RESEARCH ARTICLE

IMPROVED ACCESS TO SAFE BLOOD MUST BE PRIORITIZED AS A CORE COMPONENT OF COMPREHENSIVE EFFORTS TO PREVENT MATERNAL DEATHS IN UTTAR PRADESH, INDIA

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ABSTRACT
Background: Postpartum hemorrhage is responsible for 39% of maternal deaths in India. Provision of blood transfusion is one of the key components of functional First Referral Units (FRU) meant for providing Comprehensive Emergency Obstetric Care (CEmONC). However, in the absence of functional FRUs, there is hardly any facility available which can provide safe blood transfusion to a haemorrhagic woman in Uttar Pradesh (UP).
Aims & Objectives: The objective of this study was to argue for improving access and availability of safe blood transfusion for women, who are haemorrhagic and/ or severely anaemic, on priority basis, to prevent maternal deaths.
Materials and Methods: Community based maternal death review and facility review was conducted in district Unnao, UP, and information gathered on maternal deaths. Out of the 57 maternal deaths analyzed, 37 were due to hemorrhage and severe anaemia. Pearson correlation test was performed between maternal mortality ratio (MMR) and number of estimated pregnancies per blood bank, for five key states including UP.
Results: Out of 57 maternal deaths, 37 maternal deaths were due to hemorrhage (39%) and severe anaemia (26%). Out of 15 facilities assessed; only the district hospital (6.7%) had a blood bank and transfusion facility and the rest 14 (93.3%) of the facilities had no provision for blood transfusion, blood storage unit (BSU) or dedicated staffs to handle any emergency. A significant correlation was observed between the MMR and number of pregnancies per blood bank ($r = 0.970$, $p=0.006$).
Conclusion: Given the role of blood transfusion in multiple obstetric emergencies, provision of blood bank /BSU at the FRUs, district hospitals, sub-divisional hospital (SDH) or community health center (CHC) needs to be given high level of priority to avert preventable maternal deaths in UP.
Key Words: Blood storage Units; Maternal Deaths; Postpartum Haemorrhage; Basic Emergency Obstetric and Neonatal Care (BEmONC); Comprehensive Emergency Obstetric and Neonatal Care (CEmONC)

Introduction

Globally, 35% of all maternal deaths were due to haemorrhage, especially postpartum haemorrhage (PPH).[1,2] It is estimated that anaemia contributes to more than 115,000 maternal deaths and 591,000 perinatal deaths globally per year.[3] Maternal Mortality Ratio (MMR) in India is 212 maternal deaths per 100,000 live births. UP is the second largest contributor to maternal mortality in India, with 359 maternal deaths per 100,000 live births.[4] In India, major causes of these deaths have been identified as anaemia, hemorrhage (both ante and postpartum), toxaemia, obstructed labor, puerperal sepsis, and unsafe abortions.[4] In rural India, about 40% of the maternal deaths are due to avoidable causes such as hemorrhage and anaemia.[5] From 2010 to 2012, most of the identified First Referral Units (FRUs) could not be fully operationalized due to lack of skilled man power (particularly anaesthetics and gynaecologists), adequate infrastructure, medicines, and blood storage facilities.[6-8] Institutional deliveries were very low, at 47% in India and 24.6% in UP.[9] The objective of this paper was to argue for improving access and availability of safe blood transfusion for women, who are haemorrhagic and/ or severely anaemic, on priority basis, to prevent maternal deaths.

Materials and Methods

Study Setting: The Unnao district had a population of 3.1 million, comprising 1.5% of the state's population.[11] The health indicators of Unnao for the year 2011 were as follows: birth rate = 22.2; estimated number of annual births = 69,055; number of institutional deliveries =14,488; estimated number of maternal deaths=248.[12] The female literacy was 57%; total fertility rate was 2.58.[11]

Study Design: A facility review was undertaken in 15 public health facilities, and a community based Maternal Death Review (MDR) was also conducted using a cross sectional study design.

Study Population: Key informants were requested to identify maternal deaths occurring in the district between June 1, 2009, and May 31, 2010. Figure 1 describes the sample selection strategy for the study. Eventually, verbal autopsy could be carried out in 57 cases out of the sample of 70. The remaining 13 deaths out of 70 were lost due to different reasons. 7 deaths were found to be not related to pregnancy or childbirth, 2 were outside the study period, 2 deaths has insufficient information, and 2 deaths could not be traced.

