Introduction

India has significantly reduced maternal and child mortality over the past decade.[1] The maternal mortality ratio declined from 274 in 2003 to 113 in 2016–2018.[2] The infant mortality rate has also gone from 60 in 2003 to 28.3 per thousand live births in 2019.[3] Despite the progress, approximately 44,000 women die each year from pregnancy-related conditions in India, accounting for 17% of maternal deaths.[4]

Analysis of Maternal and Infant Death Reporting System (MIDRS) in a North Indian State during 2013–2018

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Abstract

Background: Haryana launched the Maternal and Infant Death Reporting System (MIDRS) in 2013 to report deaths and their causes. We evaluated the system in terms of its data quality, accuracy, and timing of reporting. Methods: Secondary data analysis of data about the maternal, infant, and child deaths from the state level MIDRS portal from 2013 to 2018. The portal combines infant and maternal deaths and stillbirths reported through passive and active surveillance. We used the descriptive measure of statistics (proportion) to describe the characteristics and causes of neonatal, post-neonatal, and maternal deaths. Results: Of 1,18,028 neonatal deaths, 39% (46,140) neonates died at a government facility. Gender was not recorded in 7,093 (6.0%) deaths. “Others” was a predominant category (14,664, 53%) of death. Of 2,842 maternal deaths, the cause of death was unknown in 465 (16.4%) deaths and mentioned as “others” in 1,618 (56.9%) instances. Nearly 60% of maternal deaths occurred at a health facility. Stillbirth was published as a cause of death in 228 (7.8%) child deaths (1–5 years). Missing data were observed in critical variables such as the timing of maternal mortality (50, 1.8%) and sex of child (4884, 4.3%). Conclusion: Delay in reporting, inconsistencies in data, and missing information were some challenges. Ascertainment of the exact cause of death needs to be improved through better training.

Keywords: Cause of death, infant death, maternal death, stillbirth, verbal autopsy

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Global evidence suggests that most of these deaths could be avoided through evidence-based critical health interventions such as better antenatal care, skilled birth attendance, and access to emergency obstetric care. This should be accompanied by a simultaneous review of the death occurring in the community to learn lessons and improve accordingly. A recent Cochrane review has highlighted the role of maternal and perinatal death audit and reviews as an intervention to reduce maternal and perinatal mortality and improve quality of care. It could be vital in attaining the SDGs. However, appropriate and timely audits depend on close monitoring and accurate reporting of deaths as a fundamental prerequisite.

A complete and accurate civil registration and vital statistics system provide the most reliable measure of maternal and neonatal mortality trends. The accuracy of vital statistics data used for mortality rates is determined mainly by coverage (proportion of the population covered by reporting system), quality of data, and completeness of the reported events within covered areas. A civil registration system with complete coverage, high integrity, and accurate data on the cause of death is essential for informed decision-making. However, in most developing countries, including India, the data generated by such systems are seldom used for monitoring and improving health outcomes due to poor quality and population coverage.

In India, periodic sample-based surveys such as the Sample Registration System (SRS) provide reasonable maternal and infant mortality estimates at the national and sub-national levels. However, such surveys are based on a sample of the population rather than a complete count of events. The accuracy and completeness of such surveys have also been questioned earlier by Negandhi et al, but affirm the pertinent role of such a system in improving the indicators.

