as you may injure abdominal organs
  - Step 3
    - Once the wing-like scapulae are visible, rotate the fetus until a shoulder is anterior and deliver the arm. Rotate 180 degrees and deliver the other arm. Position the fetus so that the back is facing anteriorly.
  - Step 4
    - Anteriorly place a gloved middle finger on the fetus's occiput. The index and ring finger rest on the shoulders. Place a hand posteriorly sliding the index and middle finger into a V shape along the baby's face. Gently place pressure on the cheek bones.
    - Performing these maneuvers at the same time causes the fetal head to flex.
    - Additionally, one assistant can apply suprapubic pressure to help with flexion of the head. Another assistant can support the body.
  - See ***Post delivery care*** section on last page



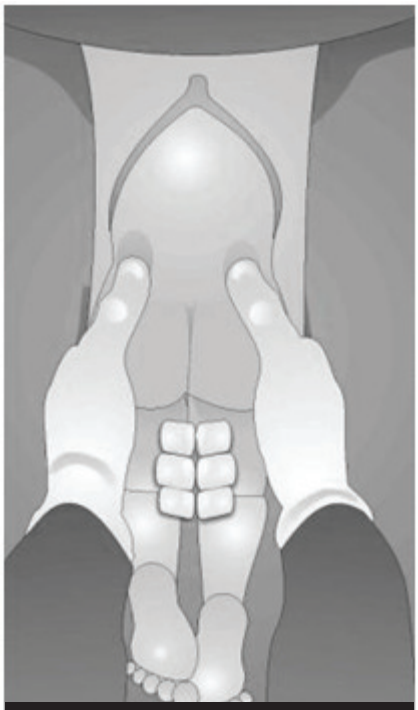
Frank breech Complete breech Footling breech

Presentation is the part of the fetus that is coming out of birth canal first

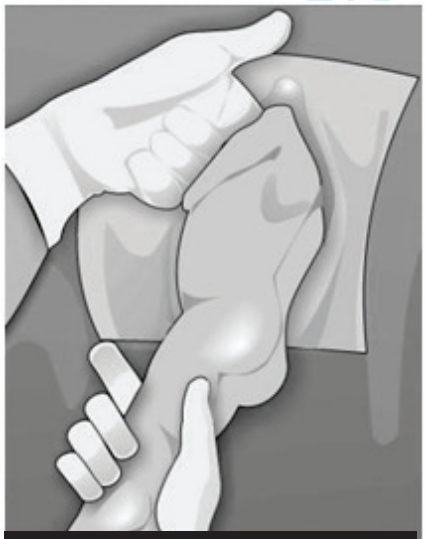
Delivery Steps for Breech Presentation



Step 1: Support the body



Step 2: Gentle traction on bony pelvis



Step 3: Rotate each shoulder anteriorly and deliver arms

Step 4: Flex the fetal head by placing the middle finger on the occiput and the other middle and index finger on the cheek bones

Cord Presentation (Prolapsed Cord)

Definition

- Umbilical cord presents/is seen before the head or other part of the baby

Key points

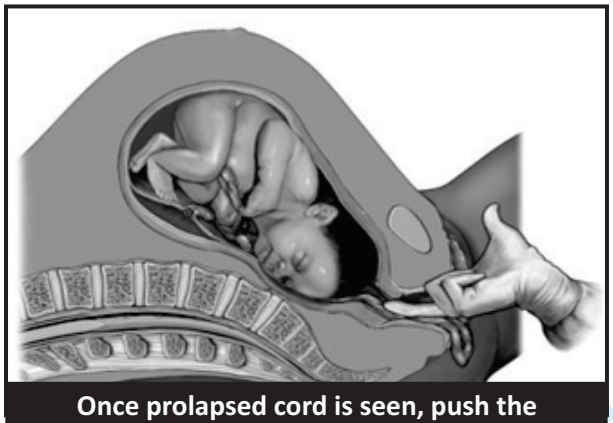
- If the umbilical cord is compressed, blood flow and oxygen don't reach the baby
- Transport immediately and try to avoid delivery in the ambulance
- Tell the patient *NOT* to push

Prehospital management options

- With two fingers of your gloved hand, gently push the presenting part of baby (not the cord) back up into the vagina until the presenting part no longer presses on the cord
  - *DO NOT* remove your hand (after elevating the presenting part of the baby) until arriving at the hospital and being relieved by other hospital personnel
- With your other hand, palpate the cord and feel the fetal HR. If <110 bpm, consider rolling the patient over and placing her in the *knee-chest position.* This may relieve pressure on the cord.

Prolonged transport or in hospital management options

- Place a Foley (urinary) catheter in the bladder and fill with 500 mL of NS. Clamp the Foley.
- Wrap the cord loosely with a moist, warm dressing



Once prolapsed cord is seen, push the presenting part (not the cord) gently back up

Knee chest position

Limb Presentation

Definition

- When one limb of the baby delivers first

Key points

- Nearly all of these patients will require delivery by caesarean-section
- Transport immediately. Avoid delivery in the ambulance if possible.
- Tell the patient *NOT* to push.

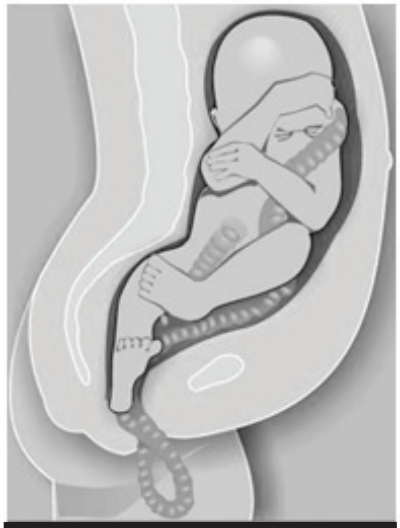
Prehospital management options

- Oxygen
- *DO NOT* attempt to deliver the baby
- *DO NOT* pull on the presenting limb
- *DO NOT* place your hand into the vagina unless there is a prolapsed cord (see ***Cord presentation*** section on previous page)

Multiple Births

Key points

- Usually both babies are born before the first placenta is delivered
- In order to prevent bleeding from the 2nd twin, carefully inspect the cord and apply a second clamp if leaking blood (oozing)
- Contractions usually restart within 5-10 minutes after the first baby is born; the second baby usually delivers within 30-45 minutes of the first baby



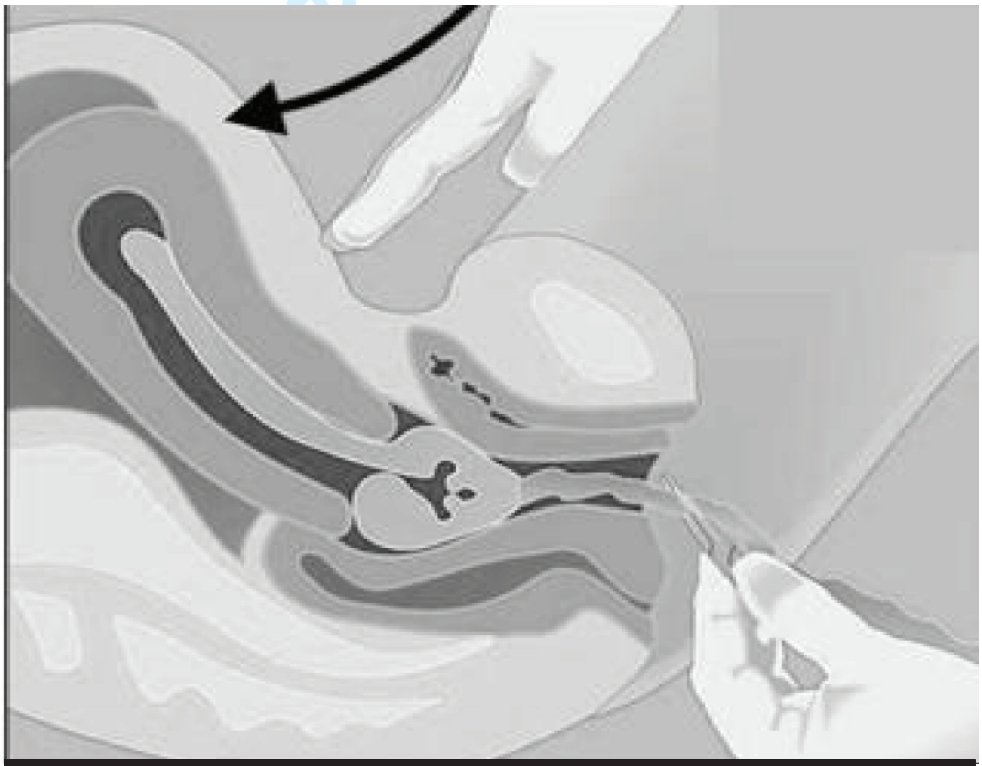
Limb presentation with prolapsed umbilical cord

Twin gestations may present with the fetuses lying in multiple positions

Post Delivery Care

Active management of 3rd stage of labor (following delivery of all fetuses)

- See ***Neonatal resuscitation protocol***
- **Oxytocin 10 Units IM** to mother immediately following delivery
  - Consider multiple fetuses and do not give until all babies are delivered
- Record time of birth
- Assess APGAR scores at 1 and 5 min after birth
- Wait until cord pulsations have stopped or 5 minutes have passed. Then, place two clamps on the cord at least 4-10 cm from the baby and cut between the clamps.
- Gently pull on the umbilical cord while providing suprapubic pressure (see below)
- Once the placenta delivers, place the placenta in a bag and give it to hospital staff
- Externally massage the uterus
- If significant ongoing bleeding or signs of maternal shock, see ***Postpartum hemorrhage protocol***



Placenta delivery: Gently pull on cord while applying pressure to suprapubic area

References

- Advanced Life Support in Obstetrics (ALSO) Provider Course Syllabus Fourth Edition, Copyright 2009, American Academy of Family Physicians

POSTPARTUM HEMORRHAGE (PPH)

Definition

- Greater than 500 mL of blood loss following delivery
- Severe PPH is >1000 mL of blood loss following delivery

Key points

- Most common cause of maternal death in developing nations
- Active management of the third stage of labor can prevent 60% of PPH
- Rapidly evaluate for and correct possible causes
- Uterine atony (soft, boggy uterus) is the most common cause of PPH

Serious signs and symptoms

- SBP <90
- HR >100
- Shortness of breath (RR >30)
- Altered mental status
- Cool or moist skin

Routine medical care

Active management of 3rd stage of labor

>500 mL of blood loss -*OR*-
Serious signs and symptoms

No

Yes

CONTACT ERC PHYSICIAN

- **Oxytocin 20 Units** in 500 mL NS (IV bolus over 20 minutes)
- 2nd IV as needed

Uterus firm

No

Yes

- Bimanual uterine massage
- Continue IV oxytocin infusion
- **Misoprostol 1000 mcg PR** *AND/OR* **Methylergonovine 0.2 mg IM** (do not give Methylergonovine if SBP >140 mmHg or known preeclampsia or chronic hypertension)

CONTACT ERC PHYSICIAN

- Perform vaginal exam for signs of uterine inversion, lacerations, and ongoing bleeding
- Consider appropriate treatment options

***Reassessment* and continue transport**

Active management of 3rd stage of labor

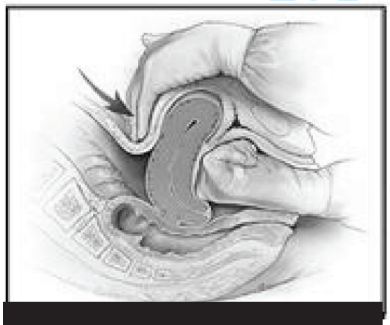
- Following delivery of all fetuses provide:
  - **Oxytocin 10 Units IM** to mother (immediately following delivery)
  - Gentle traction on umbilical cord while providing suprapubic pressure (see below)
  - External massage of uterus (see below)