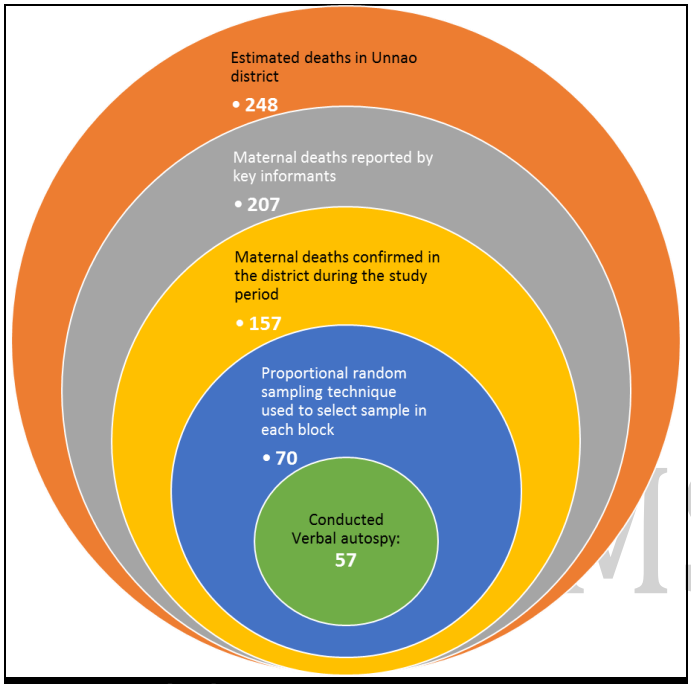

Figure-1: Sample selection strategy

15 health facilities in the district were selected to carry out a facility review, to identify the gaps in services focusing on readiness to manage obstetric complications.

Data Collection and Analysis: For conducting verbal autopsies, modified Maternal and Perinatal Death Inquiry and Response tool (MAPEDIR) was administered to husbands of the deceased and to women in the household for 57 cases. Concurrently, health facility review was also conducted across 15 selected health facilities. A tool, which was already validated and used for health facility survey to assess the current functionality of each facility, was adapted.[13-15] Data collected was coded and analyzed, and emergent themes were documented and studied to understand their implications, with respect to reducing maternal mortality. Descriptive analysis and applied chi-square test for statistical significance for verbal autopsies, with demographics against cause of death, was carried out. Sub analysis was also carried out for maternal deaths, which are associated with PPH and severe anaemia. In facility review, descriptive analysis using ratios to analyze the availability of basic infrastructure, necessary equipment, human resources, support staff, essential drugs, blood storage and transfusion services of the facilities was also carried out. All the data were analyzed anonymously using MS-Excel 2007 and SPSS 17©.

Box 1: Estimation of total number of expected pregnancies per year[10]

Expected number of live births (Y)/year = Birth rate (per 1000 population) x population of the area/1000

As some pregnancies may not result in a live birth (i.e. abortions and stillbirths may occur), the expected number of live births would be an under-estimation of the total no. of pregnancies. Hence, a correction factor of 10% is required, i.e. add 10% to the figure obtained above.

So, the total number of expected pregnancies (Z) = Y + 10% of Y

For the purpose of this manuscript, secondary data was also collected from online databases; population data from Census 2011, India; birth rate data from Sample registration system (SRS); blood banks data from Central Drug Standard Control Organization, and CHC data from Rural Health Statistics, Ministry of Health and Family Welfare. Then data was also extracted manually on demographics, expected pregnancies, existing CHCs, existing blood banks for the key states Kerala, Tamil Nadu, Karnataka, Maharashtra and UP. It was also estimated that whether the existing pregnancy load among given number of CHCs and blood banks is commensurate with the existing population of the states or not. Pregnancy load was also compared to the number of existing blood banks in UP, to corroborate with our study findings.[4,10-12,16-18] By using birth rate and total population, the expected live births and total number of expected pregnancies per annum were calculated (Box 1). Pregnancies per blood bank and pregnancies per CHC were also estimated to compare the pregnant women load on CHC and blood banks (table-2). Pearson correlation test was executed to check the correlation between MMR and number of estimated pregnancies per blood bank, for five key states including UP.

Ethics: Approval for the study was obtained from the Institutional Ethics Committee of the Public Health Foundation of India. All interviews were conducted after obtaining written consent from the family.

Results

Table 1 shows that 28% of the women got married before attaining the legal age of marriage. 74% maternal

deaths were linked to the age group 25 years and above. Maternal deaths were directly associated with the literacy status of the women (54%) and husband (46%). Maternal deaths were high among 49% of the pregnant women, who had ever sought antenatal care. Around 47% of the pregnant women belong to BPL category and had a BPL card.