To fulfill this gap in the reporting of deaths, the state of Haryana launched the Maternal and Infant Death Reporting system (MIDRS) in 2013. The primary objective of this portal is to strengthen the existing system of reporting maternal and infant deaths through health workers at the community level and from the government health facilities to provide reliable estimates of deaths. It supplemented the existing maternal and infant death reviews and stillbirth review system in knowing maternal/infant deaths and stillbirths to understand how such events can be avoided comprehensively. This online portal facilitates data flow from the community to the district level. The data are transmitted to the state headquarters and finally reaches the central level, where qualified health workers ascertain the exact cause of death. This system also pointed out the delays due to which mortality happened. MIDRS developed a renewed sense of accountability in the health system. Negandhi PH et al. also indicated that implementing such a system led to quantitative and qualitative improvements in reporting of infant and maternal deaths and stillbirths. There was a five-point reduction of IMR in a single year (2013–2014) post-implementation of this reporting system process. Such a sharp decline had been attributed to strict supervision and capacity building of the field staff, with robust implementation of the MIDRS portal. A surveillance system has various attributes, including data quality, completeness, and accuracy. Inconsistencies can happen during reporting and data entry, such as misclassification of event, logical contradiction, out-of-range/implausible values, and missing data which can significantly hamper data quality and needs to be corrected if accurate estimates are to be obtained. While there are many studies that are based on the reports emanating from these surveillance systems, we could not find much literature that has actually assessed the quality of the reported data in its raw form.

Thus, we analyzed data from the MIDRS in Haryana during the period 2013–2018 to (i) understand the cause and place of deaths and the sociodemographic correlates of maternal, infant deaths, and stillbirths, (ii) assess the inconsistencies and missingness in the reporting of these deaths, and (iii) compare the figures with the corresponding SRS figures during the same time to evaluate the reliability of estimates. This study is crucial as it evaluates the reporting process of health events at primary health care centres that focus principally on maternal and child health under the National Health Mission of Haryana. These centres are usually the first point of care and form the core of the reporting system and the review of maternal and infant deaths in their areas. The study provides an insight to the data quality which forms the very basis of many crucial policy decisions.

Methods

Study design

The present study was a secondary data analysis from the MIDRS portal in Haryana during 2013–2018.

Data source

MIDRS portal was conceptualized and conceived by the Government of Haryana in 2012. It was launched as a centralized mechanism to gather information regarding maternal deaths, infant deaths, and stillbirths from the health facilities and the community. The purpose was to ensure that all maternal deaths, infant deaths, and stillbirths in Haryana were reported and reviewed for corrective follow-up actions. Secondary data from the state-level MIDRS portal from 2013 to 2018 were analyzed.

The portal combines passive and active surveillance of maternal deaths, infant deaths, and stillbirths. As part of the passive surveillance, ASHAs, ANMs, nurses, and medical officers report every abortion, delivery, infant death, pregnancy, maternal death, and stillbirth in their community to their higher-level authorities. The information is then uploaded on the web-based portal by the district-level staff.
Under the active surveillance component, surveillance field volunteers were recruited and trained. These volunteers visited various facilities – Anganwadi centers, community health centers, cremation grounds, private hospitals, the municipal corporation's offices, and primary health centers. They retrieved information from registers and discussions with staff on any unreported maternal deaths, infant deaths, and stillbirths. They also verified the data with the health workers, following which the event was recorded on the web-based platform. [Figure 1]. Plus, a computer-generated algorithm was implemented to help prevent duplicating the data during the line listing of the unique events.

Definition of outcomes
Stillbirth is defined as a baby born with no signs of life at or after 28 weeks of gestation. Neonatal death is defined as death within the first 28 days of life. Post-neonatal death is defined as the death of a newborn between 28 days and one year of age.

Figure 1: Flow of information regarding maternal and child deaths through the MIDRS portal in Haryana, 2013–2018
Infant death is defined as the death of a child under one year of age.\[18]\] Child death is defined as the death of a child aged between one and five years.\[18]\] Maternal death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.\[19]\]

**Data analysis**

State-level data were exported from the MIDRS portal in excel format and imported into SPSS version 24 for analysis. The descriptive measure of statistics (proportion) was used to describe the characteristics and causes of neonatal, post-neonatal, and maternal deaths. MMR, IMR, and SBR were computed from the MIDRS portal and compared with the state figures reported in the SRS during the same period and displayed using a line graph.