ERC Physician

Key points

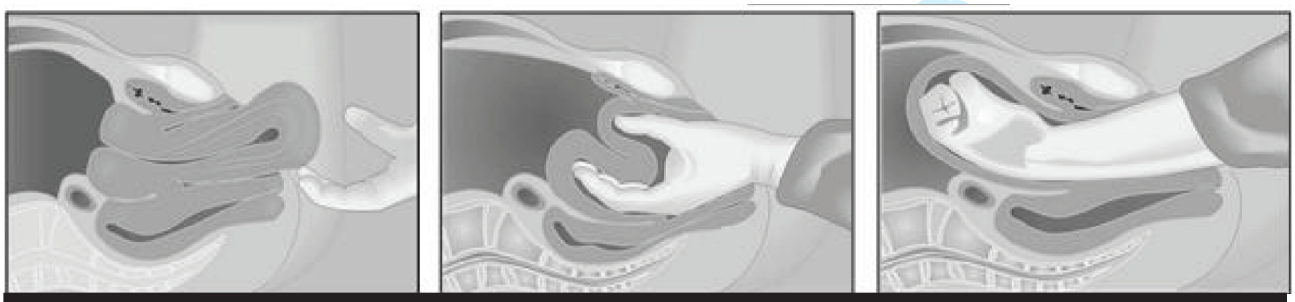
- Decisions on management options should be based on the expected time to hospital arrival

4 T's	Causes	Prehospital treatment
Tone	Decreased uterine tone	1. Uterine massage 2. Oxytocin 3. Misoprostol 4. Methylergonovine
Trauma	1. Cervical/perineal lacerations 2. Uterine inversion	1. Apply direct pressure 2. Restore uterus (see below)
Tissue	Placenta retained	Manual removal
Thrombin	Decreased clotting	Supportive measures



Bimanual uterine massage

Placental tissue removal



Inversion and restoration of uterus

References

- Advanced Life Support in Obstetrics (ALSO) Provider Course Syllabus Fourth Edition, Copyright 2009, American Academy of Family Physicians

PREECLAMPSIA/ECLAMPSIA

Key points

- Preeclampsia and eclampsia can occur from the 20th week of pregnancy until 6 weeks after delivery
- Preeclampsia is a BP >140/90 on >2 readings >6 hours apart *AND* significant protein in the urine
- Severe preeclampsia signs/symptoms include altered mental status, blurred vision and persistent headache
- Eclampsia is preeclampsia with seizures
- Obtain past medical history: medications, last menstrual period, gestational age (trimester)
- Magnesium toxicity manifests as loss of deep tendon reflexes and respiratory depression

Differential diagnosis

- Epilepsy
- Hypoglycemia
- Trauma/head injury
- Alcohol withdrawal
- Toxins/poisoning/overdose
- Chronic hypertension

Serious signs and symptoms

- Hypoxia/cyanosis
- Shortness of breath
- Seizures
- Altered mental status

Routine medical care

CONTACT ERC PHYSICIAN

- Place patient on left side if pregnant
- Oxygen by face mask
- IV access
- Seizure precautions

Seizure ongoing or recent seizure

Administer *BOTH:*

- **Magnesium sulfate 10 g IM** (5 g in each buttock)
- **Magnesium sulfate 4 g IV** over 10-15 min

- Check blood glucose (GRBS)
  - GBRS <80 mg/dL, see ***Hypoglycemia protocol***

- If SBP >160 -*OR*- DBP >110 mmHg, recheck BP in 10 min and **contact ERC physician**

No recent seizure history

- SBP >160 -*OR*- DBP >110 mmHg

Yes

- Recheck BP in 10 min and **contact ERC physician**

If SBP >160 -*OR*- DBP >110 mmHg, administer *BOTH*

- **Magnesium Sulfate 10 g IM** (5 g in each buttock)
- **Magnesium Sulfate 4 g IV** over 10-15 min

No

***Reassessment* and continue transport**

- Seizure precautions
- Shift to maternity hospital

ERC Physician

Key points

- The definitive treatment for eclampsia is delivery
- Magnesium should not be used to control hypertension
- Epigastric pain may be a sign of severe preeclampsia (also consider gallbladder disease)

Prehospital management options

- If repeat seizure occurs more than 10 minutes after the initial IV loading dose of magnesium, administer **Magnesium sulfate 2 g IV** over 10-15 minutes
- Respiratory depression may occur with magnesium toxicity
  - **Calcium gluconate 1 g IV** can be given for significant respiratory depression

Prolonged transport or in hospital management options

- If the patient continues to seize after repeat magnesium administration, consider **Midazolam 2-4 mg IV/IM**; may repeat x 1 for ongoing seizure
  - Alternate medications:
    - **Diazepam 5 mg IV/IM**; may repeat x 1 for ongoing seizure
- Antihypertensive medications
  - Treat persistent SBP >160 or DBP >110 mmHg (Goal: SBP <160 and DBP <110 mmHg)
    - **Nifedipine 20 mg PO** *(DO NOT* give sublingual)
      - **Nifedipine 10 mg PO** may be repeated every 30 min to a max of 40 mg
    - Alternate medications:
      - **Labetalol 10 mg IV**
        - If BP remains elevated above goal after 10 min, then administer **Labetalol 20 mg IV** every 10 minutes as needed to a max of 110 mg
      - **Labetalol 200 mg PO**
        - If BP remains elevated above goal after 30 min, then administer **Labetalol 200 mg PO** x 1 additional dose

How to mix and infuse Magnesium sulfate

- **Magnesium sulfate 4 g**: Mix 4 ampules of 50% $MgSO_4$ (1 g/ampule) in 100 mL NS
  - Infuse over 10 minutes, 100-150 drops per minute
- **Magnesium sulfate 2 g**: Mix 2 ampules of 50% $MgSO_4$ (1 g/ampule) in 100 mL NS
  - Infuse over 10 minutes, 100-150 drops per minute

Monitor the patients' vital signs, oxygen saturation, deep tendon reflexes, and level of consciousness every 15 minutes for the first hour, and every 30 minutes for the second hour.

Assess for signs of *magnesium toxicity* (e.g., visual changes, somnolence, flushing, muscle paralysis, loss of patellar reflexes) or pulmonary edema.

References

- Advanced Life Support in Obstetrics (ALSO) Provider Course Syllabus Fourth Edition, Copyright 2009, American Academy of Family Physicians

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

Note: *We have discussed whether this best fits under the cohort studies or cross sectional studies. Varying opinions exists within and outside our authorship group. We decided to use the cohort studies STROBE checklist. They are very similar and we hope either would have been considered appropriate.*

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract ▯ "Characteristics and Outcomes of Women Utilizing EMS for Pregnancy-Related Complaints in India: A Prospective Observational Study" <Page 1>
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found ▯ Please refer to abstract <Page 4>
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported ▯ Please refer to Introduction where we describe the importance of facility-based delivery with a skilled birth attendant to decrease the MMR and pregnancy related complications, the potential solutions that have been attempted in India, and the importance of studying the impact and reach of these solutions. <Page 6>
Objectives	3	State specific objectives, including any prespecified hypotheses ▯ "Our study seeks to characterize the demographics, management, and outcomes of obstetric patients transported and treated by GVK EMRI." <Page 6>
Methods		
Study design	4	Present key elements of study design early in the paper ▯ Please refer to paragraphs 1 and 2 of the Methods section. <Page 7>
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection ▯ Please refer to paragraphs 1, 2, and 3 of the Methods section. <Page 7>
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up. ▯ Please refer to paragraphs 2 and 3 of the Methods section. <Page 7>
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable ▯ Please refer to paragraph 4 of the Methods section. <Page 7>
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. ▯ Please refer to paragraphs 3 and 4 of the Methods section. <Page 7>
Bias	9	Describe any efforts to address potential sources of bias ▯ We acknowledged potential biases in the Limitations part of the Discussion section. <Page 11>
Study size	10	Explain how the study size was arrived at ▯ Extracted from paragraph 2 of the methods section. "We enrolled a convenience sample of patients for a defined six-week period from February 17 through April 10, 2014. Based on research assistant availability, patients were enrolled Monday through

		Saturday, during daytime hours for six hours per day." <Page 7>
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Please refer to paragraph 4 of the Methods section. <Page 7>
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Please refer to paragraph 4 of the Methods section. <Page 7>
		(*b*) Describe any methods used to examine subgroups and interactions Please refer to paragraph 4 of the Methods section. <Page 7>
		(*c*) Explain how missing data were addressed We do not report on any variables, other than mode of delivery, that had greater than 6% missing data. <Table 1, Page 15> 13.2% of patients who delivered did not have a recorded mode of delivery. Patients with a known mode of delivery were compared with those whose mode of delivery was not recorded. There were no significant differences demographically or by obstetric history between the two groups. <Table 4, Page 19>
		(*d*) If applicable, explain how loss to follow-up was addressed Rates of loss to follow-up were reported clearly in paragraph 4 of the Results section. <Page 8>
		(*e*) Describe any sensitivity analyses A sensitivity analysis was not applicable.
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Please refer to paragraphs 1, 4, and 6 of the Results section. <Page 8, 9>
		(b) Give reasons for non-participation at each stage Please refer to paragraphs 1, 4, and 6 of the Results section. <Page 8, 9>
		(c) Consider use of a flow diagram Enrolment was limited by data collector availability and the pre-defined timeline for data collection. Eligible patients were followed through to completion of the study. Patients refusing consent for treatment or transportation were initially excluded from the study as noted in the Methods section. We feel a flow diagram would add little value given that it would show no patients dropping out after enrolment in the study other than those patients loss to follow up. <Page 7>
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Please refer to Table 1 in the Results section. <Page 15>
		(b) Indicate number of participants with missing data for each variable of interest Please refer to the Tables. We chose not to note the missing data directly in the table or in footnotes because the missing data is low (<6%) for each variable and the exact number can be easily calculated from the Tables themselves. <Pages 15-19>
		(c) Summarise follow-up time (eg, average and total amount) Please refer to paragraph 4 of the Results section. <Page 8>
Outcome data	15*	Report numbers of outcome events or summary measures over time Please refer to the Results section and Tables. <Page 8, 15-19>
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included. Please refer to of the Results section. Confounder-adjusted estimates were not

		applicable. <Page 8>
		(*b*) Report category boundaries when continuous variables were categorized Please refer to paragraph 3 of the Results section. <Page 8>
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses Please refer to paragraphs 5 and 6 of the Results section. <Page 8, 9>
Discussion		
Key results	18	Summarise key results with reference to study objectives Please refer to paragraphs 2-5 of the Discussion section. <Pages 9-11>
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Please refer to the Limitations sub-section of the Discussion. <Page 11>
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Please refer to Discussion and Conclusion sections. <Pages 9-11>
Generalisability	21	Discuss the generalisability (external validity) of the study results Please refer to Limitations sub-section of the Discussion. <Page 11> "The generalizability of our findings is limited by a lack of data collection beyond daytime hours and the predominance of three of the five states in our sample."
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based. Please refer to paragraph 3 of the Methods section. "The study was funded jointly by Stanford University and GVK EMRI." <Page 7>

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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Characteristics and Outcomes of Women Utilizing Emergency Medical Services for Third-Trimester Pregnancy-Related Complaints in India: A Prospective Observational Study

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Abstract

Objectives Characterize the demographics, management, and outcomes of obstetric patients transported by emergency medical services (EMS).