Figure 2 illustrates that out of 57 maternal deaths, 37 maternal deaths were due to haemorrhage (22, 39%) and severe anemia (15, 26%). The rest 35% of maternal deaths associated with sepsis (14%), Eclampsia (11%), obstructed labour (7%) and unknown reasons (3%). Of the 57 cases analyzed, 48 women died in postnatal period while nine died in the antenatal period. Of these 48 pregnant women, 50% delivered at home, 48% in a facility and remaining 2% percent delivered en-route to a facility.

Of the fifteen facilities assessed, one was DH (6.7%), two CHCs were designated as FRUs (13.3%), four were CHCs (26.7%), and eight were Block PHCs (53.3%). None of the CHCs, designated FRUs and Block PHC's assessed met the recommended standards for BEmONC or CEmONC, according to Indian Public Health Standards (IPHS) guidelines.[19] Round-the-clock obstetric care services were not available in 93.3% (14) facilities, due to inadequate specialists and support staff.

Forty percent (06) facilities did not have Oxytocin in the labour room, while 27% (04) of the facilities did not have it even in the store. Misoprostol, the most effective drug for managing haemorrhage, was also not available in 53% (08) of the facilities. Only the district hospital (6.7%) had a blood bank and transfusion facility; and the rest 14 (93.3%) of the assessed facilities did not have any provision for blood transfusion or a blood storage unit or dedicated staffs to handle a maternal emergency or any other emergency (data not shown in the table or figure).

A significant correlation was observed between the MMR and number of pregnancies per blood bank (Pearson correlation coefficient (r) =0.970, p=0.006) among the key states including UP.

Figure 3 represents the three delays. It's a flow chart of delays occurring among women who died of PPH and severe anaemia.

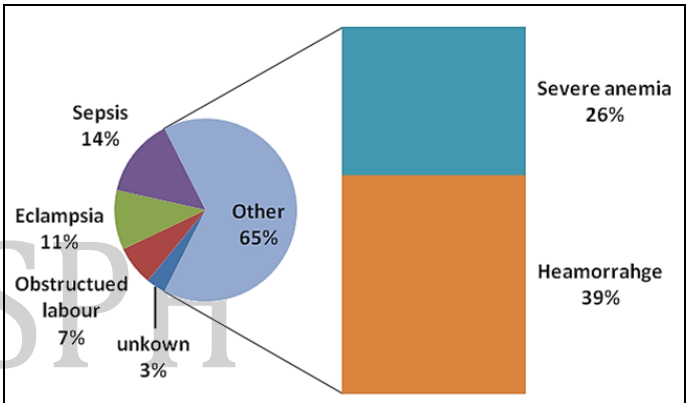

Figure-2: Cause of maternal deaths as reported, Unnao, Uttar Pradesh, India, 2010

Table-1: Demographics of the women respondents with causes of death in MDA study, Unnao district, UP, India, 2010

Characteristics		Total (N=57)		Severe Anaemia (n=15)		Hemorrhage (n=22)		Others** (n=20)		*p*-value[a]
		N	%	N	%	N	%	N	%	
Women's age at death (Years)	<25	15	26.3	4	7.00	5	8.80	6	10.5	0.866
	=>25	42	73.7	11	19.3	17	29.8	14	24.6	
Women's age at marriage (Years)	<18	16	28.1	3	5.3	6	10.5	7	12.3	0.617
	>18	41	71.9	12	21.1	16	28.1	13	22.8	
Women's education	Illiterate	31	54.4	9	15.8	13	22.8	9	15.8	0.611
	Literate	13	22.8	2	3.50	6	10.5	5	8.80	
	Don't know	13	22.8	4	7.00	3	5.30	6	10.5	
Husband's education	Illiterate	26	45.6	8	14.0	8	14.0	10	17.5	0.639
	Literate	29	50.9	6	10.5	13	22.8	10	17.5	
	Don't know	2	3.50	1	1.80	1	1.80	0	0.00	
Religion	Hindu	56	98.2	15	26.3	21	36.8	20	35.1	0.445
	Muslim	1	1.80	0	0.00	1	1.80	0	0.00	
Caste	Scheduled Castes*	25	43.9	8	14.0	9	15.8	8	14.0	0.407
	Scheduled Tribes*	1	1.80	1	1.80	0	0.00	0	0.00	
	Others	31	54.4	6	10.5	13	22.8	12	21.1	
BPL card[†]	Yes	27	47.4	6	10.5	11	19.3	10	17.5	0.793
	No	28	49.1	8	14.0	11	19.3	9	15.8	
	Don't know	2	3.50	1	1.80	0	0.00	1	1.80	
Seek Antenatal Care (ANC)	Yes	28	49.1	4	7.00	11	19.3	13	22.8	0.1
	No	25	43.9	10	17.5	8	14.0	7	12.3	
	Don't know	4	7.00	1	1.80	3	5.30	0	0.00	

