FIGO LOGIC INITIATIVE

Every death counts: Electronic tracking systems for maternal death review in India

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ABSTRACT

Maternal death review (MDR) is an important strategy to improve the quality of obstetric care and reduce maternal morbidity and mortality. MDR provides detailed information on various factors at community, facility, and district levels that influence maternal health outcomes. One of the key challenges is to analyze large volumes of data collected via a paper-based system that uses facility and community level forms. This database continues to expand quantitatively (multiple forms and data elements), which makes analysis of data increasingly difficult for timely management and analysis. The present paper describes the development process involved in linking the paper-based system with an electronic system for MDR in India. The lessons learnt from this experience can contribute to understanding how innovative technologies can be used to address large-scale public health issues in low-resource countries and in particular solutions to address maternal health.

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1. Trends in maternal mortality in India

Globally, the maternal mortality ratio (MMR) declined from 400 deaths in 1990 to 210 deaths per 100 000 live births in 2010, which represents an average annual decline of 3.1% [1].

The Government of India (GOI) launched the National Rural Health Mission (NRHM) in 2005. Its objectives included enhanced focus on reproductive and child health, augmented financial resources and local flexibility, focus on health systems strengthening, and emphasis on decentralization [2]. The key strategies that were implemented to achieve improved public health included strengthening capacities for data collection, assessment, and review to enable evidence-based planning, monitoring, and supervision; promotion of public–private partnerships; and implementation of programs.

Implementation of the NRHM had a significant impact and India has made progress in reducing its national MMR from 212 to 178 per 100 000 live births [3,4]. However, the country has a long way to go before it will meet Millennium Development Goal 5, which sets out to reduce MMR to 150 per 100 000 live births by 2015 [5], or the national 12th Five Year Plan of India, which sets out to reduce MMR to 100 per 100 000 live births by 2017 [6].

2. Status of maternal death review in India

Until 2008, the approach to maternal death review (MDR) in India was fragmented, with varying levels of implementation and different approaches to MDR across the states [7]. To ensure uniformity, the GOI finalized an operational framework for implementation of the MDR program in 2009. The program was launched nationally in December 2010 by the Maternal Health Division (MHD) of the Ministry of Health and Family Welfare [8]. After its launch, the capacity building process for all health teams at subnational level was begun in 2011, with its aim to institutionalize the MDR program at all levels. The MDR program collects key information on the factors that lead to and are responsible for a maternal death. This helps elucidate issues surrounding maternal health and subsequently the actions that are needed to improve quality of obstetric care, which will lead to reduction of maternal morbidity and mortality.

3. Overview of the paper-based system

MDR implementation is focused on meeting the following three objectives: (1) to contribute toward improved quality of obstetric care and reduce maternal mortality and morbidity; (2) to provide detailed information on various factors at institution and community level that need to be addressed to reduce maternal deaths; and (3) to disseminate information on data for surveillance, review, and remedial follow-up actions. The current paper-based system uses six forms to report both maternal and non-maternal deaths (Fig. 1). At community level, deaths

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of all women aged 15–49 years (irrespective of the cause of death, maternal or non-maternal) are reported through forms 6, 2, and 3. At facility level, deaths that occur in hospital among pregnant women or within 42 days after termination of pregnancy, irrespective of duration or site of pregnancy and including deaths from abortion and ectopic gestation, are reported through forms 6, 1, and 3. Forms 4 and 5 are used to maintain monthly records at the health facility. Each maternal death must be reported separately, using either the community or facility forms.

The primary informant form (form 6) is used by the community level health worker and facility level nodal officer to report the deaths of all women and maternal deaths, respectively, within 24 hours of a death. This tool captures basic information about the deceased woman, including name, age, date and time of death, place of death, and when the death occurred (e.g. during pregnancy or delivery or abortion, within 42 days after delivery or 6 weeks after abortion).

India is organized into states, districts, and blocks and these comprise medical colleges, district hospitals, women and child hospitals, community health centers, primary health centers, and subcenters. The block and facility registers (forms 4 and 5) are used to keep a monthly record of all deaths of women and maternal deaths, respectively, at these levels. Information about each woman is summarized (e.g. name, age, date of death, address, cause of death, date of field investigation, status of the neonate, action taken).

The facility based form (form 1) captures demographic information and medical details of the deceased, admission, level of delays, prenatal care and delivery outcome, status of the neonate, postnatal outcomes, interventions, cause of death, and socioeconomic factors.