Design Prospective observational study.

Setting Five Indian states utilizing a centralized EMS agency that transported 3.1 million pregnant women in 2014.

Participants This study enrolled a convenience sample of 1684 women in third trimester of pregnancy calling with a “pregnancy-related” complaint for free-of-charge ambulance transport. Calls were deemed “pregnancy-related” if categorized by EMS dispatchers as “pregnancy”, “childbirth”, “miscarriage”, or “labor pains”. Interfacility transfers, patients absent upon ambulance arrival, and patients refusing care were excluded.

Main outcome measures Emergency medical technician (EMT) interventions, method of delivery, and death

Results The median age enrolled was 23 years (IQR 21-25). Women were primarily from rural/tribal areas (1550/1684 (92.0%)) and lower economic strata (1177/1684 (69.9%)). Time from initial call to hospital arrival was longer for rural/tribal compared to urban patients (66 min (IQR 51-84) vs 56 min (IQR 42-73), respectively, p<0.0001). EMTs assisted delivery in 44 women, delivering the placenta in 33/44 (75%), performing transabdominal uterine massage in 29/33 (87.9%), and administering oxytocin in none (0%). There were 1411 recorded deliveries. Most women delivered at a hospital (1212/1411 (85.9%)), however 126/1411 (8.9%) delivered at home following hospital discharge. Follow-up rates at 48 hours, 7 days, and 42 days were 95.0%, 94.4%, and 94.1%, respectively. Four women died, all within 48 hours. The cesarean section rate was 8.2% (116/1411). On multivariate regression analysis, women transported to private hospitals versus government primary health centers were less likely to deliver by cesarean section (odds ratio 0.14 (0.05 to 0.43))

Conclusions
Pregnant women from vulnerable Indian populations use free-of-charge EMS for impending delivery, making it integral to the health care system. Future research and health system planning should focus on strengthening and expanding EMS as a component of EmONC.

Strengths and limitations of this study

- This study is a novel, prospective assessment of obstetric patients calling for emergency medical services across 5 states in India.
- Data was collected real-time and 42-day follow up rates were excellent (94.1%)
- Generalizability may be limited as it was a convenience sample during daytime hours.
- Limited data on in-hospital management was collected.

Introduction

As the global health community's priorities transition from the United Nation's Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs), improving access to quality maternal care remains a top priority.(1)(2) SDG 3.1 specifies a new global maternal mortality ratio (MMR) target of less than 70 per 100,000 live births by 2030. To accomplish this goal, the World Health Organization's (WHO) Global Strategy for Women's, Children's, and Adolescents' Health (2016-2030) identifies facility-based childbirth with a skilled birth attendant and comprehensive emergency obstetric care as essential, evidenced-based interventions. The impact of these interventions, however, is critically limited by inequities in access to care.(3)(4) A significant limit to access is timely transport, which may be affected by distance (5), cost (6), and even social networks (7). Yet to date, programs aimed at improving access by decreasing barriers to transport, often fail to reach the most vulnerable populations and have been unable to demonstrate a consistent reduction in maternal deaths.(8)

In India, the country-wide MMR was 174 in 2015, and is highly variable by state and urbanization.(9, 10) Public health efforts have aimed to reduce this high MMR through a number of interventions yet few have addressed the second delay, the time to reach care. Janani Express Yojana (JEY) transport program was created to improve access to timely obstetric care. To do so, JEY worked with the Janani Suraksha Yojana (JSY) program, which incentivizes women by providing conditional cash transfers to deliver at facilities. In the state of Madhya Pradesh, the JEY program achieved moderate penetration with 35% of pregnant patients utilizing their transport services. However, patients encountered frequent delays when transported by JEY vehicles.(11) Their two-hour average transport time was comparable to patients that utilized public transport, with over 50% of patients taking longer than four hours to arrive at a facility.(11) GVK Emergency Management and Research Institute (GVK EMRI) is a public-private partnership that also provides free ambulance transport along with prehospital stabilization care, and can be easily accessed using a toll-free phone number (108). In some states, they provide a separate parallel service (102) for routine pregnancy-related transport, including delivery. Call management, dispatch, and on-line medical direction are provided by a centralized, state-level, emergency call center that supports a fleet of ambulances, strategically distributed to optimize response times. Obstetric emergencies are the most common reason to call GVK EMRI for assistance, with an estimated 3.1 million transports for pregnancy-related complaints in 2014.(12)

Despite the extensive use of ambulance transport services for obstetric indications in India, the critical role of prehospital care providers in managing obstetric patients often goes under-recognized by national and international agencies. For example, prehospital care providers are not mentioned in the Every Women Every Child Global Strategy 2.0.(3) Emergency medical services (EMS) systems and prehospital care providers have the potential to significantly improve the outcomes of obstetric patients through timely prehospital medical interventions and transport to facility-based care.(13) Yet, to date,

limited research exists describing their obstetric patients, the care provided, or patient outcomes.(14)(15) Our study seeks to characterize the demographics, management, and outcomes of third-trimester obstetric patients transported and treated by GVK EMRI.

Methods

We conducted a prospective observational study of patients calling 108 for pregnancy-related complaints across five states in India – Andhra Pradesh, Assam, Gujarat, Karnataka, and Meghalaya. Launched in 2005, GVK EMRI covers the entirety of 17 states and union territories, providing free-of-charge ambulance transport and emergency care to over 750 million people in India (Figure 1). The vast majority of ambulances are staffed by a driver and a single emergency medical technician (EMT). Ambulances transport all types of emergency patients and EMTs are trained to provide basic adult and pediatric emergency care in addition to emergency obstetric care and resuscitation. They are empowered to administer life-saving medications such as oxytocin and magnesium, under the oversight of real-time, physician-guided medical direction and via standard care protocols (Supplement 1). Following initial assessment and treatment, ambulances transport patients to the nearest hospital, unless otherwise requested by the patient or her family.

We enrolled a convenience sample of patients for a defined six-week period from February 17 through April 10, 2014. Patients were enrolled Monday through Saturday, during daytime hours for six hours per day. Any woman in her third trimester of pregnancy who called 108 for a pregnancy-related complaint was eligible for enrollment. A call was considered “pregnancy-related” if it was categorized by the EMS dispatch officer as a call for “pregnancy”, “childbirth”, “miscarriage”, or “labor pains”. Exclusion criteria included calls for interfacility transfers, patients who were absent upon EMT arrival, and patients who refused care services. At initial enrollment, trained research assistants used a standardized questionnaire to collect data in real-time by phone from the EMTs caring for patients. Data included patient demographics, prior and current obstetric history, and physical exam findings. After EMTs completed patient transport, research assistants re-contacted EMTs by phone to collect additional information such as EMT interventions at the scene and en route. At the time of initial enrollment, two phone numbers were obtained, the patient’s and a friend’s or relative’s, to limit the number lost in follow-up.

Patients who did not deliver prior to hospital arrival or en route were followed up by phone at 48 hours and 7 days. If they did not deliver by 7 days, they were excluded from further analysis. All patients who delivered, prior to EMT arrival through 7 days after the dispatch call, were followed up by phone at 48 hours, 7 days, and 42 days postpartum.

The study’s primary outcomes were cesarean section and death. Demographics, obstetric history, current signs and symptoms, transport distances and times, and care characteristics were compared using chi-square analysis for categorical variables (or Fischer’s exact test when appropriate) and Wilcoxon two sample test for continuous

variables to identify univariate predictors of cesarean section. Multivariate logistic regression analysis was used to determine predictors of cesarean section based upon significance in the univariate analysis. A p-value less than 0.05 was considered significant. All data analysis was conducted via SAS Enterprise Guide for Windows, version 4.3 (SAS Institute Inc., Cary, USA). Odds ratios (OR) and 95% confidence intervals (CI) are reported for all model variables. Per GVK EMRI's standard operating procedures participants provided verbal consent for care, transport, data collection, and follow-up at the time of enrollment. The study was approved by the Institutional Review Board at Stanford University (IRB#18185) and the Ethics and Research Committee at GVK EMRI. The study was funded jointly by Stanford University and GVK EMRI.

Results

We enrolled 1684 women, approximately 1.7% of all pregnancy-related calls to 108 across the five states during the study period (Table 1). The median age of women in this study was 23 years (IQR 21-25), with few women less than 18 (0.01%) or older than 34 (1.8%). Women were largely from rural or tribal areas (92.1%) and overall transport times were significantly longer from both tribal and rural areas compared to urban areas ($p < 0.0001$) (Table 2). However, only 5.5% of transports took greater than two hours, with none lasting longer than three hours.

Almost half of all women had attended at least four antenatal care visits, as recommended by the WHO. By self-report, few current or prior pregnancies were complicated by anemia or hypertension. While almost all women presented with contractions (96.7%), only 29.3% of women had rupture of membranes prior to EMT arrival (Table 3). EMTs consistently measured basic vitals, and properly positioned mothers in the left lateral position en route. Twenty-four women presented with signs of severe preeclampsia, defined as systolic blood pressure >160 mmHg or diastolic blood pressure > 110 mmHg, or eclampsia, defined by an EMT witnessed seizure. Only one of these women (4.5%) received magnesium as indicated by standard GVK EMRI protocol.

Of enrollees, 1411 mothers delivered during the study period; 186 (11%) women did not deliver by seven days and were excluded from further follow-up; and 87 (5.2%) women were lost to follow-up prior to delivering. Of these 1411 mothers, 80 delivered in the prehospital setting, of which 36 delivered prior to arrival of the EMT and an additional 44 delivered on scene or during transport to the hospital (Table 3). Of these 44 EMT-assisted deliveries, EMTs regularly delivered the placenta and provided transabdominal uterine massage. In only 1.3% of all prehospital deliveries, including both deliveries prior to EMT arrival and EMT assisted, did the EMT administer oxytocin. In that case, it was given to a woman with postpartum hemorrhage. However, there were no incidents of documented severe postpartum hemorrhage, defined by one liter or more of estimate blood loss. In 95% of the cases where oxytocin was not administered post-delivery, EMTs stated the reason was that it was "not indicated".

Follow-up rates at 48 hours, 7 days, and 42 days were 95.0%, 94.4%, and 94.1% respectively. In total, four women died during this study, and all died within 48 hours after arrival at the hospital. One of these women presented with eclampsia, but the final etiology of their deaths is unknown. Most women delivered at a hospital (85.9%), and those were overwhelmingly at government hospitals (82.9%). There were 154 deliveries (10.9%) that occurred at home, and 81.8% of these occurred after being discharged from the hospital to which EMTs had originally transported women. EMTs assisted in 44 deliveries (3.2%).

The overall rate of cesarean section was 8.2%. The states of Karnataka and Meghalaya each had only one woman deliver by cesarean section, and therefore, these states were not included in univariate and multivariate regression analysis predicting cesarean section. State, hospital type (private versus government), hospital level (e.g. primary versus tertiary), and first pregnancy were significantly correlated with cesarean section on univariate analysis ($p < 0.001$).

Multivariate logistic regression analysis identified several factors that significantly impacted the likelihood of cesarean section ($n = 791$; c-statistic 0.75) (Table 4). Women who were initially transported to a tertiary care center, such as a medical college, were significantly less likely to deliver by cesarean section than those initially taken to primary care centers (odds ratio 0.18 (95% confidence interval 0.08 to 0.41)). Similarly, women initially transported to a private hospital rather than a government primary care center were significantly less likely to deliver by cesarean section (0.14 (0.05 to 0.43)). In contrast, women with a history of a previous cesarean section or who were nulliparous were more likely to deliver by cesarean section (3.28 (1.37 to 7.82) and 3.38(1.89-6.05), respectively).

