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Averting maternal death and disability

Efficient and effective emergency obstetric care in a rural Indian community where most deliveries are at home

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Abstract

Objectives: Most life threatening obstetric complications require hospital treatment to avert maternal mortality. Some assume that in developing countries hospital service for the poor must be in government hospitals and that a large proportion of deliveries needs to be in these hospitals to provide timely access to emergency care. This presents a major problem in countries like India, where almost all rural deliveries are at home and accessible government hospitals generally do not provide surgical treatment for obstetric emergencies. The study's objective was to determine obstetric outcomes, patterns and costs of obstetric care in a part of rural Maharashtra, India, where obstetric outcomes appear relatively good even though most deliveries are at home and government hospitals do not provide emergency obstetric care (EmOC). *Methods:* 2905 pregnancies were identified and followed to term to learn the number and types of complications, where these complications were treated, how many women received EmOC and how these services affected outcome. *Results:* Eighty-five percent of 2861 deliveries after 24 weeks were at home. A total of 14.4% of deliveries after 24 weeks had identified complications. Of these complicated deliveries, 78.9% were in a hospital. Forty-eight percent of hospital deliveries were in a private hospital, 35% in our project hospital and 18% in a government hospital. Hospitalized patients with obstetric complications constituted 11.4% of all deliveries. The cesarean section rate for all deliveries was 2.0%. Twenty-two of the cesareans were in private

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hospitals, 32 in our hospital and four in a government hospital. Hospital case fatality (deaths of mothers with identified complications) was 0.3%. Overall case fatality was 0.5%. However, there were only two maternal deaths from obstetric causes (70 per 100 000 live births), making these rates less than robust. The perinatal mortality rate was 36 per thousand live and still births. These outcome and process indicators are better than those reported in most of India, but both maternal deaths could have been prevented by early referral to hospital and 64% of perinatal deaths were to infants delivered at home. *Conclusions:* A network of private clinics with a voluntary, low cost hospital is providing effective EmOC in a remote rural area at very low per capita cost in the absence of easily accessible government service and with only 15% of deliveries in hospitals. Charges are low but low per capita cost is primarily due to intelligent self-selection of patients who need hospital care. Even though overall cost is low, cost is still an important barrier for many poor families. Improving the purchasing power of poor families through insurance or subsidy could be a more effective way to improve EmOC than trying to improve inadequate government facilities.

Keywords: Emergency obstetric care; Referral; Home deliveries; India

1. Introduction

The Safe Motherhood Program, launched in 1987, has emphasized the importance of access to emergency obstetric care (EmOC) to manage the common causes of obstetric death: obstructed labor, hemorrhage, eclampsia and infection [1–4]. Some have assumed that most of the population in very poor countries would have to receive services in government hospitals, and that home deliveries would have to be phased out to provide for rapid response to emergencies. Certainly it is true that most places with low maternal mortality have high rates of hospital delivery — over 90% in Sri Lanka, for example. If such high rates were to be essential, it would pose important problems for many countries, such as India, Bangladesh and Pakistan, where most deliveries in rural areas are still at home and public hospital systems have serious deficiencies. In India, the generally poor results achieved in providing service for a much simpler problem, family planning, does not lead to optimism about the future for clinical services in government hospitals [5].

In our project area 85% of deliveries are at home and the nearest government hospital able to perform cesarean sections is more than 2 h away, but obstetric outcomes are better than might be expected. Maternal deaths are rare, perinatal mortality is lower than in most of India, and it is unusual to encounter complications attributable to total lack of obstetric care such as vesico-vaginal fistula, ruptured uterus, and sepsis related to prolonged obstructed labor.

Several factors have contributed to this situation:

- cultural and traditional objections to modern obstetric care have almost disappeared;
- almost every family knows that obstructed labor, hemorrhage, convulsions, and sepsis are treatable conditions;
- women's health has improved, due primarily to improved nutrition and health care before pregnancy begins;
- in the private and public sector the number of doctors, auxiliary nurse midwives and others with basic obstetric knowledge has increased many fold;
- basic obstetric services are available in several private clinics and our own small hospital; and
- intense competition has kept the cost of private care relatively low.