The community based form (form 2) captures demographic information, non-medical information, availability of health facilities and services, transport, and prenatal, intranatal, and postnatal service delivery.

The MDR case summary (form 3) is a report that is prepared for each deceased woman. The same form is used at the facility and community level.

4. Concerns arising from use of the paper-based system

The paper-based system is problematic for the following reasons:

- Use of multiple forms. Maternal deaths are reported using five facility based forms or five community based forms.
- Repetitive information. A wealth of information on each maternal death is captured, which is repeated across the forms. This makes it difficult to manage and collate for analysis.

- Paper-based data collection. This makes it difficult and challenging to carry out analysis for a single maternal death.
- Vast amount of data. For each maternal death, 100–150 data items are captured through the MDR forms. It is impossible to analyze this volume of data in a timeframe that facilitates prompt action.
- Tracking of forms. Given that more than one form is used for recording and reporting data, it is difficult to keep track of which form has been completed and submitted at different levels.
- Linkage with the maternal health database. The GOI runs software called the mother and child tracking system (MCTS). MCTS has a database of all critical health parameters (e.g. height, weight, hemoglobin, number of prenatal check-ups, gravidity, parity) of approximately 20 million pregnant women. At present, linking the MCTS with the MDR program is challenging given the sheer numbers in India.
- Movement of pregnant women. The majority of pregnant women in India stay with their mother during pregnancy and/or delivery and return back to their own home after delivery. As these locations may or may not be in the same city/district/state, determining the quality of services given by a particular health facility and assigning the cause of death to the right facility for improvement poses its own set of challenges.

5. The solution: An electronic system

National MDR software to address the above concerns and strengthen data management systems was developed for the MHD through a public–private partnership. The Avni Health Foundation designed and developed the software with the technical support of the MHD, the National Informatics Centre (NIC), the MCTS team, the National Statistics Division (NSD), and funding support from The Federation of Obstetric and Gynaecological Societies of India (FOGSI). FOGSI was supported by the FIGO Leadership in Obstetrics and Gynecology for Impact and Change (LOGIC) Initiative in Maternal and Newborn Health through a grant from the Bill and Melinda Gates Foundation. The aim of this initiative was to improve maternal and newborn health in low-resource countries by strengthening the roles of obstetric and gynecological national associations.

5.1. Steps in the design, development, and deployment of MDR software

5.1.1. Formation of a technical working group
The technical working group was responsible for ensuring the launch of technically sound software that met the necessary operational, security,
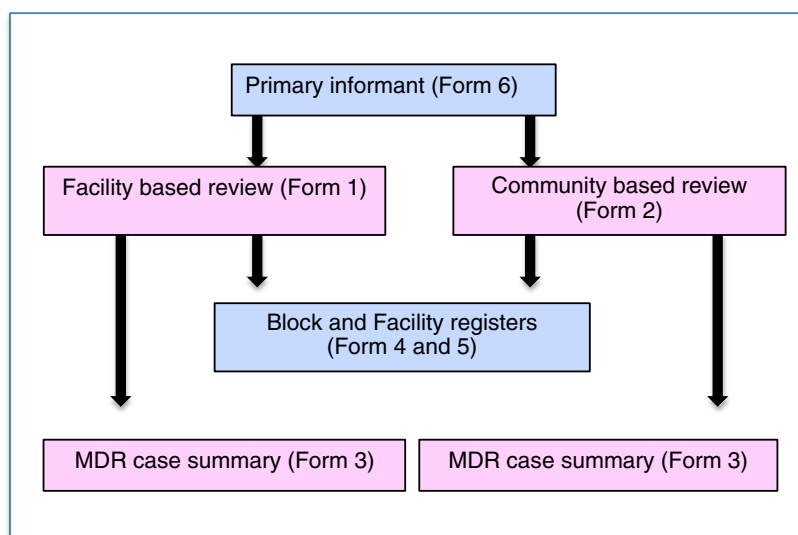