Discussion

This is the first prospective study to evaluate the characteristics and outcomes of obstetric patients transported by the world's largest EMS organization, GVK EMRI. Our study enrolled patients from one third of the states in which GVK EMRI operates, providing evidence of the vast potential of a centralized EMS to reach vulnerable women during the third trimester and childbirth.

Providing Timely Care for Vulnerable Populations

Leveraging existing EMS resources, such as dispatch center, ambulances, and care providers, increases the capacity to reach vulnerable women during childbirth and decreases time to facility-based obstetric care. Our findings demonstrate that women from vulnerable populations were able to access emergency obstetric services by phone, either directly or through a friend or relative. Of the women transported, less than 40% had a secondary level education, and 70% were dependent on the low-income government health insurance program (white ration card). Using self-identified caste as a proxy of social status, we also found that almost 80% of patients were from lower social strata. These categories are used as they are in national population health level

monitoring: “scheduled caste” are considered the lowest, most socially disadvantaged groups, whereas “scheduled tribe,” also a disadvantaged group, is defined by their physical isolation; “below caste” is an intermediary group socially, and “other caste” includes all those who do not belong to the aforementioned group and have the highest social status. Moreover, with a median call-to-facility arrival time of 65 minutes (IQR 50-84), this overwhelmingly rural population was connected quickly to facility-base care. This is in accordance with the World Health Organization (WHO) and the United Nations Population Fund (UNFPA) recommendations that laboring women have access to emergency obstetric and newborn care (EmONC) facilities within two hours. Longer times have been associated with worse outcomes including higher maternal mortality.(16)(17) However, one population was not well represented in our sample: women less than 18 years old. Only one patient (0.01%) enrolled in our study was less than 18. This is much lower than expected given that 2.5% of all women enrolled, and 22% of women nationally, report having their first pregnancy before age 18.(18) The reason for this unexpectedly low percentage may be that women less than 18 years have restricted autonomy and/or lower health literacy than older women. Further investigation is needed.

Providing Appropriate Care for Prehospital Deliveries

In advance of assessing and treating pregnant patients, over 99% of GVK EMRI’s EMTs have undergone Basic Life Support in Obstetrics (BLSO®) training in addition to their initial EMT B training (ranging from 6 weeks previously to 10 weeks (450 hours) currently). Appropriate practices such as obtaining maternal vital signs and placing the patient in the left lateral decubitus position were performed in almost all patients. Of our study patients, EMTs assisted in the delivery of 44 (3.1%) patients. Of these, the placenta was delivered in 75% of patients and most patients received transabdominal uterine massage. Active management of the third stage of labor (AMSTL) is within GVK EMRI’s EMTs’ scope of practice and is highlighted in their emergency care protocols. Despite this, not a single patient received oxytocin, the key component of AMSTL, following an EMT-assisted delivery.(19) In fact, for the cohort of prehospital deliveries, 95% of EMTs reported that administration was not indicated. The rationale for this misconception, despite access to standard protocols and contact with call center physicians for real-time medical direction, is likely multi-factorial. Possible explanations include a lack of provider comfort with oxytocin administration and the overall protocol, or an environment where physicians may not be supportive of EMTs providing oxytocin. Further, there are additional opportunities to improve the quality of EmONC beyond AMSTL. Only one patient with postpartum hemorrhage received oxytocin, and no patients with eclampsia or severe preeclampsia received magnesium. GVK EMRI has already begun responding to these quality gaps by conducting EmONC refresher programs for practicing EMTs. Further focused efforts at the institutional, development partner, and government levels will likely be needed. Potential solutions include multi-agency, multi-specialty quality improvement efforts that bring together key stakeholders from healthcare facilities, government, and prehospital providers. Together, these groups can collectively problem solve and elucidate regional standards

of care, including scope of practice for EMTs, continuing medical education, and standardized certification.

Improving Facility-Based Deliveries

In this study, women recognized the appropriate time frame to come to a facility for a delivery. The vast majority of women (93%) delivered within approximately 48 hours of the original dispatch call. A significant number of patients transported to hospitals who were subsequently discharged delivered within the next two days at home, constituting 7.2% of all deliveries. Perhaps most striking is that 82% of these post-discharge home deliveries occurred the day of transport. This may be an opportunity for facility-based quality improvement regarding the detection of early labor and patient discharge education, or system-based interventions such as maternity waiting homes.(20)

The overall cesarean section rate of 8.2% was below the national average of 12.1% in India,(21) and the traditionally recommended rate by the WHO of 10-15%.(22) Prior reports have suggested that delivery in private facilities is associated with increased rates of cesarean delivery in India and other South Asian countries.(23) However, this did not hold true in rural India, where public facilities were found to have higher rates of cesarean delivery.(24) Our study is consistent with this latter finding. Cesarean section rates in private hospitals were 3.5% compared to 10.9% in public hospitals, with the highest rate in rural public hospitals (11.2%). Further, the increased likelihood of delivering by cesarean section if transported to a primary care center may be indicative of multiple different clinical scenarios. Future studies should examine interfacility transfers for obstetric emergencies to determine the need for obstetric emergency-specific referral protocols.

Limitations

Any conclusions regarding maternal mortality are limited as there were few maternal deaths in our sample. The estimated MMR for our study population is at least 280, but may be as high as 291, if all infants that died the day of birth are assumed to be stillborn. Without taking into account the known deep disparity between urban and rural MMR's,(10) the expected MMR would be 152,(25) weighted by a state's proportion of our sample size but not inclusive of Meghalaya, which has no available recent MMR. The generalizability of our findings is limited by a lack of data collection beyond daytime hours and the predominance of three of the five states in our sample. Lastly, two factors may limit the accuracy of our cesarean section rates: patients lost to follow-up and missing data. While our follow-up rates were strong, we still lost 168 patients in follow-up and for 139 women we did not have the mode of delivery recorded. These women may have had different rates of cesarean section and/or complications, including death.

Conclusions

Pregnant women from vulnerable Indian populations – geographically isolated, low socioeconomic status – use a free-of-charge ambulance service for impending delivery.

EMTs regularly deliver women in the field and consistently perform basic assessment and management of pregnant patients, reaching women within the internationally recommended two hours of EmOC. Together, the ability to reach vulnerable populations, provide care, and connect women makes EMS an integral part of the health care system. We have identified several areas in need of quality improvement including AMSTL and the management of PPH, eclampsia and severe preeclampsia. Future research and health system planning should focus on how to strengthen and expand EMS as a critical component of emergency obstetric care services.

MS, EP, GR and SM contributed to the study design, implementation, data analysis, and manuscript production. EM, AE and LL contributed to study design and manuscript production. JN and CB contributed to data analysis and manuscript production. MS and SM accept full responsibility for the work and conduct of the study, had access to the data, and controlled the decision to publish. MS affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained. Special thanks to Anne Tecklenberg Strehlow for her assistance editing and Aruna Gimkala, Marada Lakshmana Rao, Royal Uddin Ahmed, Rupjoy Maibangsa, Rajini Danthala, Divya Patel, Steffy Christian, Chandrashekhraswami Kendadmath, Sahyadri Venkateshappa, Shylaja Muniyappa, and Isberth Tham for collecting data and ensuring data quality.

Full dataset available by request from the corresponding author at strehlow@stanford.edu. Consent was not obtained but the presented data are anonymised and risk of identification is low.

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that (1) no authors have support from any outside companies or organizations for the submitted work; (2) no authors have any relationships with any companies or organizations that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) no authors have any non-financial interests that may be relevant to the submitted work.

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Table 1. Characteristics of Women in Their Third Trimester of Pregnancy Transported by Emergency Medical Systems for Pregnancy-Related Complaints

Characteristics*		All	Delivered	Did not deliver	Not followed**
		N (%)	N (%)	N (%)	N (%)
All patients		1684	1411	188	85
Age	Median (IQR)	23 (21-25)	23 (21-26)	24 (21-26)	23 (21-25)
	15-19	83 (4.9%)	70 (5%)	7 (3.7%)	6 (7.1%)
	20-24	958 (56.9%)	797 (56.5%)	106 (56.4%)	55 (64.7%)
	25-29	500 (29.7%)	428 (30.3%)	58 (30.9%)	14 (16.5%)
	30-34	112 (6.7%)	90 (6.4%)	13 (6.9%)	9 (10.6%)
	35-39	27 (1.6%)	23 (1.6%)	3 (1.6%)	1 (1.2%)
	40-44	4 (0.2%)	3 (0.2%)	1 (0.5%)	0 (0%)
Geographic location	Rural	1333 (79.2%)	1115 (79%)	153 (81.4%)	65 (76.5%)
	Urban	134 (8.0%)	107 (7.6%)	13 (6.9%)	14 (16.5%)
	Tribal	217 (12.9%)	189 (13.4%)	22 (11.7%)	6 (7.1%)
Economic status	Pink card	479 (28.4%)	415 (29.4%)	46 (24.5%)	18 (21.2%)
	White card	1177 (69.9%)	974 (69%)	140 (74.5%)	63 (74.1%)
Social status	Other Caste	343 (20.4%)	281 (19.9%)	35 (18.6%)	27 (31.8%)
	Below Caste	608 (36.1%)	501 (35.5%)	78 (41.5%)	29 (34.1%)
	Scheduled Caste	297 (17.6%)	250 (17.7%)	35 (18.6%)	12 (14.1%)
	Scheduled Tribe	430 (25.5%)	375 (26.6%)	39 (20.7%)	16 (18.8%)
Education	None	637 (37.8%)	520 (36.9%)	87 (46.3%)	30 (35.3%)
	Primary	429 (25.5%)	354 (25.1%)	54 (28.7%)	21 (24.7%)
	Secondary	428 (25.4%)	376 (26.7%)	34 (18.1%)	18 (21.2%)
	Intermediate	90 (5.3%)	81 (5.7%)	5 (2.7%)	4 (4.7%)
	Graduate	40 (2.4%)	33 (2.3%)	5 (2.7%)	2 (2.4%)
Obstetric history					
Anemia		125 (7.4%)	97 (6.9%)	18 (9.6%)	10 (11.8%)
Hypertension		42 (2.5%)	39 (2.8%)	2 (1.1%)	1 (1.2%)
Antenatal care visits	0	108 (6.4%)	92 (6.5%)	14 (7.5%)	2 (2.4%)
	1	142 (8.4%)	117 (8.3%)	23 (12.2%)	2 (2.4%)
	2	235 (14.0%)	196 (13.9%)	22 (11.7%)	17 (20%)
	3	384 (22.8%)	317 (22.5%)	38 (20.2%)	29 (34.1%)
	4+	778 (46.2%)	661 (46.9%)	87 (46.3%)	30 (35.3%)
Seen by physician during visit		1309 (77.7%)	1095 (77.6%)	139 (73.9%)	75 (88.2%)
Parity	Nulliparous	725 (43.1%)	803 (56.9%)	117 (62.2%)	39 (45.9%)
	Multiparous	959 (56.9%)	608 (43.1%)	71 (37.8%)	46 (54.1%)
Age at first pregnancy ***	15-19	227 (23.7%)	192 (23.9%)	29 (24.8%)	6 (15.4%)
	20-24	647 (67.5%)	541 (67.4%)	79 (67.5%)	27 (69.2%)
	25-29	76 (7.9%)	64 (8%)	8 (6.8%)	4 (10.3%)

	30-34	4 (0.4%)	3 (0.4%)	0 (0%)	1 (2.6%)
	35-39	1 (0.1%)	0 (0%)	1 (0.9%)	0 (0%)
Prior cesarean section***	Yes	89 (9.3%)	70 (8.7%)	16 (13.7%)	3 (7.7%)
	No	865 (90.2%)	728 (90.7%)	101 (86.3%)	36 (92.3%)
Years since prior pregnancy***	< 2 years	435 (45.4%)	358 (44.6%)	56 (47.9%)	21 (53.9%)
	24-35 months	240 (25.0%)	207 (25.8%)	25 (21.4%)	8 (20.5%)
	> 3 years	277 (28.9%)	232 (28.9%)	36 (30.8%)	9 (23.1%)

*Values may not add up to 100% as most categories have missing data. All missing data was less than 6%.