** "Scheduled Castes" and "Scheduled Tribes" are historically disadvantaged communities. † Can be used to access all the welfare schemes provided by the Government of India. ** Others include Sepsis, Eclampsia, obstructed labour, and unknown cause. [a] P values , 0.05 were considered statistically significant.*

Table 2: Maternal and child mortality indicators, population, existing CHCs and existing blood banks in selected Indian states, 2011[4,10-12,17,18]

	Kerala	Tamil Nadu	Maharashtra	Karnataka	Uttar Pradesh
Area(km^2)	38,863	1,30,058	3,07,713	1,91,791	2,40,928
Population density per km^2	859	555	365	319	828
Population growth rate	4.86	15.6	15.99	15.67	20.09
Sex ratio	1,084	995	946	968	908
Literacy rate	93.91	80.33	82.91	75.6	69.72
Maternal Mortality Rate(MMR) (2010)	81	97	104	178	359
Birth rate	15.2	15.9	16.7	18.8	27.8
Total population	3,33,87,677	7,21,38,958	11,23,72,972	6,11,30,704	19,95,81,477
Expected live births (2011)*	5,07,492	11,47,009	18,76,628	11,49,257	55,48,365
Total no. of expected pregnancies annually (2011)*	5,58,242	12,61,710	20,64,291	12,64,183	61,03,202
Existing blood bank(as of March 2012)	163	271	293	178	212
No. of existing CHCs(2010)	233	256	365	325	515
No.of pregnancies per blood bank*	3,425	4,656	7,045	7,102	28,789
No. of pregnancies per CHC*	2,396	4,929	5,656	3,890	11,851
CHCs to blood banks ratio*	1.4	0.9	1.2	1.8	2.4