Fig. 1. The six paper-based forms used to collect information on maternal and non-maternal deaths in India at facility and community level.
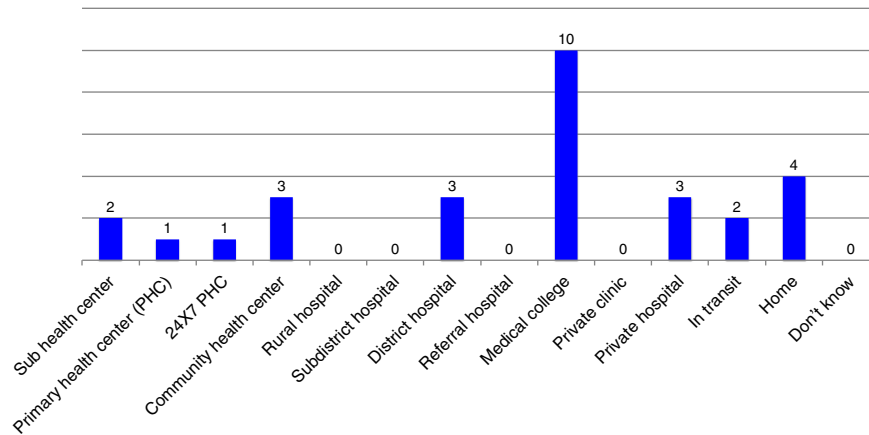
Fig. 2. Location of 29 maternal deaths reported through the community form.

and administrative guidelines. The group was formed of representatives from the MHD, NIC, MCTS, NSD, Avni Health Foundation, and FOGSI.

5.1.2. Appointment of an independent technical organization

The independent technical organization was responsible for understanding the technical requirements of the hardware and software and designing, developing, testing, and deploying the software. It was also responsible for training, day-to-day troubleshooting, and ensuring that up-to-date software was running.

5.1.3. Strengthening the software design

Technically sound software was designed that was compatible with the specifications of the hardware and robust to allow approximately 150 simultaneous users.

5.1.4. Developing, linking to MCTS, completing security audit, testing, and deployment

The software is linked to all parameters contained within the forms and with the MCTS to capture available data and generate reports. Security audit was completed, which allowed it to be deployed on government servers.

5.1.5. Launching the software

The software was launched by the Additional Secretary of the Ministry of Health and Family Welfare in November 2013.

5.1.6. Training of health teams and troubleshooting

National-level master trainers have been created and scale-up of the training program is in progress.

5.1.7. Data entry of old and new records

The database needs to be sustained.

5.1.8. Generating reports

District, state, and national level reports are generated and used to plan steps to reduce maternal morbidity and mortality, and improve overall maternal health outcomes.

5.2. Salient features of the MDR software

The software is based on the latest technology. It is stable, robust, and secure as it has been developed on a GOI-approved platform, cleared a rigorous external security audit, and is using the server resources of the existing GOI setup. It has the capacity to allow 150 users simultaneously for data entry and generation of reports. Sufficient provision has been also made to increase the capacity should the need arise in the future.

The MCTS database is linked to the MDR database for increased efficiency. The basic details of each maternal death are pulled into the MDR database and there is no need for entry of these data items.

Access is controlled and security is high. Each user has a pre-approved level of access, which links the user to the state and district. Three levels of access have been defined, and each user may have permission for one or all of these levels to allow them to: (1) enter and edit data; (2) view and download reports; (3) generate passwords and create and delete users. The system logs off a user if there is inactivity for 15 minutes; if an incorrect username/password is used more than three times then the system blocks further access.

The look, feel, and flow of the user interface on the computer screen are similar to the paper forms. A non-technical person with experience
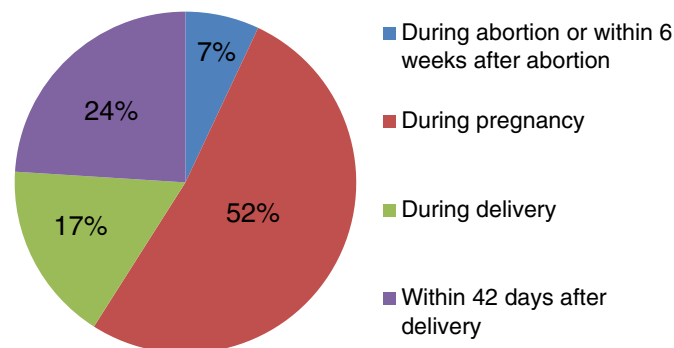