** "Not followed" are patients lost to follow up prior to delivering.

***Of multiparous mothers only (N=959)

Table 2. Response and Transport Times for Women Transported by Emergency Medical Systems for Pregnancy-Related Complaints

Characteristic	Incident Location			
	All	Urban	Rural/Tribal	*p* value
Response time (min)				
Call to dispatch	3 (2-4)	3 (2-4)	3 (2-4)	0.55
Dispatch to scene	24 (16-35)	17 (11-28)	25 (16-35)	<0.0001
Time on scene	7(5-10)	9 (5-12)	7 (5-10)	0.076
Scene to hospital	26 (17-40)	22 (12-35)	26 (18-40)	0.005
Total time: call to hospital	65 (50-84)	56 (42-73)	66 (51-84)	<0.0001
Distance from scene to hospital (km)	15 (9-23)	12 (6 -17)	15 (9-23)	<0.0001

* All values are median (IQR)

Table 3. Presentation and EMT Management of Women Transported by Emergency Medical Services for Pregnancy-Related Complaints

Patient Presentation and Management	N (%)
All patients	1684
Presentation	
Contractions	1628 (96.7%)
Rupture of membranes	493 (29.3%)
Severe preeclampsia	22 (1.3%)
Eclampsia	2 (0.1%)
EMT Actions	
Pulse, blood pressure, and respiratory rate measured	1633 (97.0%)
Placed in left lateral decubitus position	1610 (95.6%)
Deliveries Assisted by an EMT	44
Active management of third stage of labor*	
Placental delivery	33 (75%)
Oxytocin	0 (0%)
Uterine massage**	29 (87.9%)

*Of EMT assisted deliveries (N=44)
**Of patients whose placenta was delivered (N=33)

Table 4. Predictors of Cesarean Section, Multivariate Analysis

	Odds Ratio (95% CI)	
Characteristics	**Unadjusted**	**Adjusted**
State		
Gujarat	ref	ref
Andhra Pradesh	1.84 (1.1-3.08)	1.86 (0.98-3.54)
Assam	3.98 (2.34-6.77)	3.22 (1.70-6.10)
Age	1.04 (0.98-1.09)	1.11 (1.04-1.19)
Low economic status	0.84 (0.5-1.4)	1.19 (0.63-2.26)
Receiving hospital type		
Primary, government	ref	ref
Secondary, government	0.62 (0.39-0.97)	0.48 (0.29-0.78)
Tertiary, government	0.21 (0.1-0.45)	0.16 (0.07-0.37)
Private	0.17 (0.07-0.43)	0.17 (0.06-0.46)
Other	0.19 (0.06-0.62)	0.22 (0.06-0.77)
Cesarean section history		
Multiparous, no prior	ref	ref
Nulliparous	2.06 (0.97-4.38)	3.36 (1.47-7.71)
Multiparous, prior cesarean section	1.61 (1.06-2.44)	2.96 (1.71-5.10)
Twin gestation	2.69 (0.83-8.73)	3.51 (0.96-12.75)
Premature gestation	1.62 (0.95-2.76)	2.15 (1.19-3.89)

N = 853 (739 normal deliveries and 114 cesarean sections). C-statistic = 0.75.

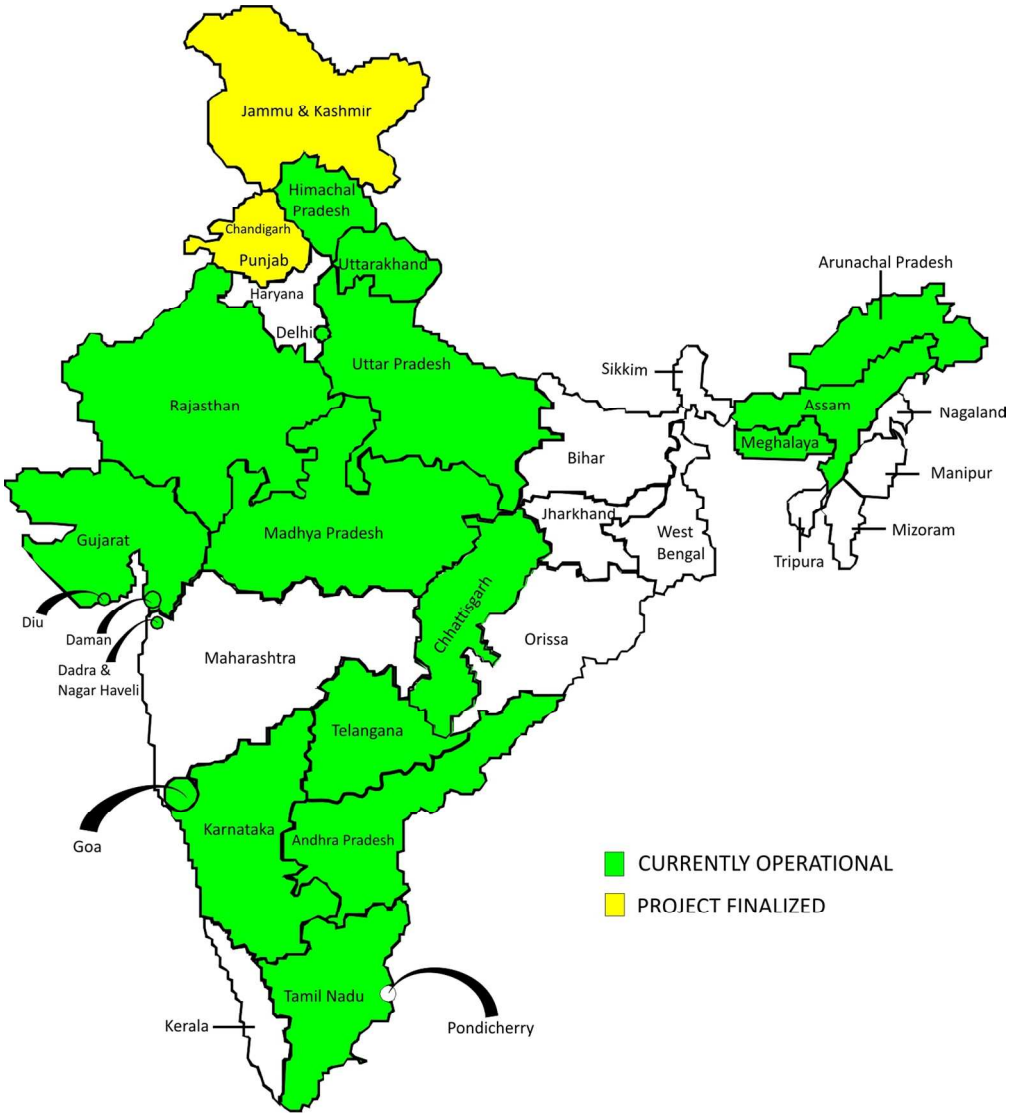


Figure 1: Map of India Showing Location of GVK EMRI Emergency Medical Services
199x220mm (200 x 200 DPI)

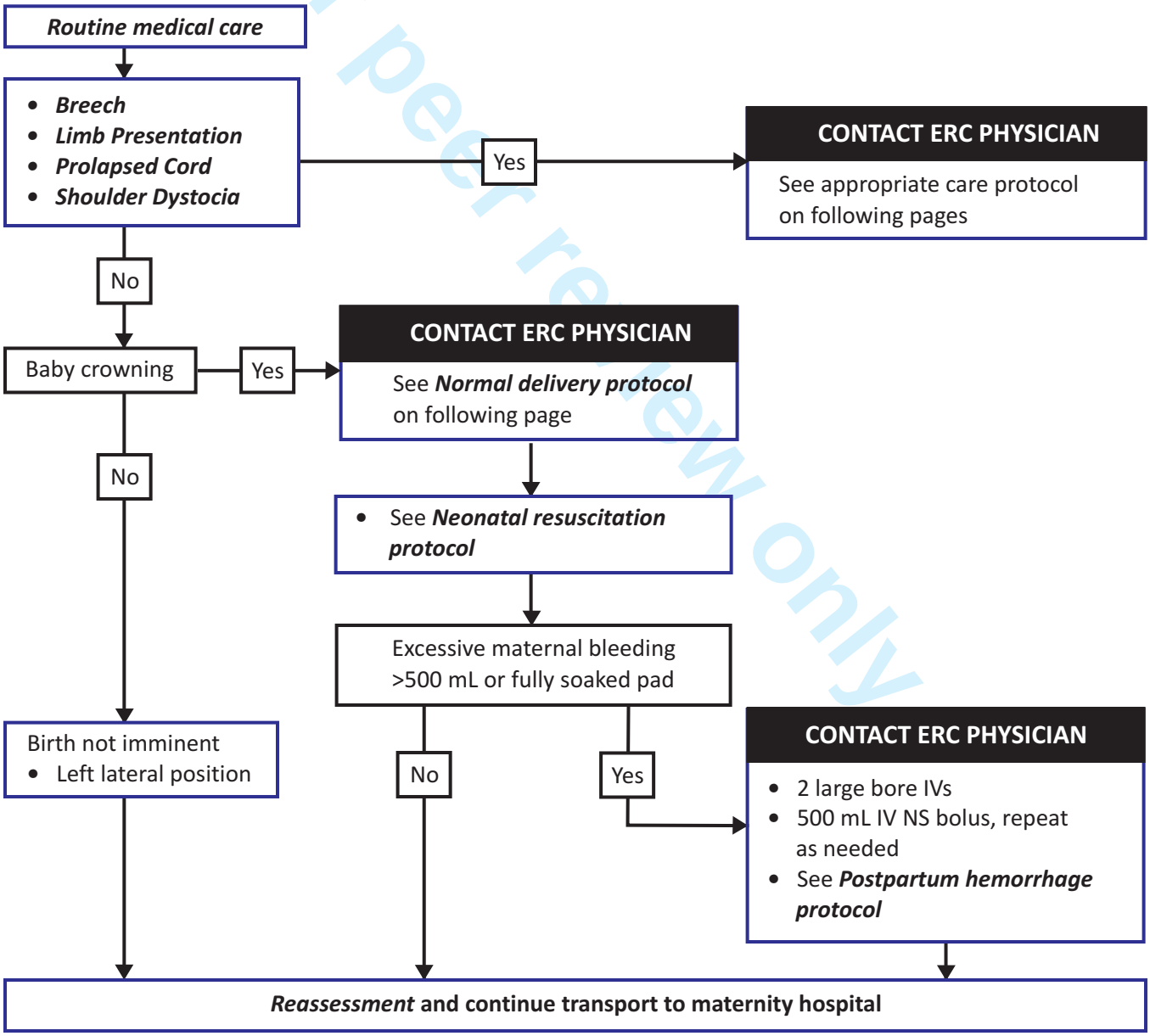
CHILDBIRTH (Uncomplicated/Complicated)