**Ethical approval**

As this study involved secondary data already collected in the MIDRS portal, the Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease, Paris, France, waived the need for informed consent. Permission to extract data from the MIDRS portal was obtained from the Government of Haryana, India.

**Results**

Figure 2 compares the IMR and SBR derived from two sources: the MIDRS portal and the Sample Registration Surveys (SRS) during the same period (2014–2018). It shows that the SBRs reported by the SRS were lower, whereas the IMRs were higher than those reported by the MIDRS.

Of 1,18,028 neonatal deaths, 65017 (55.1%) were males, gender was not recorded in 7,093 (6.0%) deaths. More than half (66,304, 56.2%) of the deaths were reported by the ANMs, followed by the ASHAs (15,316, 13.0%). Stillbirth was the main cause of death reported (48,525, 41.1%), followed by ‘others’ (32,525, 27.6%) and ‘unknown’ (18,718, 15.9%). Nearly 46,140 (39%) neonates died at a government facility followed by a private hospital (33,121, 28.1%) and home (29,737, 25.2%). [Table 1]. Of 27,661 post-neonatal deaths reported between 2013 and 2018 through the MIDRS portal, deaths were equally distributed in both genders. Majority (15,411, 55.7%) of the deaths occurred at home followed by public health facilities (5,494; 19.9%) and private facility (4,522; 16.3%). Nearly two-thirds of all such deaths were reported by the ANMs (17,419; 63%), followed by ASHA workers (3,647; 13.2%). Regarding the cause of death, ‘others’ were a predominant category (14,664; 53%), followed by unknown (7,101; 25.7%). Stillbirth was reported in 2000 (7.2%) post-neonatal deaths. [Table 1]. The portal is also being used to report child deaths (aged one to five years). A total of 2,918 such child deaths were reported during the study period, mostly by the ANMs (n = 1,868, 64%). Males accounted for nearly half (n = 1,462) of all child deaths; gender was missing in 4% of instances. Most of the deaths happened at home (1,710 58.6%). [Table 1] Cause of death was ‘unknown’ in 621 (21.3%) cases, while ‘others’ (1,863; 63.8%) was the most predominant category of child death. Stillbirth was reported as a cause of death in 228 (7.8%) child deaths. [Table 1]

Further, a total of 2,842 maternal deaths were reported during the period 2014–2018, of which 870 (30.4%) occurred during the antepartum period, 1005 (36.3%) during the intra-natal period, and 940 (33.0%) occurred during the postnatal period. Nearly two-thirds (1,891, 66.5%) were reported by ANMs, followed by doctors (368, 12.9%) and ASHA workers (353, 12.4%). Around 38% (n = 1,068) of all maternal deaths were observed among the socially backward classes of the community (SC/ST). Nearly 60% of maternal deaths occurred at a health facility and another 17% at home. About half (48.1%) of all deaths were among mothers aged less than 25 years. The cause of death was unknown in 465 (16.4%) deaths and mentioned as ‘others’ in 1618 (56.9%) instances. The outcome of pregnancy was unknown in 297 (10.5%) cases. [Table 2] Meantime to report maternal and child death was around 30 days and 60 days, respectively. [Table 3].

There were many inconsistencies in the data set derived from the portal [Table 4]. Missing data was observed in critical variables such as the timing of maternal death (50, 1.8%) and sex of child (4884, 4.3%). The unknown cause was also a common finding observed in the outcome of pregnancy (297, 10.5%), cause of maternal (465, 16.4%), and child death (26, 440, 17.8%). As an abnormal finding, children who died between one and five years of age were labeled as stillbirth in 228 (7.8%) deaths. Likewise, the entry date was filed earlier than the date of death among infant deaths in 17,451 (11.7%) deaths.

**Discussion**

Accurate reporting of maternal and infant deaths and stillbirths is crucial to monitor progress toward sustainable
development goals (SDGs). MIDRS was envisaged as a registry (or surveillance system) for registering or reporting maternal/infant deaths and stillbirths by getting information from multiple sources and then de-duplicating the information received.