** Computed*

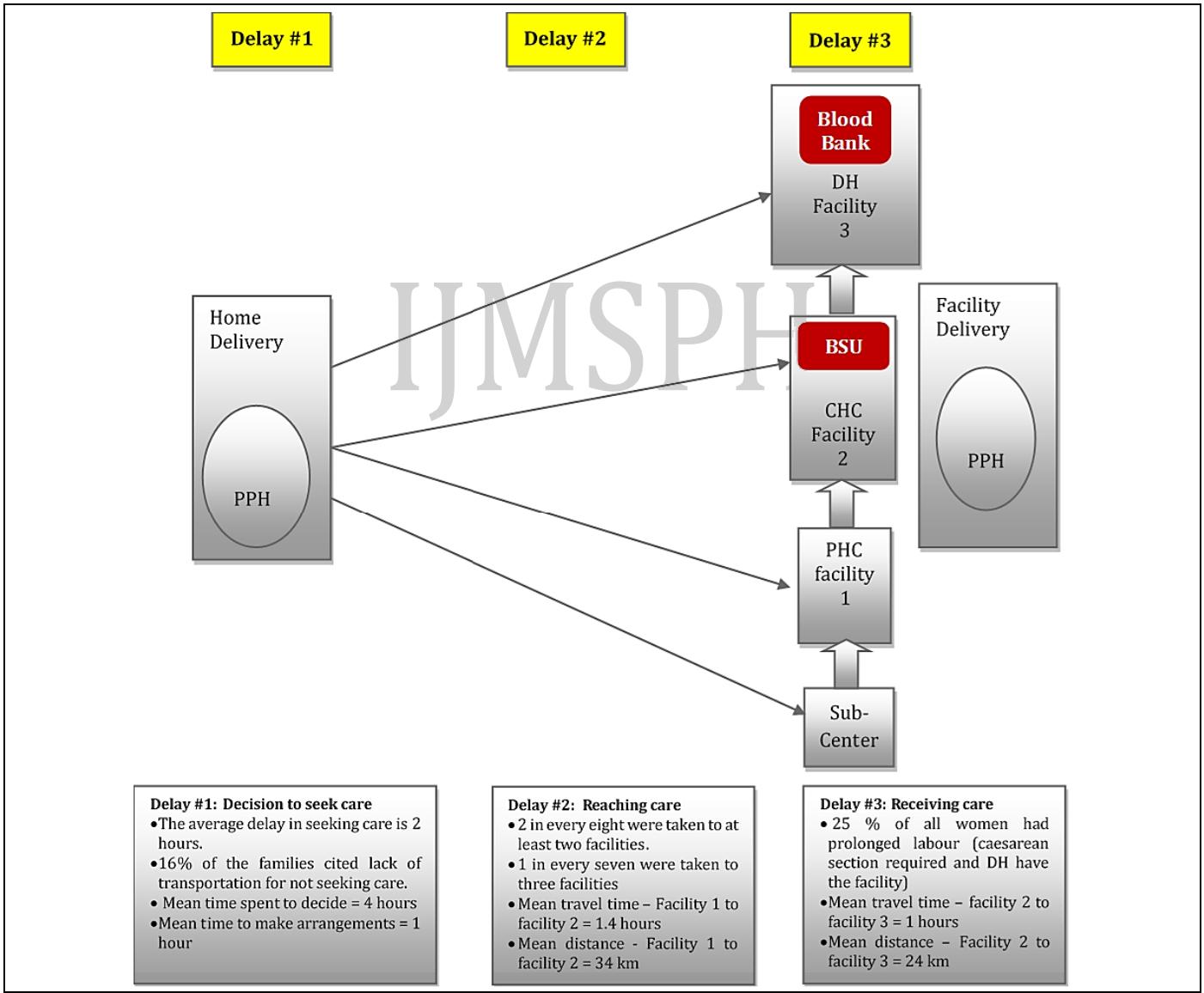

Figure-3: Flow chart of delays occurs among women who died of PPH and severe anaemia (N=37), Unnao District, UP, India, 2010 (PPH: Post-Partum Haemorrhage; PHC: Primary Health Centre; CHC: Community Health Centre; DH: District Hospital; BSU: Propose Blood Storage Units at the CHC to transfuse blood, may avert maternal deaths). #1 delay in decision to seek care, #2 delay in reaching care and #3 delay in receiving care. Around 47% of the deliveries took place in home, 53% of the women died within 4 hours of the onset of hemorrhage (PPH) and 40% of those women referred from facility-1 due to lack of blood. There should be trained staff and a good referral system at the PHC/CHC levels to handle the PPH cases. As proposed, if government set ups a functional blood storage units (BSUs) at the CHC/FRU, maybe 50% of the PPH deaths can be averted.

A sub analysis of 37 maternal deaths of the total 57 maternal deaths from the study was carried out. The average delay in seeking care is 2 hours; where 16% of the families cited lack of transportation for not seeking care; Mean time spent to decide = 4 hours; Mean time to make arrangements = 1 hour. Two in every eight were taken to at least two facilities; 1 in every seven were taken to three facilities; Mean travel time – Facility 1 to facility 2 = 1.4 hours; Mean distance - Facility 1 to facility 2 = 34 km. 25 % of all women had prolonged labor (caesarean section required and DH had the facility); Mean travel time from facility 2 to facility 3 = 1 hours; Mean distance – Facility 2 to facility 3 = 24 km.

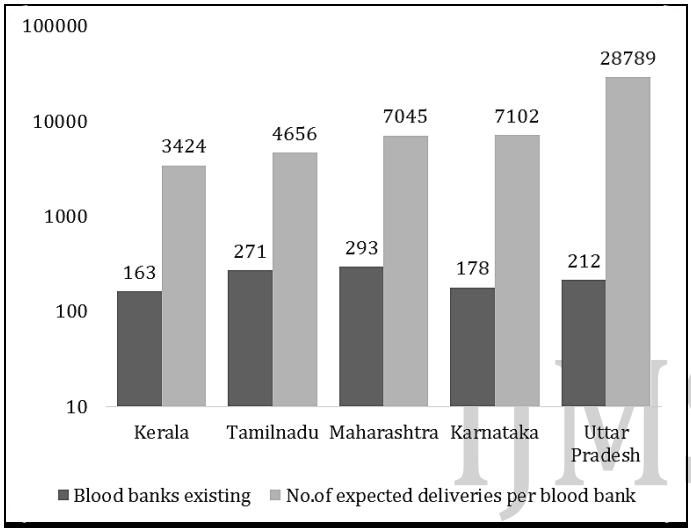

Figure-4: Existing blood banks and no. of expected pregnancies per blood bank, 2011

Discussion

Though the study was conducted in one of the districts, Unnao in UP, the preliminary results from the study inspired a broader picture for whole of UP. Of the 5.08 million deliveries expected in UP in 2010[11,20], severe PPH is estimated to have occurred in approximately 558,800 (11% of live births) and would have caused more than a third of the total 18,271 (32.7%)[21] maternal deaths in UP that year[4]. The situation is worsened by the presence of anaemia in more than 50% of the pregnant mothers.[22] Putting this in perspective, approximately 1,530 cases of severe hemorrhage occur daily in UP, an average of 21 in every district – and the need for appropriate management using uterotonic drugs and blood transfusions should be anticipated. Our study finding further substantiates these statements; 65% of the maternal deaths were due to severe anaemia and hemorrhage, as per Figure 1.