Key points

- Symptoms: Abdominal/back pain, vaginal bleeding/gush of fluid, minutes between contractions
- History of current pregnancy: Antepartum care, estimated gestational age, complications
- OB history: Number of pregnancies and c-sections, prior complications during pregnancy
- Physical exam: Inspecting external vaginal area for crowning/presenting part if patient feels like she wants to push or if she feels there is something protruding from her vagina
- *DO NOT* pull/push baby

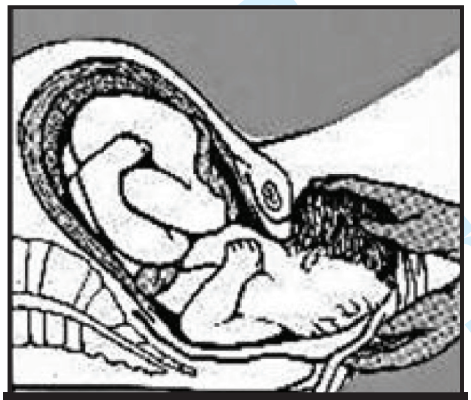
Serious signs and symptoms

- Part other than head presenting from vagina (arm, leg, umbilical cord)
- Excessive maternal bleeding
- Prolonged contractions (>6 contractions in 10 minutes or duration >2 minutes)
- Shortness of breath
- Altered mental status

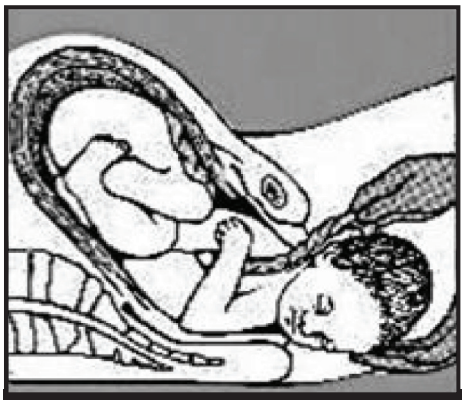


Normal Delivery

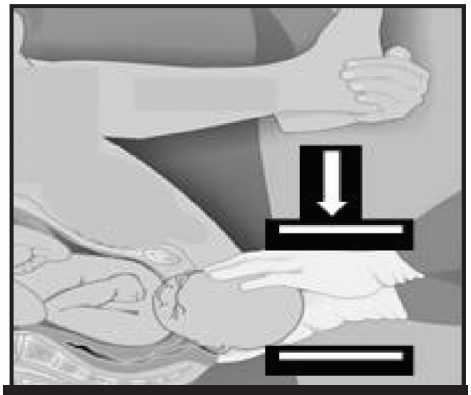
- Position patient
- Prepare OB kit
- As head delivers, suction with bulb syringe (only if not spontaneously breathing)
- Check for cord wrapped around neck
- If cord around neck, slip over shoulders/head of baby
  - If unable to unwrap cord, place umbilical clamps 5 cm apart and cut cord between clamps
- Support head, deliver body
- Place baby next to mother; dry baby and keep warm (see ***Neonatal resuscitation protocol***)
- See ***Post delivery care*** on last page



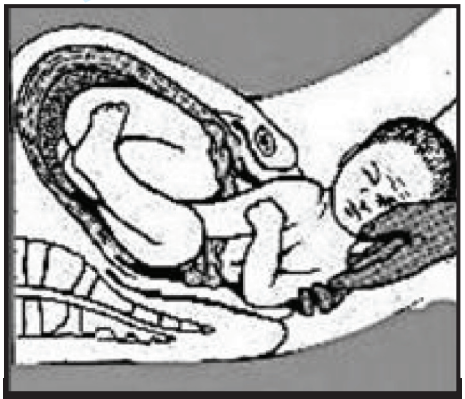
Step 1: Support head and let head turn to side to align with body



Step 2: Check for cord and slip over head if present



Step 3: Keeping hands parallel to floor, apply downward pressure to deliver shoulder



Step 4: Support body and place next to mother

Shoulder Dystocia

Definition

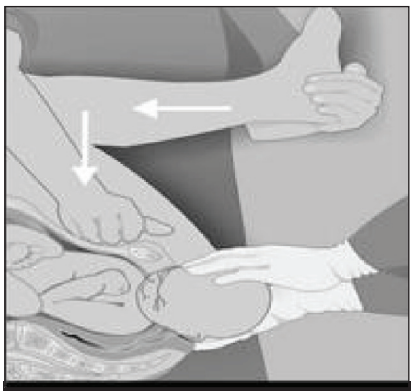
- Inability to deliver either shoulder within 60 seconds of delivery of head

Key points

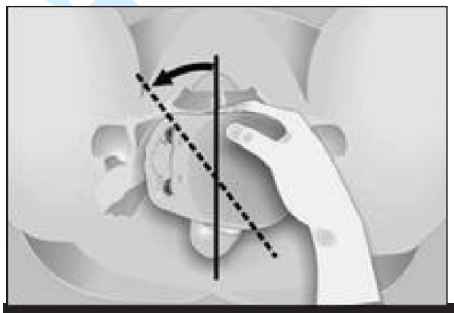
- Complications
  - Severe hypoxia, traumatic brachial plexus injuries and humerus/clavicle fractures
- *Turtle sign:* when fetal head moves back into the mother's perineum
- ***HELPERR (HeLP-R*** for BLSO provider denoted by *below) mnemonic can assist with recall of correct actions

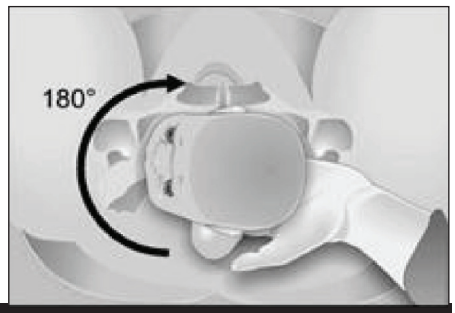
Prehospital management options

- H: Call for **H**elp*
- E: Consider **E**pisiotomy (only if additional space needed for hands to complete maneuvers below)
- L: Position **L**egs, pull knees to chest*
- P: Suprapubic **P**ressure (not fundal)*
- E: **E**nter vagina with hands to push on posterior aspect of anterior shoulder and other maneuvers
- R: **R**oll patient to knee to chest position, then deliver the posterior shoulder*
- R: **R**emove the arm, sweep posterior arm across chest

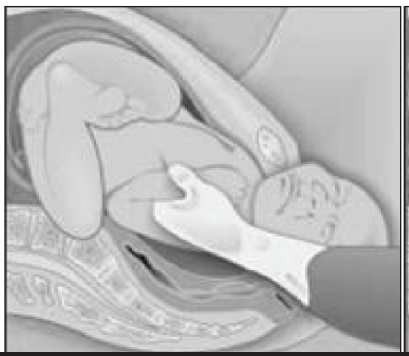


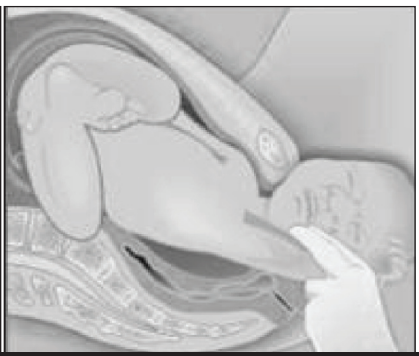
Legs: Pull knees up
Pressure: Push down in suprapubic area (not fundal)



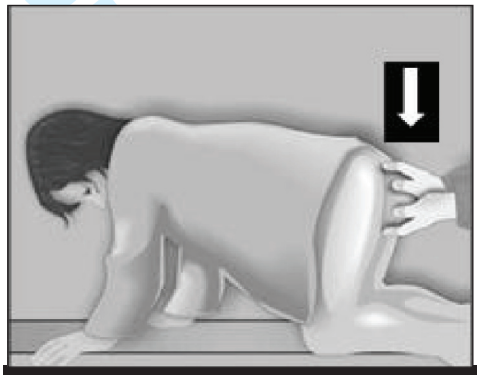


Enter maneuvers:
1) Push anterior shoulder forward
2) Pressure: Push anterior shoulder backward and posterior shoulder forward





Remove posterior arm by bending at elbow and sweeping across chest and out



Roll on to knee chest position and deliver posterior shoulder first by gentle downward pressure on fetal head

Breech Presentation

Definition

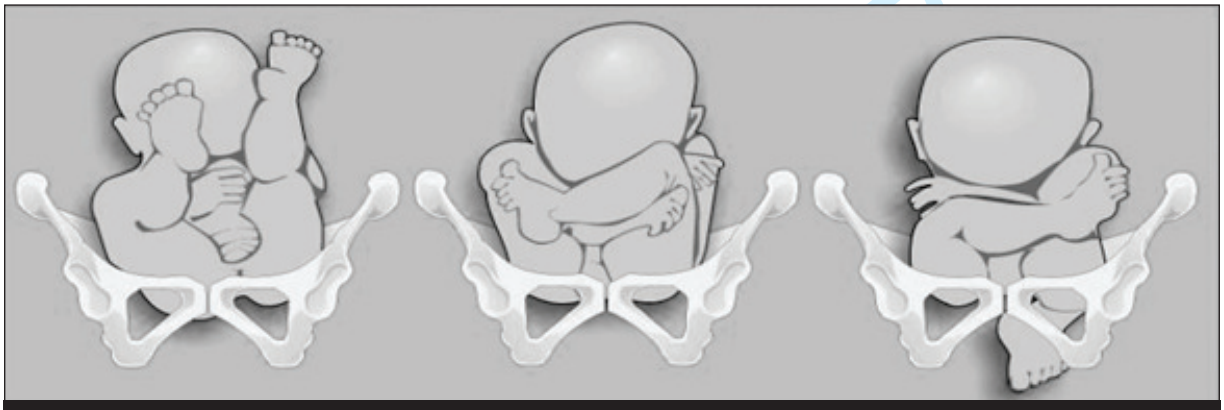
- When buttocks (or legs) deliver first

Key points

- Transport immediately
- *AVOID* delivery in ambulance if possible. Tell patient not to push.