2. The community

The 25 villages in this analysis are in south-central Maharashtra, in the southernmost part of Ahmednagar District, surrounding the town of Jamkhed, population approximately 50 000. The district capital, Ahmednagar, has large public and private hospitals, which provide full obstetric ser-

vices, and is 80 km away from Jamkhed town — approximately 2 h by car. A hospital in Jamkhed has an operating room, but up to now has never simultaneously had both an anesthetist and an obstetrician available to perform a cesarean section. The government hospital at Barshi, 100 km from Jamkhed, does do cesarean sections and is convenient for some of the project villages.

There are more than 50 registered medical practitioners in the area, only eight of them fully qualified physicians with an MBBS degree. Both MBBS and non-MBBS doctors take obstetric patients and four or five have quite large obstetric practices. They do not do cesarean sections and rarely do any other kind of surgical procedure. 'Non-MBBS' doctors are almost all trained in Ayurvedic medical schools, but use allopathic practices almost exclusively. Patients needing surgery are referred out, most commonly to our hospital but not infrequently to other, more distant places (see Fig. 2).

All private facilities charge fees. While our hospital has comparable charges, they are somewhat lower for patients from active project villages. We maintain a 20% reserve for charity. Until recently, blood transfusion was easily available using local donors; local laboratories did cross-matching and other tests. Recent legal decisions in India have made this impossible until a fully trained pathologist is available. We have partially addressed this problem by keeping two units of legally tested O + blood on hand at all times.

The area is drought prone and one of the poorest in rural Maharashtra, but there has been considerable development in the last 25 years. All villages are served by some sort of road. Jeeps are accessible for most villages, either in the village or in an adjacent one. All villages are electrified, have schools and have tube wells with clean water. Starting with food for work programs in the early 1970s and continuing to the present, hundreds of check dams have been constructed. (Check dams are small dams designed to retard drain-off of rainwater and maintain a higher water table.) These and other water conservation projects have made irrigation much more widely available, so that agricultural production has increased. Sugar factories in adjacent districts provide opportunities for employment giving supplemental income to many families. Ninety-five percent of the people in villages are Hindu. While the caste system still exists, it has not kept the lower castes from participating in economic development, attending school, and having access to clean water.

All of the above does not mean that these villages are rich. The considerable progress that has occurred has converted a desperate situation, not compatible with life for many, into one that is less desperate, more equitable, and holds the possibility for improvement. Forty percent of rural Maharashtran families are below the poverty line [6] — which, in 1994 was defined as a disposable income of 230 Rupees ($6.60) per capita per month. This income level was chosen by the National Sample Survey of India to define a group that did not have enough disposable income to maintain an adequate diet for all of the year [7]. Those below the poverty line spend 70% of income on food.

3. The project and its villages

The Comprehensive Rural Health Project (CRHP) at Jamkhed started work in 1971 [8]. The area was chosen because of its serious health problems and because local political support was available. From the beginning it has been a comprehensive project, addressing all of the important factors influencing health. The most important problem in 1972 was drought and famine so the project became the leader in the development of food for work programs, which started check dam construction, and in feeding programs for high-risk groups. Agricultural development through farmers' clubs has always been an important component. Prevention of disease through better nutrition, better water supply, immunization, health education and family planning were the main activities in the beginning, but as government activities in these areas became stronger they were largely turned over to government. Equal participation of all caste and religious groups in all programs has been an essential

element. Clinical medical services through clinics and a small hospital have been available from the beginning.

Over 29 years CRHP has worked in 175 villages in the Jamkhed area. It was never intended that the project would stay permanently in any village. As conditions improve, active works stops in a village and starts in a new one. The present 25 villages have been active for 5 to 10 years and are now the base for training programs for persons from other parts of India and from many other countries, who want to start similar programs. Training and organizing is now under way in 25 new villages not included in this review. There are no other non-governmental organizations doing health work in the area.

The CRHP hospital admits 4000–5000 patients per year, with 425 deliveries in 2000. Forty-five percent of deliveries are complicated and 38% are by cesarean section. Only 20% of deliveries are referrals from active project villages. It is the only hospital in the area equipped and staffed to do a cesarean section, although women in some peripheral villages can just as easily go elsewhere.