According to Census 2011, UP has a huge population base with 19.9 crores, which was 6 times the Kerala and twice that of Maharashtra population. There were 515 CHCs and 212 blood banks in UP. Total number of expected pregnancies per annum in UP alone is 61,03,202, which is more than the sum of the four key states with 51, 48,426 pregnancies per annum. The existing number of CHCs and blood banks were not commensurate with UP's population growth rate. The MMR of UP is more than Kerala (4.4 times), Tamil Nadu (3.7 times), Maharashtra (3.4 times), Karnataka (2.0 times) & the national average (1.7 times), as per Table 2.

As indicated in Figure 4, UP with 212 blood banks, has one of the highest number of pregnancies per blood bank (28789), compared to better performing states like Kerala (3425) and Tamil Nadu (4656). In UP, compared to other large states in India, nearly double the numbers of pregnancies are being served by a CHC. This is coupled with the fact that there are nearly two CHCs served by a single blood bank (2:1) in UP, compared to 1:1 in other states. This evidence tells us that there may be chances of high maternal deaths due to hemorrhage in UP, as shown in Table 2.

Active Management of the Third Stage of Labor (AMTSL) consists of three basic procedures: prophylactic use of an uterotonic agent (preferably Oxytocin) within one minute following delivery of the baby, delivery of the placenta with controlled cord traction and uterine massage after delivery of the placenta at every 15 minutes for two hours. The definition of AMTSL is supported by the International Federation of Gynaecology and Obstetrics (FIGO), the International Confederation of Midwives (ICM) and the WHO (Prendiville et al 2001; Joint Statement 2003; WHO 2000).

This definition differs from that of the original research protocol in the frequently cited Bristol (Prendiville et al. 1988) and Hinchingbrooke trials (Rogers et al 1998), where uterine massage is not included. The third stage of labor is the period between the birth of the infant and the delivery of the placenta. Active management of this period involves a combination of drugs and physical aid to deliver the placenta. By shortening the time between childbirth and placental delivery, AMTSL reduces the mother's blood loss. When excessive bleeding does occur it can be quickly identified and treated.

AMTSL can alone prevent PPH by over 60%.[23] Our study found out that 39% of the maternal deaths are attributed

to PPH, which is slightly higher than the global estimates of 35% of all maternal deaths due to haemorrhage.[1,2,24] Pregnant women with severe PPH were referred for blood transfusion to a CHC/ FRU/ DH, as this is the only life saving measure at that stage. From our study, it is evident that blood transfusion facility is available only at the DH, and precious lives were lost either at the healthcare facility of origin or in transit, while the family tried desperately to reach a facility where blood transfusion is available, as shown in Figure 3.

Mothers with hemorrhage need to be stabilized by giving obstetric first aid like IV Fluids, Oxytocin/ Misoprostol before being referred to another appropriate facility. This may mean referring to a DH/FRU directly, if patient is bleeding and there is no facility for blood transfusion available in any of the intermediate facilities. This will save precious time and may save the mother's life. From our study, it was evident that only when the woman reached the DH, she had received a blood transfusion. Only two (out of 57) women could reach the DH and receive blood transfusion. 65% of the women were not even administered an intravenous (IV) fluid before referral. This is evident from the fact that most of the deaths during referral occurred between facility 1 and facility 2. Receiving a safe blood transfusion as part of the therapy for PPH can make the difference between death and the possibility of recovery and survival.[25,26]

Our study also found out that 26% of the maternal deaths are attributed to severe anaemia. If a woman is anaemic at the time of child birth and experiences a PPH, it is very critical condition and most likely, she would need a blood transfusion. Given that 39% of PPH and 26% of severe anaemia attributed maternal deaths in Unnao, UP; state health department should focus on appropriate facilities, based on geographical location, proximity to the population, staffing, and delivery load, to provide emergency blood transfusion.[27] Blood transfusion is needed not just for PPH cases, but also for the cases of septicemia, severe anaemia, post abortion complications and those needing caesarean section.[28,29] In a study done in Rajasthan, increasing the availability of blood transfusion saved nearly 70% of lives due to hemorrhage.[26] States with low MMR have always focused on providing accessible and available safe blood transfusion services in addition to other key measures, like referral transport and provision of Basic Emergency Obstetric Care (BEmOC) services.[30]

Recommendations

The Health and Family welfare department, UP should take a decision and implement the following recommendations to avert preventable maternal deaths in the state.