This was important as the health department was under-reporting these adverse events due to accountability issues. The comparison of these numbers with Human Resource Management System (HRMS) data will substantiate it.

This study yielded some interesting findings for primary health care providers including the family physicians to work on those neglected areas of maternal and child health morbidity and mortality. Mortality among male children was more than females, probably because female infants are presumed to be biologically

Table 1: Characteristics of the infant deaths, still births, and child deaths as per MIDRS reporting from 2013-2018

|                | <1 month | 1-12 months | 1-5 years | Total |
|----------------|----------|-------------|-----------|-------|
| Total          | 1,18,028 (%100.0) | 27,661 (100.0) | 2,918 (100.0) | 1,48,607 (100.0) |
| Year of death  |          |             |           |       |
| 2013           | 22425 (19.0) | 5710 (20.6) | 169 (5.8) | 28304 (19.0) |
| 2014           | 25615 (21.7) | 6439 (23.3) | 802 (27.5) | 32856 (22.1) |
| 2015           | 21897 (18.6) | 5239 (18.9) | 658 (22.5) | 27794 (18.7) |
| 2016           | 18753 (15.9) | 3982 (14.4) | 468 (16.0) | 23203 (15.6) |
| 2017           | 15141 (12.8) | 3258 (11.8) | 440 (15.1) | 18839 (12.7) |
| 2018           | 14197 (12.0) | 3033 (11.0) | 381 (13.1) | 17611 (11.9) |
| Gender         |          |             |           |       |
| Female         | 45864 (38.9) | 13140 (47.5) | 1340 (45.9) | 60344 (40.6) |
| Male           | 65071 (55.1) | 13465 (48.7) | 1462 (50.1) | 79998 (53.8) |
| Not Known      | 7093 (6.0) | 1056 (3.8) | 116 (4.0) | 8265 (5.6) |
| Religion       |          |             |           |       |
| Hindu          | 102662 (87.0) | 23160 (83.7) | 2363 (81.0) | 128185 (86.3) |
| Muslim         | 12892 (10.9) | 3926 (14.2) | 475 (16.3) | 17293 (11.6) |
| Sikh           | 1784 (1.5) | 392 (1.4) | 58 (2.0) | 2234 (1.5) |
| Christian      | 46 (0.0) | 13 (0.0) | 6 (0.2) | 65 (0.0) |
| Others         | 644 (0.5) | 170 (0.6) | 16 (0.5) | 830 (0.6) |
| Caste          |          |             |           |       |
| General        | 31264 (26.5) | 6750 (24.4) | 642 (22.0) | 38656 (26.0) |
| Other Backward Class | 24471 (20.7) | 6157 (22.3) | 769 (26.4) | 31397 (21.1) |
| Scheduled Caste and Scheduled tribes | 43855 (37.2) | 10384 (37.2) | 1060 (36.3) | 55199 (37.2) |
| Others         | 18438 (15.6) | 4470 (16.2) | 447 (15.3) | 23355 (15.7) |
| Place of Death |          |             |           |       |
| Government Hospitals | 46140 (39.1) | 5494 (19.9) | 478 (16.4) | 52112 (35.1) |
| Private Hospitals | 33121 (28.1) | 4522 (16.3) | 440 (15.1) | 38083 (25.6) |
| At Home        | 29737 (25.2) | 15411 (55.7) | 1710 (58.6) | 46858 (31.5) |
| In Transit     | 2217 (1.9) | 772 (2.8) | 102 (3.5) | 3091 (2.1) |
| Others         | 6813 (5.8) | 1462 (5.3) | 188 (6.4) | 8463 (5.7) |
| Type of Informer |        |             |           |       |
| Doctor         | 12443 (10.5) | 1504 (5.4) | 31 (1.1) | 13978 (9.4) |
| Auxiliary Nurse Midwife | 66304 (56.2) | 17419 (63.0) | 1868 (64.0) | 85591 (57.6) |
| ASHA           | 15316 (13.0) | 3647 (13.2) | 403 (13.8) | 19366 (13.0) |
| Surveillance Field Volunteer* | 8392 (7.1) | 2377 (8.6) | 511 (17.5) | 11280 (7.6) |
| Staff Nurse    | 8741 (7.4) | 776 (2.8) | 28 (1.0) | 9545 (6.4) |
| Anganwadi Worker | 3925 (3.3) | 1284 (4.6) | 56 (1.9) | 5265 (3.5) |
| Immunization Field Volunteer | 1714 (1.5) | 393 (1.4) | 0 | 2107 (1.4) |
| Quality monitoring officer | 43 (0.0) | 5 (0.0) | 0 | 48 (0.0) |
| Others         | 1150 (1.0) | 256 (0.9) | 21 (0.7) | 1427 (1.0) |
| Cause          |          |             |           |       |
| Still Birth    | 48525 (41.1) | 2000 (7.2) | 228 (7.8) | 50753 (34.2) |
| Low Birth Weight | 11334 (9.6) | 2309 (8.3) | 118 (4.0) | 13761 (9.3) |
| Asphyxia       | 3537 (3.0) | 569 (2.1) | 34 (1.2) | 4140 (2.8) |
| Sepsis         | 2999 (2.5) | 856 (3.1) | 36 (1.2) | 3891 (2.6) |
| Hypothermia    | 390 (0.3) | 162 (0.6) | 18 (0.6) | 570 (0.4) |
| Not Known      | 18718 (15.9) | 7101 (25.7) | 621 (21.3) | 26440 (17.8) |
| Others         | 32525 (27.6) | 14664 (53.0) | 1863 (63.8) | 49052 (33.0) |