Training of Village Health Workers (VHWs) has probably been the project's most important activity. These are mature women, selected, trained, and now working in their own villages. They are not paid by the project, except for a Rs 50 per diem 1 day per week, when they come to the project center for a meeting. Additional income comes from fees for services and the sale of basic medicines. They provide basic health education and clinical service, particularly for women and small children in their villages. They are trained to conduct a safe home delivery, to identify problems requiring referral, and to discuss the indications for referral with pregnant women and their families. There are very few traditional birth attendants in this area and most deliveries at home are conducted by family members. VHWs are called for the actual delivery in 40% of those cases in which the mother chooses to deliver in the home village. They identify and follow all pregnant women in their villages, including many who go outside to be with the maternal family during and for several months after delivery. They keep a record of the outcome, the place of delivery and any complications before during and after delivery. If an outside referral is necessary, they usually accompany the family. The VHW records are reviewed in weekly meetings at the project center.

The pattern of migration of mothers in the months before delivery is complicated. As in most of India, more than 90% of marriages are between families from different villages and many women go home to be with their mothers at the time of delivery. Among the 2861 pregnancies here that went to term, 37% were to mothers who left a CRHP village to go to the maternal home and 28% were to mothers who now reside outside the CRHP but came to the maternal home for delivery (see below and Table 2).

4. Methods

The VHWs' record books for the preceding 4 years were reviewed. Each record was reviewed with the VHW who had followed the pregnancy, but we did not review hospital or clinic records outside of our own facility. Information was recorded on 2905 pregnancies entered in these books between 1 January 1996 and 1 July 1999 and followed to term. All pregnancies followed by the VHWs were included, regardless of whether the birth took place in a CRHP village or outside. Because the VHWs were village residents and personally acquainted with the families, they were able to obtain detailed information about events before, during and after delivery even in cases in which they were not present at delivery. In the case of women who went outside for delivery, this information was usually obtained from the mother after her return to her husband's village, but there were 60 instances in which the mother did not return and the informant was a close relative. There were no maternal deaths identified outside of the CRHP villages.

Ninety percent of pregnancies among village residents were identified by the 26th week. Ninety-two percent of mothers who came to a CRHP village from outside came before the 35th week of gestation. Some preterm deliveries will have been missed in this latter group, which is a

factor in the slightly lower rate of preterm delivery observed among those who came from outside. Abortions were missed in most cases, as events before the fourth or fifth month of gestation were not recorded. These problems will be present in any population-based survey of pregnancy outcomes in Indian villages.

Date of delivery was known exactly, but date of last menstrual period was recorded as the *month* of the last menstrual period (LMP). Length of gestation was estimated by calculating the weeks elapsed between the 15th of the LMP month and the date of delivery. Maternal deaths were confirmed by family interviews to determine the probable causes and whether they were related to the pregnancy.

The reliability and validity of information in the VHW records was checked in a 10% sample of households, randomly selected using village maps created with the help of community residents. In addition, selected residents in each village were interviewed to confirm maternal deaths and major complications as well as to identify any that were missed. All maternal and infant deaths reported or identified were confirmed with a household interview. Accuracy of the VHW records was greater than 90% in 23 of 25 villages. In the two with less than 90% accuracy, 100% of households were interviewed to confirm outcomes and check for additional pregnancies. Through this process, 153 additional pregnancies, four deaths of pregnant or parturient women and 15 perinatal deaths were identified. All of the additional deaths of pregnant or parturient women were from accident or illness unrelated to the pregnancy.

Data were processed in EpiInfo 6.04b [9].

5. Results

Of the pregnancies that went beyond 24 weeks, 2436 (85%) were delivered at home — most often by a family member, but in 23% of cases by a project VHW. (In the case of mothers that did not leave the project village for delivery, 40%