Fig. 3. Time of occurrence of 29 maternal deaths reported through the community form.
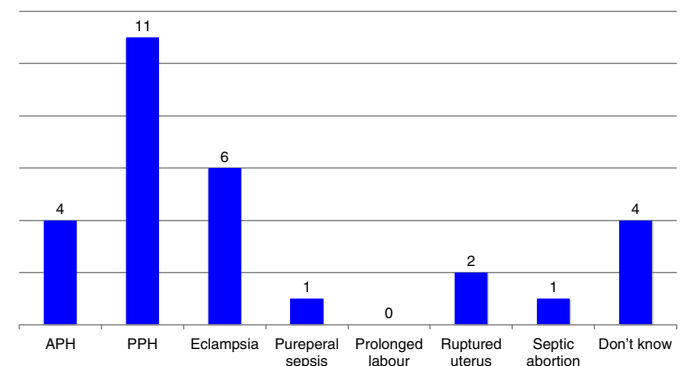

Fig. 4. Probable cause of 29 maternal deaths reported through the community form. Abbreviations: APH, antepartum hemorrhage; PPH, postpartum hemorrhage.

- ■ Lack of human resources
- ■ Delay in woman seeking help
- ■ Refusal of treatment
- ■ Lack of facilities, equipment, or consumables
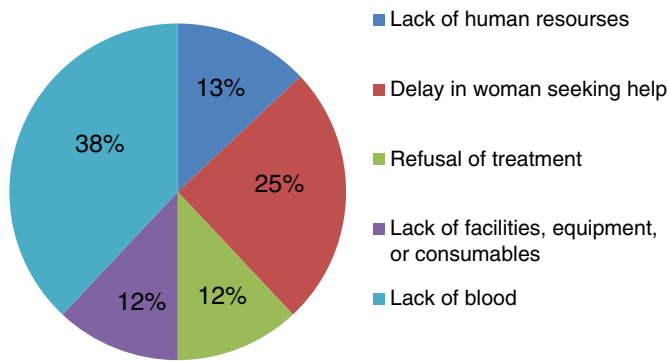- ■ Lack of blood

Fig. 5. Factors contributing to 19 maternal deaths reported through the facility form.

only of data entry can input the information easily. Navigation through the software is simple.

Data entry follows a linear flow, which means that only after the key boxes are completed does the next form open for further data entry. Repeated data is auto-filled in all subsequent forms. Each page is auto-saved, and drop-down menus are triggered when there is need to select an option for data entry. Furthermore, some critical fields have been made compulsory, and fields with date and time information are converted to hours for analysis and report generation. It is a simple and yet smart application.

A user-friendly report generation module has been added that allows users to generate reports on multiple choice parameters; for example, for a particular period the software will generate a report that shows how many women died in a particular district, aged 18 — 25 years, who were housewives or illiterate. A total of 77 reports can be generated using several parameters listed in the forms. In addition, a user can also generate a complete report with all the data items and corresponding pie charts. All reports can be extracted to Microsoft Excel (Microsoft Corp, Redmond, WA, USA) for further analysis if required. The software is flexible to the needs of the user.

A dummy site the same as the official site has been created to facilitate training; this site allows users to practice and use the features of the software without fear of corrupting the official database.

6. Results

The software has been well received by users and praised for its simplicity, user-friendliness, ease of navigation, security features, and its ability to generate reports to enable planning to improve maternal health outcomes. Some sample charts generated by the software
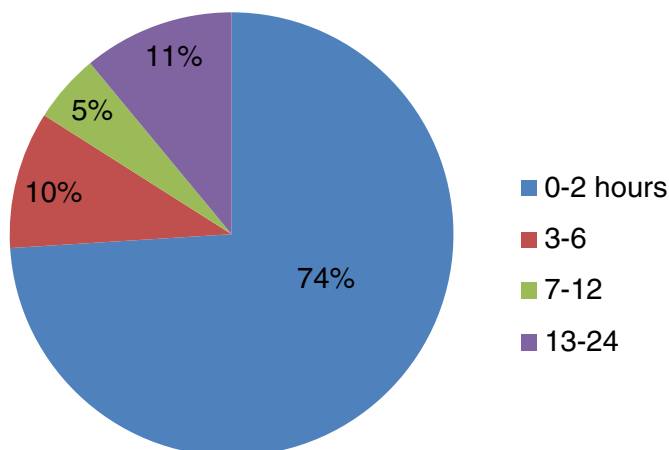