*No Surveillance Field Volunteer since 2016. ASHA: Accredited Social Health Activist; MIDRS: Maternal and Infant Death Reporting System
advantageous compared to male infants.\textsuperscript{[20,21]} On the contrary, secondary data analysis from Haryana depicted higher mortality among female infants.\textsuperscript{[22]} However, it was never envisaged to know the gender or causes of death from MIDRS. Globally, increased child mortality is associated with gender inequality, and girls seem to disproportionately suffer from this, particularly in lower-income and upper-middle-income countries.\textsuperscript{[23]} The Beti Bachao Beti Padhao (Save the daughter, educate the daughter) campaign launched by the Government of India from Haryana is a welcome step in this regard. However, we cannot attribute the lower mortality among girls to this campaign. The higher proportion of maternal and child deaths seen among the scheduled castes than other castes in our study indicates inequitable access to health which echoed the same by other studies.\textsuperscript{[24]} As we move toward universal health coverage, we need to reduce this gap.

More than half of all post-neonatal and child deaths have happened at home, which indicates a delay in identifying danger signs and delays in seeking care or non-seeking of care among

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### Table 2: Characteristics of maternal deaths in India, as per the MIDRS reporting from 2013-18

| Time of death               | Antepartum period | Intrapartum | Post-Partum Period | Medical Termination of Pregnancy | Total        |
|-----------------------------|-------------------|-------------|--------------------|----------------------------------|--------------|
| Total                       | 2842 (100.0)      |             |                    |                                  |              |
| Type of Informer            |                   |             |                    |                                  |              |
| Doctor                      | 116 (13.3)        | 135 (13.4)  | 114 (12.1)         | 3 (11.1)                         | 368 (12.9)   |
| Auxiliary Nurse Midwife     | 560 (64.4)        | 654 (65.1)  | 661 (70.3)         | 16 (59.3)                        | 1891 (66.5)  |
| ASHA                        | 119 (13.7)        | 129 (12.8)  | 102 (10.9)         | 3 (11.1)                         | 353 (12.4)   |
| Surveillance field volunteer*| 39 (4.5)          | 24 (2.4)    | 34 (3.6)           | 3 (11.1)                         | 100 (3.5)    |
| Anganwadi Worker            | 11 (1.3)          | 24 (2.4)    | 6 (0.6)            | 0                                | 41 (1.4)     |
| Staff Nurse                 | 13 (1.5)          | 19 (1.9)    | 8 (0.9)            | 1 (3.7)                          | 41 (1.4)     |
| Others                      | 12 (1.4)          | 20 (2.0)    | 15 (1.6)           | 1 (3.7)                          | 48 (1.7)     |
| Caste of the mother         |                   |             |                    |                                  |              |
| General                     | 205 (23.6)        | 240 (23.9)  | 245 (26.1)         | 4 (14.8)                         | 694 (24.4)   |
| Other Backward Classes      | 177 (20.3)        | 216 (21.5)  | 200 (21.3)         | 5 (18.5)                         | 598 (21.0)   |
| Schedule and ST             | 337 (38.8)        | 385 (38.3)  | 332 (35.3)         | 14 (51.9)                        | 1068 (37.6)  |
| Others                      | 151 (17.4)        | 164 (16.3)  | 163 (17.3)         | 4 (14.8)                         | 482 (17.0)   |
| The religion of the mother  |                   |             |                    |                                  |              |