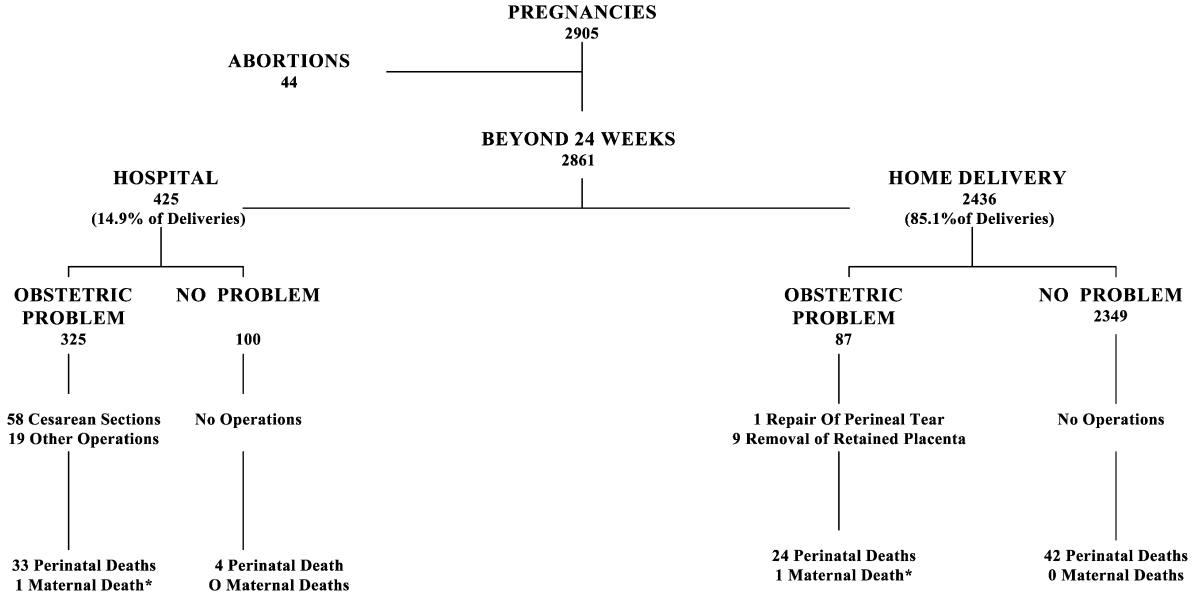

Fig. 1. Identified obstetric complications, place of delivery and outcome.

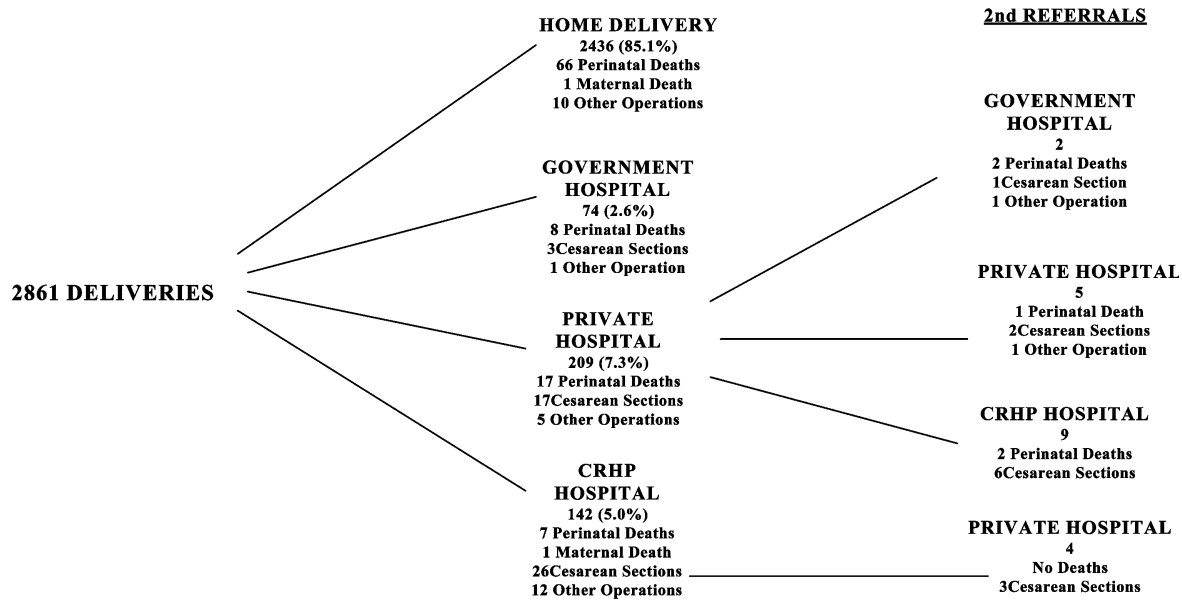

Fig. 2. Movement through the health system and outcomes.