- Operationalize Blood Storage Units (BSU) at the sub-divisional hospital (SDH) or CHC level on priority basis. Besides operationalizing FRUs, provision of blood transfusion facility in CHCs at strategic geographic locations in Unnao and other districts of UP is needed.
- Majority of maternal deaths were attributed to PPH and were preventable, so Skilled Birth Attendant (SBA) & EmOC trainings for the staff should be prioritized where most of the deliveries are taking place and provide guidelines on AMTSL.
- Managing the third stage of labour more effectively in health facilities, would include ensuring the availability of Oxytocin or Misoprostol at all facilities conducting deliveries.
- Medical staff besides the medical officer at all CHCs should be trained for providing safe blood transfusion in an emergency.
- An obstetrician and an anesthetist or medical officer/s trained in life saving anesthetic skills (LSAS) or EmOC at all FRUs including CHCs should be recruited or reallocated.

Conclusion

By strengthening the public health infrastructure, especially setting up blood storage units or linking up health facilities with nearby blood banks, and placing trained staff at the secondary level hospitals (district level and CHCs), availability and access to safe blood transfusion services can be ensured to all pregnant women who come to the facility with obstetric emergency. Given the high maternal mortality ratio in the state of UP, the above mentioned strategy alone can prevent a large number of maternal deaths.