| Hindu                       | 722 (83.0)        | 838 (83.4)  | 810 (86.2)         | 26 (96.3)                        | 2396 (84.3)  |
| Muslim                      | 134 (15.4)        | 138 (13.7)  | 113 (12.0)         | 1 (3.7)                          | 386 (13.6)   |
| Sikh                        | 10 (1.1)          | 21 (2.1)    | 15 (1.6)           | 0                                | 46 (1.6)     |
| Christian and Others minorities| 4 (0.5)          | 8 (0.8)     | 2 (0.2)            | 0                                | 14 (0.5)     |
| Age of the mother           |                   |             |                    |                                  |              |
| <18                         | 0 (0.0)           | 1 (0.1)     | 2 (0.2)            | 0                                | 3 (0.1)      |
| >35                         | 67 (7.7)          | 64 (6.4)    | 53 (5.6)           | 1 (3.7)                          | 185 (6.5)    |
| 18-24                       | 416 (47.8)        | 483 (48.1)  | 450 (47.9)         | 15 (55.6)                        | 1364 (48.0)  |
| 25-34                       | 387 (44.5)        | 457 (45.5)  | 435 (46.3)         | 11 (40.7)                        | 1290 (45.4)  |
| Outcome of the current Pregnancy |         |             |                    |                                  |              |
| Live Birth                  | 38 (4.4)          | 619 (61.6)  | 716 (76.2)         | 6 (22.2)                         | 1379 (48.5)  |
| Still Birth                 | 75 (8.6)          | 213 (21.2)  | 158 (16.8)         | 2 (7.4)                          | 448 (15.8)   |
| Abortion                    | 31 (3.6)          | 5 (0.5)     | 4 (0.4)            | 12 (44.4)                        | 52 (1.8)     |
| Not Delivered               | 593 (68.2)        | 65 (6.5)    | 5 (0.5)            | 3 (11.1)                         | 666 (23.4)   |
| Not Known                   | 133 (15.3)        | 103 (10.2)  | 57 (6.1)           | 4 (14.8)                         | 297 (10.5)   |
| Place of Death              |                   |             |                    |                                  |              |
| Government Hospital         | 317 (36.4)        | 437 (43.5)  | 329 (35.0)         | 11 (40.7)                        | 1094 (38.5)  |
| Home                        | 206 (23.7)        | 102 (10.1)  | 160 (17.0)         | 5 (18.5)                         | 473 (16.6)   |
| Private Hospital            | 148 (17.0)        | 277 (27.6)  | 212 (22.6)         | 6 (22.2)                         | 643 (22.6)   |
| In Transit                  | 90 (10.3)         | 80 (8.0)    | 90 (9.6)           | 0                                | 260 (9.1)    |
| Others                      | 109 (12.5)        | 109 (10.8)  | 149 (15.9)         | 5 (18.5)                         | 372 (13.1)   |
| Documented cause of death   |                   |             |                    |                                  |              |
| Hemorrhage                  | 24 (2.8)          | 166 (16.5)  | 107 (11.4)         | 2 (7.4)                          | 299 (10.5)   |
| Sepsis                      | 21 (2.4)          | 32 (3.2)    | 60 (6.4)           | 3 (11.1)                         | 116 (4.1)    |
| Anemia                      | 72 (8.3)          | 58 (5.8)    | 50 (5.3)           | 1 (3.7)                          | 181 (6.4)    |
| Eclampsia                   | 43 (4.9)          | 36 (3.6)    | 37 (3.9)           | 0                                | 116 (4.1)    |
| Others                      | 548 (63.0)        | 497 (49.5)  | 560 (59.6)         | 13 (48.1)                        | 1618 (56.9)  |
| Not Known                   | 147 (16.9)        | 188 (18.7)  | 122 (13.0)         | 8 (29.6)                         | 465 (16.4)   |