were delivered by a VHW.) A total of 412 patients (14.4% of all deliveries) had identified obstetric complications. Of those with obstetric problems, 78.9% had a hospital delivery. Of all home deliveries, 3.7% were attended by private doctors, government health workers, or 'trained' birth attendants called in by the family. Fifteen percent of births were in hospitals, most often a small cottage hospital with a non-MBBS doctor. Overall, 47.5% of hospital deliveries were in a private facility, 34.6% were at the CRHP hospital, and 17.9% were in a government hospital. Thirty-two cesarean sections were done at our hospital, 22 in private hospitals and four in government hospitals (Figs. 1 and 2).

Hospitalized patients with obstetric complications constituted 11.4% of all 2861 deliveries (Table 1). The cesarean rate for all deliveries was 2%. Hospital case fatality (maternal deaths from obstetric causes among patients with obstetric complications) was 0.3% and overall case fatality was 0.5%. With only two maternal deaths the confidence interval for the maternal mortality ratio is very wide, but we have estimated with 95% confidence that this ratio is below 250 per 100 000 (using an exact binomial test). WHO and UNICEF currently estimate a maternal mortality ratio of 550 per 100 000 for India as a whole [10]. Both maternal deaths were due to bleeding: one patient had severe postnatal bleeding and died at home 24 h after delivery. The other arrived at our hospital with a hemoglobin of 6 g and a history of antenatal hemorrhage. She died after cesarean section for partial placental abruption. Both could probably have survived with prompt hospitalization, even in our situation where the possibility of blood transfusion is limited.

The overall perinatal death rate was 36/1000. Out of 103 perinatal deaths, 66 were home deliveries. We were not able to assign causes to most of the perinatal deaths (both stillbirths and deaths during the first week) not associated with obstetric complications.

A total of 1070 women (37%) left the CRHP villages that were their home to be with their mothers during and after delivery. Most went to the maternal home 2 or more months before delivery and stayed 2 months or longer afterward. Women who left the CRHP village had the same rate of complications, the same rate of hospital delivery, and the same rates of preterm delivery and perinatal death as those who delivered in a

Table 1
Outcome and process indicators at CRHP and in two other rural South Asian locations

	CRHP		Pune District Maharashtra, India [17]		Mawanella District Sri Lanka [17]	
	No.	Rate	No.	Rate	No.	Rate
Deliveries	2861		4138		1762	
Outcome indicators						
Stillbirths	54	18.9[a]	81	19.6[a]	45	25.5[a]
Perinatal deaths	103	36.0[a]	187	45.2[a]	55	31.2[a]
Neonatal deaths	62	22.1[b]	153	37.7[b]	12	6.9[b]
Maternal deaths	2	70[c]	4	97[c]	1	57[c]
Preterm births		2.2%		6.6%		11.3%
Process indicators						
Hospital/Health Center deliveries	425	14.9%	31%	97%		
Cesarean sections	58	2.0%	2%	4%		
Obstetric comp's	412	14.4%				
Hospitalized obstetric comp's	325/412	78.9%				
Hosp. obst. comp. as % of all pregnancies	325/2861	11.4%				
Hospital case fatality	1/325	0.3%				
Overall case fatality	2/412	0.5%				
Perinatal deaths associated with obst. comp's.	57/2861	19.9[a]				

Maternal deaths are deaths from obstetric causes or from conditions aggravated by the pregnancy. 'Case fatality' refers to maternal deaths among women with obstetric complications. Births at less than 24 weeks are considered abortions and not included.
[a] Per 1000 live births and stillbirths.
[b] Per 1000 live births.
[c] Per 100 000 live births.

CRHP village (Table 2). Among infants born in a CRHP village, those born to mothers with no resident maternal family had a significantly higher perinatal mortality rate and those born to mothers who came to the project village to be with the maternal family had a significantly lower rate.