Prehospital management options

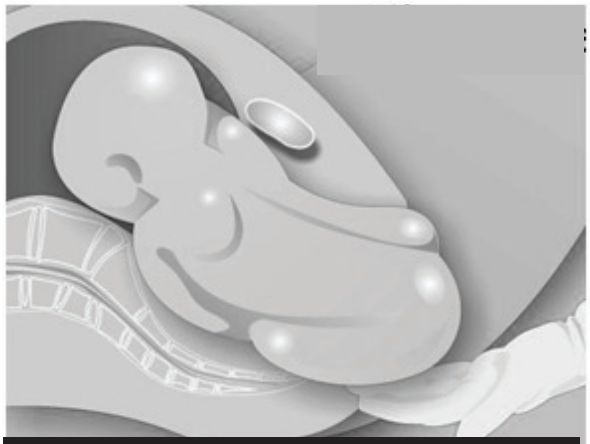
- Determine if buttocks or limb is presenting first
  - If limb (leg or arm) is presenting first, see ***Limb presentation*** section on the following page
- Delivery of breech presentation
  - Step 1
    - Support baby and allow delivery to proceed passively until base of umbilical cord is seen
    - *DO NOT* pull baby
  - Step 2
    - Grab the bony pelvis and femurs and apply gentle traction
    - *DO NOT* grab the abdomen as you may injure abdominal organs
  - Step 3
    - Once the wing-like scapulae are visible, rotate the fetus until a shoulder is anterior and deliver the arm. Rotate 180 degrees and deliver the other arm. Position the fetus so that the back is facing anteriorly.
  - Step 4
    - Anteriorly place a gloved middle finger on the fetus's occiput. The index and ring finger rest on the shoulders. Place a hand posteriorly sliding the index and middle finger into a V shape along the baby's face. Gently place pressure on the cheek bones.
    - Performing these maneuvers at the same time causes the fetal head to flex.
    - Additionally, one assistant can apply suprapubic pressure to help with flexion of the head. Another assistant can support the body.
  - See ***Post delivery care*** section on last page



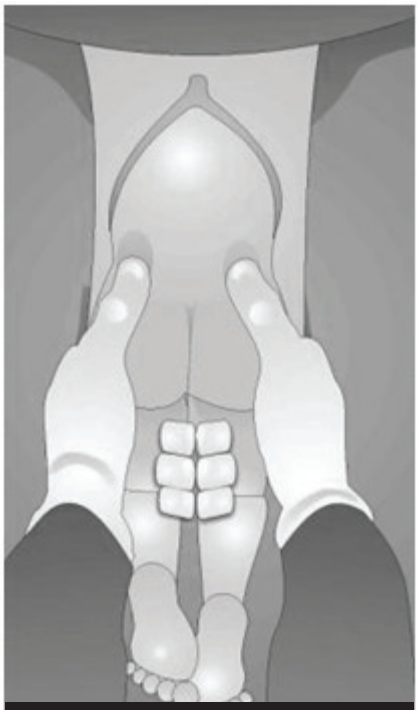
Frank breech Complete breech Footling breech

Presentation is the part of the fetus that is coming out of birth canal first

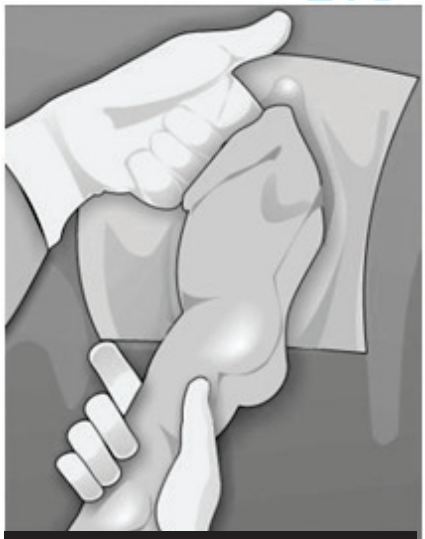
Delivery Steps for Breech Presentation



Step 1: Support the body



Step 2: Gentle traction on bony pelvis



Step 3: Rotate each shoulder anteriorly and deliver arms

Step 4: Flex the fetal head by placing the middle finger on the occiput and the other middle and index finger on the cheek bones

Cord Presentation (Prolapsed Cord)

Definition

- Umbilical cord presents/is seen before the head or other part of the baby

Key points

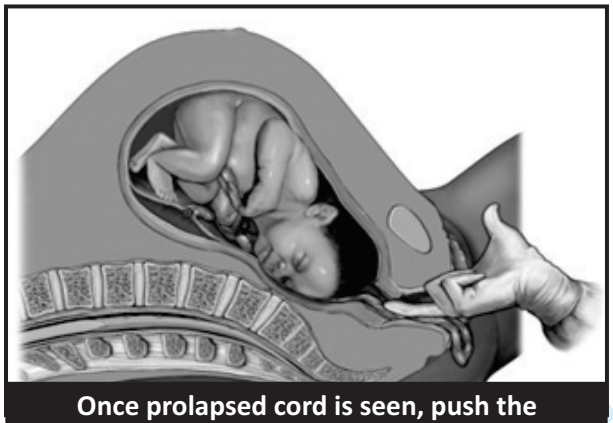
- If the umbilical cord is compressed, blood flow and oxygen don't reach the baby
- Transport immediately and try to avoid delivery in the ambulance
- Tell the patient *NOT* to push

Prehospital management options

- With two fingers of your gloved hand, gently push the presenting part of baby (not the cord) back up into the vagina until the presenting part no longer presses on the cord
  - *DO NOT* remove your hand (after elevating the presenting part of the baby) until arriving at the hospital and being relieved by other hospital personnel
- With your other hand, palpate the cord and feel the fetal HR. If <110 bpm, consider rolling the patient over and placing her in the *knee-chest position.* This may relieve pressure on the cord.

Prolonged transport or in hospital management options

- Place a Foley (urinary) catheter in the bladder and fill with 500 mL of NS. Clamp the Foley.
- Wrap the cord loosely with a moist, warm dressing



Once prolapsed cord is seen, push the presenting part (not the cord) gently back up

Knee chest position

Limb Presentation

Definition

- When one limb of the baby delivers first

Key points

- Nearly all of these patients will require delivery by caesarean-section
- Transport immediately. Avoid delivery in the ambulance if possible.
- Tell the patient *NOT* to push.

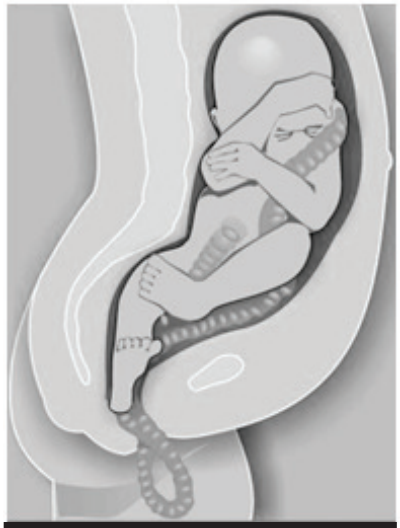
Prehospital management options

- Oxygen
- *DO NOT* attempt to deliver the baby
- *DO NOT* pull on the presenting limb
- *DO NOT* place your hand into the vagina unless there is a prolapsed cord (see ***Cord presentation*** section on previous page)

Multiple Births

Key points

- Usually both babies are born before the first placenta is delivered
- In order to prevent bleeding from the 2nd twin, carefully inspect the cord and apply a second clamp if leaking blood (oozing)
- Contractions usually restart within 5-10 minutes after the first baby is born; the second baby usually delivers within 30-45 minutes of the first baby



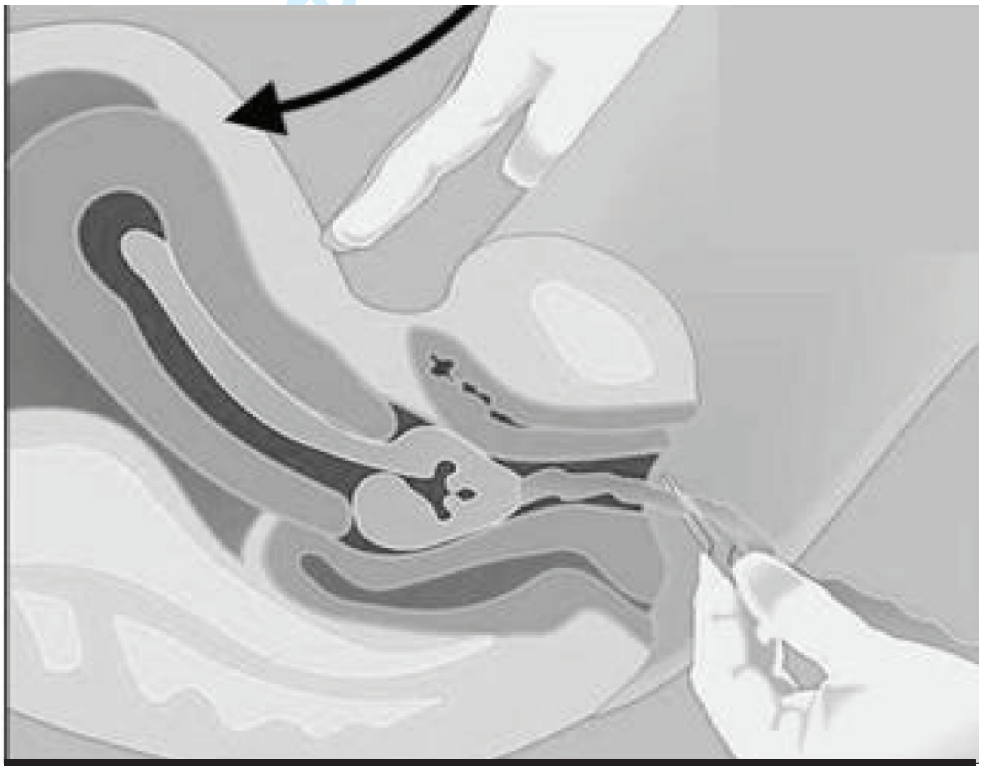
Limb presentation with prolapsed umbilical cord

Twin gestations may present with the fetuses lying in multiple positions

Post Delivery Care

Active management of 3rd stage of labor (following delivery of all fetuses)

- See ***Neonatal resuscitation protocol***
- **Oxytocin 10 Units IM** to mother immediately following delivery
  - Consider multiple fetuses and do not give until all babies are delivered
- Record time of birth
- Assess APGAR scores at 1 and 5 min after birth
- Wait until cord pulsations have stopped or 5 minutes have passed. Then, place two clamps on the cord at least 4-10 cm from the baby and cut between the clamps.
- Gently pull on the umbilical cord while providing suprapubic pressure (see below)
- Once the placenta delivers, place the placenta in a bag and give it to hospital staff
- Externally massage the uterus
- If significant ongoing bleeding or signs of maternal shock, see ***Postpartum hemorrhage protocol***



Placenta delivery: Gently pull on cord while applying pressure to suprapubic area

References

- Advanced Life Support in Obstetrics (ALSO) Provider Course Syllabus Fourth Edition, Copyright 2009, American Academy of Family Physicians

POSTPARTUM HEMORRHAGE (PPH)

Definition

- Greater than 500 mL of blood loss following delivery
- Severe PPH is >1000 mL of blood loss following delivery

Key points

- Most common cause of maternal death in developing nations
- Active management of the third stage of labor can prevent 60% of PPH
- Rapidly evaluate for and correct possible causes
- Uterine atony (soft, boggy uterus) is the most common cause of PPH

Serious signs and symptoms

- SBP <90
- HR >100
- Shortness of breath (RR >30)
- Altered mental status
- Cool or moist skin

Routine medical care

Active management of 3rd stage of labor

>500 mL of blood loss -*OR*-
Serious signs and symptoms

No

Yes

CONTACT ERC PHYSICIAN

- **Oxytocin 20 Units** in 500 mL NS (IV bolus over 20 minutes)
- 2nd IV as needed

Uterus firm

No

Yes

- Bimanual uterine massage
- Continue IV oxytocin infusion
- **Misoprostol 1000 mcg PR** *AND/OR* **Methylergonovine 0.2 mg IM** (do not give Methylergonovine if SBP >140 mmHg or known preeclampsia or chronic hypertension)

CONTACT ERC PHYSICIAN

- Perform vaginal exam for signs of uterine inversion, lacerations, and ongoing bleeding
- Consider appropriate treatment options