\*No Surveillance Field Volunteer since 2016. ASHA: Accredited Social Health Activist; MIDRS: Maternal and Infant Death Reporting System
Maternal deaths

Table 3: Average time to report infant and maternal deaths in the MIDRS portal after death, Haryana, 2014-2018

| Variable                  | n  | Mean | SD  | Min | Max | P      |
|---------------------------|----|------|-----|-----|-----|--------|
| Infants death             |    |      |     |     |     |        |
| <1 month                  | 104091 | 60.2 | 86  | 0   | 1056| 0.000  |
| 1-12 months               | 24573  | 63.8 | 87  | 0   | 1053|        |
| 1-5 years                 | 2492  | 67.7 | 100 | 0   | 1336|        |
| Total                     | 131156 | 61.0 | 86  | 0   | 1336|        |
| Maternal deaths           |    |      |     |     |     |        |
| 42 days after delivery    | 940  | 29.2 | 64  | 0   | 817 | 0.392  |
| Delivery                  | 1005 | 31.9 | 60  | 0   | 706 |        |
| MTP                       | 27   | 32.1 | 48  | 1   | 251 |        |
| Pregnancy                 | 870  | 27.8 | 40  | 0   | 526 |        |
| Total                     | 2842 | 29.8 | 56  | 0   | 817|        |

*MIDRS: Maternal and Infant Death Reporting System

Table 4: Missing data and other inconsistencies in the reported deaths data extracted from the MIDRS portal, Haryana from 2013-2018

| Variable                        | n (%)
|---------------------------------|------|
| Missing data                    |      |
| Timing of maternal death        | 50   | (1.7) |
| Sex of child                    | 4,884| (4.3) |
| Caste                           | 628  | (0.6) |
| Age                             | 07   | (0.2) |
| Unknown cause/outcome           |      |
| Outcome of pregnancy            | 297  | (10.5)|
| Cause of maternal death         | 465  | (16.4)|
| Cause of child death            | 26,440| (17.8)|
| Logical inconsistency            |      |
| Stillbirth as a cause of death   | 26   | (1.2) |
| among children aged 1-5 years   |      |
| Date of entry earlier than the date of death for infant deaths | 17,451| (11.7)|
| Date of entry earlier than the date of death for maternal deaths | 7   | (0.2) |

*MIDRS: Maternal and Infant Death Reporting System

Caregivers of children. Similar findings have been reported from several studies in low-middle-income countries related to various child illnesses like fever, acute respiratory infections, and diarrhea.[25] The health literacy of parents has been shown to influence decision-making for seeking timely care.[25] Counseling regarding danger signs and the availability of health care services by the health care staff should be prioritized. Akin to birth preparedness, the ‘illness preparedness’ strategy is needed for drawing up effective responses in case of common childhood ailments. Even though most of the deliveries are taking place in a health facility, one-fourth of neonatal deaths occur at home. Home-based postnatal care looks like a promising strategy to tackle these deaths.