The direct cost of the obstetric service provided was estimated by combining the well known prevailing fees in the area with our own estimates of the cost of transport, medical supplies, and food for patient and attendants (Table 3). Fees charged in our area combine the cost of the physicians' services with the hospital cost. Patients' families buy the medical supplies needed and provide food for patients and attendants. The CRHP hospital charges fees similar to those of a private hospital — Rs 500 (US$12.50) for a normal delivery and Rs 5000 (US$125) for a cesarean section. We have used these fees as a base for calculating the cost of all non-government hospital deliveries, but patients from active project villages pay somewhat less and approximately 25% of all CRHP patients pay lower fees, based on the family situation. The estimate for the cost of government service includes medical supplies, food, and a variable charge for professional services. This last is difficult to be sure of, because it is illegal. With 85% of patients not requiring hospital care, the overall

Table 2
Location of mother in last months of pregnancy

	Deliveries		Hospital deliveries		Deliveries with obstetric complications		Preterm deliveries[a]		Perinatal deaths[b]	
	No.	%*	No.	%**	No.	%**	No.	%**	No.	%**
Left CRHP village to go to mother's family	1070	37.4	155	14.5	141	13.2	22	2.1	39	36.4
Stayed at CRHP village with husband's family	802	28.0	118	4.7	120	15.0	27	3.4	44	54.9
Came to CRHP village to be with mother	797	27.9	123	15.4	124	15.6	15	1.9	12	15.1
Visitor	19	0.7	6	0.6	5	26.3	0	2		
Both husband and mother in CRHP village	172	6.1	19	11.0	22	12.8	0	5	29.1	
Total	2861	100	421	14.7	412	14.4	64	2.2	102	35.7

* Percentage of all deliveries. ** Percentage of deliveries in this category (155/1070, etc.).
[a] Excluding visitors, for observed differences chi square = 8.80; $P < 0.05$.
[b] Excluding visitors, for observed differences chi square = 17.63; $P < 0.01$.

Table 3
Estimated direct cost (in rupees) of assisted deliveries in the CRHP villages

	Rupees
Hospital and clinic deliveries:	
54 private cesareans @ Rs 5000 + 1000[a]	324 000
18 private other operations @ Rs 1000 + 500	27 000
276 private vaginal deliveries @ Rs 500 + 100	165 600
20 patients seen at a private hospital and referred out @ Rs 300 + 100	8000
4 government hospital cesarean sections @ Rs 2000	8000
1 government other operation @ Rs 1000	1000
70 government vaginal deliveries @ Rs 150	10 500
Subtotal	544 100
Home deliveries:	
556 VHW deliveries @ Rs 80	44 500
20 'trained dai' deliveries @ Rs 80	1600
41 government health worker deliveries @ Rs 150	6200
29 doctor assisted deliveries @ Rs 300	8700
Subtotal	61 000
Transport:	
445 trips to hospital or between hospitals @ Rs 500	222 500
TOTAL	827 600

827 600/2861 = Rs 290 = US 0.90 per delivery. With birth rate @ 35/1000, cost is Rs 10 = US 0.24 per capita per year. With General Fertility Rate @ 120/1000 women (per 1000 women aged 15–44), cost is Rs 35 = US 0.83 per woman per year.
[a] Rs 5000 for professional services and hospital, plus Rs 1000 for medical supplies and food for patient and attendants.

average direct cost came to Rs 10 (US$0.24) per capita per year or Rs 35 (US$0.83) per woman of childbearing age per year.

6. Discussion

Because all of these pregnancies either began in a project village or came to a project village for delivery, we believe that the CRHP's effort to teach when referral is needed during delivery was an important factor in these results. However, the project did not play the only role in service delivery. Thirty-seven percent of women went outside of the project area to have delivery at their mothers' homes. CRHP personnel were present at only 23% of home deliveries and 36% of hospital deliveries. There was no difference in hospital utilization or outcome between those who delivered in a CRHP village and those who went outside for delivery (Table 2). The most complicated problems usually came to the project hospital, but for various reasons 45% of cesarean sections were done in other hospitals. Even in relatively remote parts of India, projects and hospitals like ours function as a part of a system which, especially in the private sector, is increasingly able to provide for basic obstetric emergencies. Of course there is variation between states and regions, but this certainly true in most of Maharashtra. Another prospective pregnancy survey in a district adjacent to ours produced comparable results, with a 2% cesarean rate (Table 1). This area is also rural, with a similar economic status, but relatively close to a large city (Pune). Obstetric referrals were to a private hospital in Pune, which charges the usual fees, but provides some charity.