- ■ 0-2 hours
- ■ 3-6
- ■ 7-12
- ■ 13-24

Fig. 6. Duration from onset of complication to admission to a facility among 19 women who died.
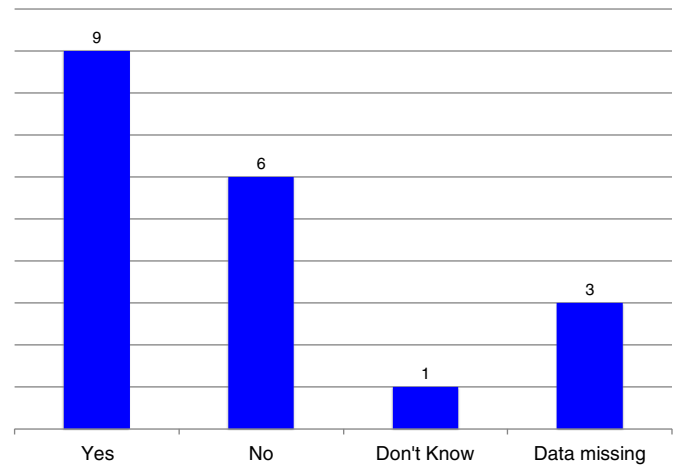

Fig. 7. Referral from a lower center to the current facility among 19 women who died.

demonstrate the usefulness of the electronic system. Figs. 2–4 were generated using the data collected through the community forms and Figs. 5–7 were created using data collected through the facility forms.

6.1. Factors leading to successful implementation of the MDR software

- Aligning the objectives and strategies for India into the program plans.
- Having a clear road map for implementation.
- Anticipating challenges and having an action plan for both planned and unplanned issues arising.
- Working with program "champions" who saw the implementation through to its logical conclusion.
- Developing public — private partnerships involving key stakeholders for guidance and support.
- Ensuring that all program implementation timelines were adhered to by identifying a project management system.
- Sharing regular updates on the program's progress ensured timely help and kept the team motivated to deliver high-level performance.

6.2. Challenges faced during implementation of the MDR software

- Change in leadership. Transfer of key officials who were part of the technical working group occurred.
- Establishing linkage with an existing software (MCTS) for database access.
- Security audit and administrative clearances to meet GOI standards.
- Managing diverse teams of public health professionals and software engineers.
- Strengthening the system requirements (servers, coding location, speed, storage, update maintenance).
- Meeting the software coding platform requirements (open source/closed).

6.3. Next steps and the way forward

The next steps include program scale-up and timely rollout of the software across India from March 2014. More reports and features are to be added according to the requirements of those using it in the field. Establishing links to existing databases for child and neonatal death review programs will enable central generation of reports and comprehensive reviews to improve maternal, child, and neonatal outcomes across India.

Conflict of interest

The authors have no conflicts of interest.

References

[1] World Health Organization, UNICEF, UNFPA, The World Bank. Trends in maternal mortality: 1990 to 2010 WHO, UNICEF, UNFPA and The World Bank estimates. Geneva: WHO; 2012. https://www.unfpa.org/webdav/site/global/shared/documents/publications/2012/Trends_in_maternal_mortality_A4-1.pdf.

[2] Government of India. National Rural Health Mission (2005–2012). Mission Document. http://www.nird.org.in/Brgf/doc/Rural%20HealthMission_Document.pdf.

[3] Office of Registrar General, India. Special Bulletin on Maternal Mortality in India 2007–09. Sample Registration System. http://censusindia.gov.in/Vital_Statistics/SRS_Bulletins/Final-MMR%20Bulletin-2007-09_070711.pdf; June 2011.

[4] Office of Registrar General, India. Special Bulletin on Maternal Mortality in India 2010–12. Sample Registration System. http://www.censusindia.gov.in/vital_statistics/SRS_Bulletins/MMR_Bulletin-2010-12.pdf; December 2013.

[5] Press Information Bureau, Government of India, Ministry of Health and Family Welfare. Millennium Development Goals. http://pib.nic.in/newsite/PrintRelease.aspx?relid=95498; May 2013.

[6] Planning Commission, Government of India. Brief on the functions of Health, and Family Welfare Division, Twelfth Five Year Plan (2012–2017). http://planningcommission.gov.in/sectors/index.php?sectors=hea.

[7] UNICEF. Maternal and Perinatal Death Inquiry and Response. Empowering communities to avert maternal death in India. http://www.unicef.org/india/MAPEDIR-Maternal_and_Perinatal_Death_Inquiry_and_Response-India.pdf.

[8] Maternal Health Division, Government of India. Maternal Death Review Guidebook. http://nrhm.gov.in/images/pdf/programmes/maternal-health/guidelines/maternal_death_review_guidebook.pdf; December 2010.