***Reassessment* and continue transport**

Active management of 3rd stage of labor

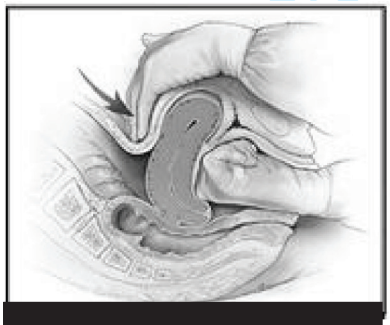
- Following delivery of all fetuses provide:
  - **Oxytocin 10 Units IM** to mother (immediately following delivery)
  - Gentle traction on umbilical cord while providing suprapubic pressure (see below)
  - External massage of uterus (see below)

ERC Physician

Key points

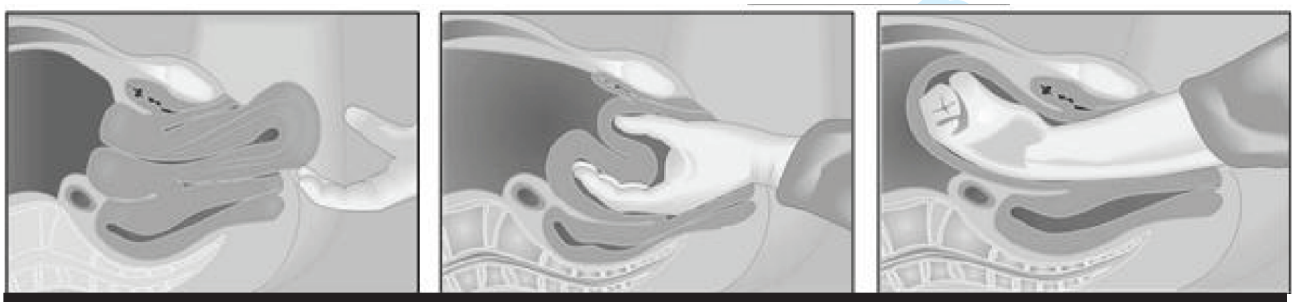
- Decisions on management options should be based on the expected time to hospital arrival

4 T's	Causes	Prehospital treatment
Tone	Decreased uterine tone	1. Uterine massage 2. Oxytocin 3. Misoprostol 4. Methylergonovine
Trauma	1. Cervical/perineal lacerations 2. Uterine inversion	1. Apply direct pressure 2. Restore uterus (see below)
Tissue	Placenta retained	Manual removal
Thrombin	Decreased clotting	Supportive measures



Bimanual uterine massage

Placental tissue removal



Inversion and restoration of uterus

References

- Advanced Life Support in Obstetrics (ALSO) Provider Course Syllabus Fourth Edition, Copyright 2009, American Academy of Family Physicians

PREECLAMPSIA/ECLAMPSIA

Key points

- Preeclampsia and eclampsia can occur from the 20th week of pregnancy until 6 weeks after delivery
- Preeclampsia is a BP >140/90 on >2 readings >6 hours apart *AND* significant protein in the urine
- Severe preeclampsia signs/symptoms include altered mental status, blurred vision and persistent headache
- Eclampsia is preeclampsia with seizures
- Obtain past medical history: medications, last menstrual period, gestational age (trimester)
- Magnesium toxicity manifests as loss of deep tendon reflexes and respiratory depression

Differential diagnosis

- Epilepsy
- Hypoglycemia
- Trauma/head injury
- Alcohol withdrawal
- Toxins/poisoning/overdose
- Chronic hypertension

Serious signs and symptoms

- Hypoxia/cyanosis
- Shortness of breath
- Seizures
- Altered mental status

Routine medical care

CONTACT ERC PHYSICIAN

- Place patient on left side if pregnant
- Oxygen by face mask
- IV access
- Seizure precautions

Seizure ongoing or recent seizure

Administer *BOTH:*

- **Magnesium sulfate 10 g IM** (5 g in each buttock)
- **Magnesium sulfate 4 g IV** over 10-15 min

- Check blood glucose (GRBS)
  - GBRS <80 mg/dL, see ***Hypoglycemia protocol***

- If SBP >160 -*OR*- DBP >110 mmHg, recheck BP in 10 min and **contact ERC physician**

No recent seizure history

- SBP >160 -*OR*- DBP >110 mmHg

Yes

- Recheck BP in 10 min and **contact ERC physician**

If SBP >160 -*OR*- DBP >110 mmHg, administer *BOTH*

- **Magnesium Sulfate 10 g IM** (5 g in each buttock)
- **Magnesium Sulfate 4 g IV** over 10-15 min

No

***Reassessment* and continue transport**

- Seizure precautions
- Shift to maternity hospital

ERC Physician

Key points

- The definitive treatment for eclampsia is delivery
- Magnesium should not be used to control hypertension
- Epigastric pain may be a sign of severe preeclampsia (also consider gallbladder disease)

Prehospital management options

- If repeat seizure occurs more than 10 minutes after the initial IV loading dose of magnesium, administer **Magnesium sulfate 2 g IV** over 10-15 minutes
- Respiratory depression may occur with magnesium toxicity
  - **Calcium gluconate 1 g IV** can be given for significant respiratory depression

Prolonged transport or in hospital management options

- If the patient continues to seize after repeat magnesium administration, consider **Midazolam 2-4 mg IV/IM**; may repeat x 1 for ongoing seizure
  - Alternate medications:
    - **Diazepam 5 mg IV/IM**; may repeat x 1 for ongoing seizure
- Antihypertensive medications
  - Treat persistent SBP >160 or DBP >110 mmHg (Goal: SBP <160 and DBP <110 mmHg)
    - **Nifedipine 20 mg PO** *(DO NOT* give sublingual)
      - **Nifedipine 10 mg PO** may be repeated every 30 min to a max of 40 mg
    - Alternate medications:
      - **Labetalol 10 mg IV**
        - If BP remains elevated above goal after 10 min, then administer **Labetalol 20 mg IV** every 10 minutes as needed to a max of 110 mg
      - **Labetalol 200 mg PO**
        - If BP remains elevated above goal after 30 min, then administer **Labetalol 200 mg PO** x 1 additional dose

How to mix and infuse Magnesium sulfate

- **Magnesium sulfate 4 g**: Mix 4 ampules of 50% $MgSO_4$ (1 g/ampule) in 100 mL NS
  - Infuse over 10 minutes, 100-150 drops per minute
- **Magnesium sulfate 2 g**: Mix 2 ampules of 50% $MgSO_4$ (1 g/ampule) in 100 mL NS
  - Infuse over 10 minutes, 100-150 drops per minute

Monitor the patients' vital signs, oxygen saturation, deep tendon reflexes, and level of consciousness every 15 minutes for the first hour, and every 30 minutes for the second hour.

Assess for signs of *magnesium toxicity* (e.g., visual changes, somnolence, flushing, muscle paralysis, loss of patellar reflexes) or pulmonary edema.

References

- Advanced Life Support in Obstetrics (ALSO) Provider Course Syllabus Fourth Edition, Copyright 2009, American Academy of Family Physicians

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

Note: *We have discussed whether this best fits under the cohort studies or cross sectional studies. Varying opinions exists within and outside our authorship group. We decided to use the cohort studies STROBE checklist. They are very similar and we hope either would have been considered appropriate.*

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract □ "Characteristics and Outcomes of Women Utilizing EMS for Pregnancy-Related Complaints in India: A Prospective Observational Study" <Page 1>
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found □ Please refer to abstract <Page 4>
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported □ Please refer to Introduction where we describe the importance of facility-based delivery with a skilled birth attendant to decrease the MMR and pregnancy related complications, the potential solutions that have been attempted in India, and the importance of studying the impact and reach of these solutions. <Page 6>
Objectives	3	State specific objectives, including any prespecified hypotheses □ "Our study seeks to characterize the demographics, management, and outcomes of obstetric patients transported and treated by GVK EMRI." <Page 6>
Methods		
Study design	4	Present key elements of study design early in the paper □ Please refer to paragraphs 1 and 2 of the Methods section. <Page 7>
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection □ Please refer to paragraphs 1, 2, and 3 of the Methods section. <Page 7>
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up. □ Please refer to paragraphs 2 and 3 of the Methods section. <Page 7>
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable □ Please refer to paragraph 4 of the Methods section. <Page 7>
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. □ Please refer to paragraphs 3 and 4 of the Methods section. <Page 7>
Bias	9	Describe any efforts to address potential sources of bias □ We acknowledged potential biases in the Limitations part of the Discussion section. <Page 11>
Study size	10	Explain how the study size was arrived at □ Extracted from paragraph 2 of the methods section. "We enrolled a convenience sample of patients for a defined six-week period from February 17 through April 10, 2014. Based on research assistant availability, patients were enrolled Monday through

		Saturday, during daytime hours for six hours per day." <Page 7>
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Please refer to paragraph 4 of the Methods section. <Page 7>
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Please refer to paragraph 4 of the Methods section. <Page 7>
		(*b*) Describe any methods used to examine subgroups and interactions Please refer to paragraph 4 of the Methods section. <Page 7>
		(*c*) Explain how missing data were addressed We do not report on any variables, other than mode of delivery, that had greater than 6% missing data. <Table 1, Page 15> 13.2% of patients who delivered did not have a recorded mode of delivery. Patients with a known mode of delivery were compared with those whose mode of delivery was not recorded. There were no significant differences demographically or by obstetric history between the two groups. <Table 4, Page 19>
		(*d*) If applicable, explain how loss to follow-up was addressed Rates of loss to follow-up were reported clearly in paragraph 4 of the Results section. <Page 8>
		(*e*) Describe any sensitivity analyses A sensitivity analysis was not applicable.
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Please refer to paragraphs 1, 4, and 6 of the Results section. <Page 8, 9>
		(b) Give reasons for non-participation at each stage Please refer to paragraphs 1, 4, and 6 of the Results section. <Page 8, 9>
		(c) Consider use of a flow diagram Enrolment was limited by data collector availability and the pre-defined timeline for data collection. Eligible patients were followed through to completion of the study. Patients refusing consent for treatment or transportation were initially excluded from the study as noted in the Methods section. We feel a flow diagram would add little value given that it would show no patients dropping out after enrolment in the study other than those patients loss to follow up. <Page 7>
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Please refer to Table 1 in the Results section. <Page 15>
		(b) Indicate number of participants with missing data for each variable of interest Please refer to the Tables. We chose not to note the missing data directly in the table or in footnotes because the missing data is low (<6%) for each variable and the exact number can be easily calculated from the Tables themselves. <Pages 15-19>
		(c) Summarise follow-up time (eg, average and total amount) Please refer to paragraph 4 of the Results section. <Page 8>
Outcome data	15*	Report numbers of outcome events or summary measures over time Please refer to the Results section and Tables. <Page 8, 15-19>
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included. Please refer to of the Results section. Confounder-adjusted estimates were not

		applicable. <Page 8>
		(*b*) Report category boundaries when continuous variables were categorized Please refer to paragraph 3 of the Results section. <Page 8>
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses Please refer to paragraphs 5 and 6 of the Results section. <Page 8, 9>
Discussion		
Key results	18	Summarise key results with reference to study objectives Please refer to paragraphs 2-5 of the Discussion section. <Pages 9-11>
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Please refer to the Limitations sub-section of the Discussion. <Page 11>
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Please refer to Discussion and Conclusion sections. <Pages 9-11>
Generalisability	21	Discuss the generalisability (external validity) of the study results Please refer to Limitations sub-section of the Discussion. <Page 11> "The generalizability of our findings is limited by a lack of data collection beyond daytime hours and the predominance of three of the five states in our sample."
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based. Please refer to paragraph 3 of the Methods section. "The study was funded jointly by Stanford University and GVK EMRI." <Page 7>

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.