The definition of an 'obstetric complication' can be imprecise, especially in situations where most births take place at home. Even in a hospital it is hard to define when bleeding or prolonged labor become a complication. Retrospective surveys generally give much higher rates than prospective [11]. Comparisons of rates for various complications vary widely between different reports [12–14], largely because of different perceptions of what is a complication. Still, it is generally believed that between 10 and 20% of pregnancies will develop a complication that should be treated in a hospital [15]. Our rate of 15% complicated deliveries falls within that range.

The estimated per capita cost of the obstetric service provided is low, even for India, but the cost of a surgical procedure to one of the 40% of families below the poverty line is a serious burden. A family of five that is at the poverty line will have annual disposable income of Rs 14 000. Rs 6000 for a cesarean section represents 43% of this annual disposable income. As these families spend 70% of income on food, they may well have to reduce food intake to pay the bill. Cash payment is usually required before hospital discharge. Most poor families get the money from a moneylender, at high interest rates.

In terms of both outcome and process indicators, the obstetric results reported here compare favorably with other reports from poor developing countries, even though 85% of deliveries were at home (Table 1). Perinatal and neonatal death rates are quite low for rural India. Maternal deaths are few, although a statistically valid rate cannot be calculated. Seventy-nine percent of women with recognized obstetric complications were treated in a hospital. Two percent of deliveries were by cesarean section. It is important to note that all this came about in the absence of reasonably accessible government obstetric services, without any organized program to transport patients with obstetric complications to a medical facility, and despite considerable financial barriers to the use of the private sector.

However, there is plenty of room for improvement in these results. Two-thirds of perinatal deaths were home deliveries, both deaths from obstetric causes and from other causes such as low birth weight, aspiration, respiratory infections and sepsis which can usually be effectively treated by hospital or energetic home treatment programs [16]. It is likely that many of the unexplained stillbirths were actually infants born with a heartbeat who could have been resuscitated with mouth to mouth or other assisted respiration. Both of the maternal deaths from bleeding required early hospitalization, but lived long enough to have survived if there had been ener-

getic efforts to get them to a hospital in time. Finally, movement through the system is slow, so that avoidable maternal and perinatal deaths occur in hospital from obstetric complications — 23 of 29 perinatal deaths associated with prolonged labor were deaths of babies born in hospitals.

7. Summary and conclusions

The important findings are:

- 79.4% of women with obstetric complications found their way to a hospital, even though almost all deliveries start at home and 85% deliver at home;
- primary and secondary obstetric services were widely available outside of government hospitals in a remote rural area;
- the per capita cost of these services was very low, primarily because of intelligent self selection by the women and their families; and
- basic knowledge about the need and indications for hospital obstetric care was widespread.

We conclude that while accessible hospital back-up for home delivery is essential, great progress toward reduction of maternal and perinatal mortality can be made long before a 90–100% rate of hospital delivery is achieved. Progress in staffing and equipping government hospitals to provide this backup has been extremely slow, both in our area and in other parts of India. Given this lack of progress and the rapid increase in availability of obstetric care at relatively low cost in the private sector, private practitioners and non-government hospitals will provide most hospital obstetrics in most of rural India for the foreseeable future. Fortunately 110 fully qualified obstetricians finish training programs in Maharashtra every year, and the increase in training posts has consistently exceeded the increase in population. Because the 'market' of paying patients in cities is already saturated, most of them will have to practice in the small towns scattered across the rural areas.

Even though the per capita cost of the mixture of home delivery and hospital care found in our area is well within what can be afforded in India, there are important financial barriers to utilization of hospitals by families below the poverty line. Private hospitals provide charity, but few are in a position to give care below cost to the large numbers of families that need it. It would be ideal to spread the per capita cost through the community with some sort of insurance, but experience with health insurance in poor developing countries has not been good [18,19]. Given the small amount of income left after meeting necessities, poor families that need insurance have not been willing to pay enough to create practical programs. A small subsidy (less than Rs 100 — US$2.50 — per woman per year) could resolve the problem for the poor and improve the financial position of those private hospitals giving charity care. Creating purchasing power for women in poor families would influence the way obstetric service delivery develops in India. New ideas about how to create and administer such a subsidy are needed.

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