ANMs and ASHA workers have been the primary source of information for deaths, with some contribution from doctors and staff nurses, probably due to the incentive attached to reporting a death. Although this is an encouraging sign, there are concerns regarding the quality of data and the ascertainment of the cause of death as they are not most qualified to ascertain the exact cause of death. Special field volunteers introduced in Haryana for active surveillance of infant and maternal deaths revealed that all deaths in the ANM register were not reported to the HMIS due to fear of punitive action, thereby leading to underreporting deaths.[26] A substantial proportion of deaths were ‘unknown’ or ‘others’ which renders the data futile for informed decision-making and action. Possible reasons for this include (i) difficulty in ascertaining the cause of death due to lack of efficient tools or lack of adequate training, (ii) poor recording due to lack of supportive supervision. Cause of fatalities may be assigned after the data uploading by a trained person only, probably above the level of a Lady Health Visitors (LHV) to minimize the number of unknown and other causes of deaths. The verbal autopsy could be implemented with rigorous training and on-field supervision to ascertain deaths better. A social autopsy is another promising tool to identify societal causes contributing to death, which has been tried in another North Indian state and should be implemented in Haryana even more rigorously.[22]

Of all the reported maternal deaths, more than one-third died during delivery. This is more concerning for the program. This stresses the effective implementation of the Birth Preparedness and Complication Readiness (BPCR) strategy among pregnant women of Haryana to reach the health facility timely.[24] Infrastructure at the health facilities has also been considered to manage complicated pregnancies with the effective implementation of the LAQSHAY guidelines.[27]

It is essential to ensure accuracy in reporting important events such as deaths as they form the basis for crucial policy decisions. Delay in reporting deaths, invalid entries (such as stillbirths as a cause of post-neonatal and child deaths), and missing information on several key variables were some of the deficiencies noted in the reporting system, similar to findings by Said A in Tanzania.[28] System-generated warning messages, data quality/inconsistency checks, automated messages could ensure better data quality. Community-based death reporting should be incorporated formal registration of maternal and child deaths in low- and middle-income countries for a better outcome.[29]

The IMR of Haryana, according to the SRS, was higher than those reported from the MIDRS portal, which points toward underreporting in the portal as over-reporting of deaths is highly unlikely. Under-reporting could be due to (i) fear of punitive action, (ii) unnoticed deaths in the community for various reasons, and (iii) inefficient data entry. We must ensure completeness of MIDRS through community participation, raising awareness among the community members about the importance of reporting deaths, linking it to some incentivization/schemes, or mandating through laws. Further operational research is required to understand the impact of these interventions on death reporting.
The SBR, according to the MIDRS portal, was much higher than those reported by the SRS. This could probably be due to separate reporting for stillbirths done in Haryana. Haryana is among the few states with unique reporting forms for stillbirths under the MIDRS. Over-reporting of stillbirths is also a possibility pointing toward the need for staff training for accurate ascertainment of the cause of death through proper history taking.

Delay in reporting deaths was around 30 and 60 days for maternal and child deaths, respectively, the reasons for which could be explored through a qualitative inquiry. This will provide valuable insights on how to reduce this delay.

**Summary and Conclusions**

MIDRS has been instrumental in improving the timely death audits and timely corrective measures that are still helping in realizing our SDGs in time. To attain an optimal level of care, primary care providers should focus on some of the neglected areas in maternal and child health care. Equitable access to health care for all, delay in identifying danger signs can be addressed through proper implementation of HBNC and BPCR, refresher training of data collectors and verbal autopsy need attention to lower maternal and infant death rates.

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**Conflicts of interest**

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