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References

1. Khalid SK, Daniel W, Lale S, Gülmezoglu AM,Van Look PFA. WHO analysis of causes of maternal death: a systematic review. Lancet 2006;367:1066-74.
2. Bhutta ZA, Chopra M, Axelson H, Berman P, Boerma T, Bryce J, et al. Countdown to 2015 decade report (2000–10): taking stock of maternal, newborn, and child survival. Lancet 2010;375:2032–44.
3. Balarajan Y, Ramakrishnan U, Özaltin E, Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. Lancet. 2011;6736:62304-5.
4. Special bulletin on maternal mortality in India : 2007-2009 [Internet]. Office of Registrar General,India, Ministry of Home Affairs, Government of India. June 2011 [cited 2013 Feb 10]. Available from: URL: http://www.censusindia.gov.in/vital_statistics/SRS_Bulletins/Final-MMR%20Bulletin-2007-09_070711.pdf
5. WHO Country Cooperation Strategy 2006 to 2011: India [Internet]. 2006 [cited 2013 Feb 11]. Available from: URL: http://whoindia.healthrepository.org/bitstream/123456789/177/1/WHO%20CCS%20-%20India%20-%20full%20doc%20-%20final%20edition.pdf.
6. National Rural Health Mission, Ministry of Health and Family Welfare, Government of India. Fourth Common Review Mission Report. 2010.
7. National Rural Health Mission, Ministry of Health and Family Welfare, Government of India. Fifth Common Review Mission Report. 2011.
8. National Rural Health Mission, Ministry of Health and Family Welfare, Government of India. Sixth Common Review Mission Report. 2012.
9. District Level Household and Facility Survey - 3: Factsheet - India [Internet]. Ministry of Health and Family Welfare, Government of India. 2007-08 [cited 2013 Feb 14]. Available from: URL: http://www.jsk.gov.in/dlhs3/india.pdf.
10. Guidelines for antenatal care and skilled attendence at birth by ANMs/LHVs/SNs [Internet]. Maternal Health Division, Department of Family Welfare, Government of India. 2010 [cited 2013 Feb 13]. Available from: URL: http://nihfw.org/NCHRC/Publication/Guidelines%20and%20Manuals/ANM%20Guidelines%20.pdf.
11. Census of India [Internet]. Ministry of Home Affairs, Government of India. 2011 [cited 2013 Feb 12]. Available from: URL: http://www.censusindia.gov.in/2011-prov-results/paper2/census2011_paper2.html.
12. Sample Registration System [Internet]. Ministry of Home Affairs, Government of India. 2012 [cited 2013 Jan 20]. Available from: URL: http://www.censusindia.gov.in/vital_statistics/SRS_Bulletins/SRS_Bulletin-October_2012.pdf.
13. Engender Health, Mailman School of Public Health, Columbia University. Quality Improvement for Emergency Obstetric Care: Toolbook. New York, USA: Engender Health; 2003. Available from: URL: http://www.engenderhealth.org/files/pubs/maternal-health/qi-emoc-toolbook/qi-emoc-toolbook.pdf.
14. World Health Organization, UNFPA, UNICEF and Averting Maternal Death and Disability (AMDD). Monitoring emergency obstetric care : a handbook. Geneva, Switzerland: World Health Organization; 2009. Available from: URL: http://whqlibdoc.who.int/publications/2009/9789241547734_eng.pdf.
15. United Nations Children's Fund (UNICEF), WHO, UNFPA. Guidelines for Monitoring the Availability and Use of Obstetric Services. New York, USA: United Nations Children's Fund; 1997. Available from: URL: http://www.childinfo.org/files/maternal_mortality_finalgui.pdf.
16. Family Welfare Statistics in India [Internet]. Statistics Division, Ministry of Health and Family Welfare, Government of India. 2011 [cited 2013 Jan 25]. Available from: URL: http://mohfw.nic.in/WriteReadData/l892s/972971120FW%20Statistics%202011%20Revised%2031%2010%2011.pdf.
17. Number of licensed Blood Banks in the Country: Director General Health Services, Central Drugs Standard Control Organization; 2012 [2013 Feb 13]. Available from: URL: http://cdsco.nic.in/html/BloodList.html.
18. Rural Health Statistics in India, 2011 [Internet]. National Rural Health Mission, Ministry of Health and Family Welfare, Government of India. 2011 [cited 2013 Feb 10]. Available from: URL: http://nrhm-mis.nic.in/UI/RHS/RHS%202011/RHS%20-March%202011-%20Tables-%20Final%209.4.2012.pdf.
19. Indian Public Health Standards (IPHS):Revised 2012 [Internet]. 2012 [cited 2013 Feb 11]. Available from: URL: http://mohfw.nic.in/NRHM/iphs.htm.
20. Annual Health Survey [Internet]. Ministry of Home Affairs, Government of India. 2010-11 [cited 2013 Feb 12]. Available from: URL: http://censusindia.gov.in/vital_statistics/AHSBulletins/files/01-Uttar%20Pradesh%20AHS%20Bulletin.pdf.
21. Maternal Mortality in India 1997 to 2003: Trends, Causes and Risk Factors [Internet]. 2006 [cited 2013 Jan 29]. Available from: URL: http://www.health.mp.gov.in/Maternal_Mortality_in_India_1997-2003.pdf.
22. National Family Health Survey - 3 [Internet]. International Institute of Population Sciences. 2005-06 [cited 2013 Jan 10]. Available from: URL: http://www.rchiips.org/NFHS/pdf/Uttar%20Pradesh.pdf.
23. Begley CM, Gyte GML, Murphy DJ, Devane D, McDonald SJ, McGuire W. Active versus expectant management in the third stage of labour. Cochrane Database of Systematic Reviews 2011;7:1-124.
24. Inter-Agency and Expert Group on MDG Indicators, United Nations. The Millennium Development Goals Report. Department of Economic and Social Affairs, United Nations Secretariat; 2011.
25. Nama V, Karoshi M, Kakumani V. The single unit transfusion in post partum hemorrhage: A new perspective. Int J Fertil Womens Med. 2006;51:58-63.
26. Joseph S, Roy N. Improving blood availability in peripheral health institutions, Rajasthan Health Sector Policy Reforms Options Database, Central Bureau of Health Intelligence, Ministry of Health and Family Welfare, Government of India; 2005 [updated October 2005; cited 2013 Feb 11]. Available from: URL: http://www.cbhi-hsprod.nic.in/listdetails.asp?roid=222.
27. Mavalankar DV, Rosenfield A. Maternal Mortality in Resource-Poor Settings: Policy Barriers to Care. American Journal of Public Health 2005;95:200-3.
28. WHO Recommended Interventions for Improving Maternal and Newborn Health [Internet]. 2009 [cited 2013 Jan 31]. Available from: URL: http://whqlibdoc.who.int/hq/2007/WHO_MPS_07.05_eng.pdf.
29. Ramani KV, Mavalankar DV, Govil D. Study of Blood-transfusion Services in Maharashtra and Gujarat States, India. J Health Popul Nutr 2009;27:259-70.
30. Kumar S. Reducing maternal mortality in India: Policy, equity, and quality issues. Indian J Public Health 2010;54:57-64.

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