

# BMJ Open Maternal death surveillance efforts: notification and review coverage rates in 30 low-income and middle-income countries, 2015–2019

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## ABSTRACT

**Objective** Performance of maternal death surveillance and response (MDSR) relies on the system's ability to identify and notify all maternal deaths and its ability to review all maternal deaths by a committee. Unified definitions for indicators to assess these functions are lacking. We aim to estimate notification and review coverage rates in 30 countries between 2015 and 2019 using standardised definitions.

**Design** Repeat cross-sectional surveys provided the numerators for the coverage indicators; United Nations (UN)-modelled expected country maternal deaths provided the denominators.

**Setting** 30 low-income and middle-income countries responding to the Maternal Health Thematic Fund annual surveys conducted by the UN Population Fund between 2015 and 2019.

**Outcome measures** Notification coverage rate ( $CR_n$ ) was calculated as the proportion of expected maternal deaths that were notified at the national level annually; review coverage rate ( $CR_r$ ) was calculated as the proportion of expected maternal deaths that were reviewed annually.

**Results** The average annual  $CR_n$  for all countries increased from 17% in 2015 to 28% in 2019; the average annual  $CR_r$  increased from 8% to 13%. Between 2015 and 2019, 22 countries (73%) reported increases in the  $CR_n$ —with an average increase of 20 (SD 18) percentage points—and 24 countries (80%) reported increases in  $CR_r$  by 7 (SD 11) percentage points. Low values of  $CR_r$  contrasts with country-published review rates, ranging from 46% to 51%.

**Conclusion** MDSR systems that count and review all maternal deaths can deliver real-time information that could prompt immediate actions and may improve maternal health. Consistent and systematic documentation of MDSR efforts may improve national and global monitoring. Assessing the notification and review functions using coverage indicators is feasible, not affected by fluctuations in data completeness and reporting, and can objectively capture progress.

## INTRODUCTION

The United Nations (UN) Global Strategy for Women's and Children's Health<sup>1</sup> placed reduction of maternal mortality high on the

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This study captures and provides an international overview of maternal deaths notification and review coverage rates.
- ⇒ The study measured coverage rates with uniform definitions and methods.
- ⇒ The study has limitations inherent to cross-sectional surveys and to the United Nations methodology of estimating maternal deaths at the country level using statistical modelling.
- ⇒ The current design of the Maternal Health Thematic Fund surveys prevents estimation of the coverage rates at the subnational level.

international agenda with its 2012 resolution calling for the elimination of preventable maternal deaths,<sup>2</sup> reaffirmed in 2015 in the agenda of the Sustainable Development Goals.<sup>3</sup> Coupled with the framework created by the UN Commission on Information and Accountability for Women's and Children's Health (CoIA)<sup>4</sup> to attain such a goal, a global momentum emphasising tracking progress of resources and results through timely information for action has emerged. An estimated 295 000 maternal deaths occurred in 2017 worldwide, down by 35% from the 2000 level (451 000 maternal deaths)<sup>5</sup>; still most low/middle-income countries (LMICs) continue to have high levels of maternal mortality.

Maternal death surveillance and response (MDSR) is one component of global maternal and newborn health (MNH) programmes that provides a critical feedback loop between information and continuous improvements in life-saving interventions. It is designed to inform the health systems by counting every maternal death, analysing their medical and non-medical causes, and examining what could have been done to prevent them.<sup>6</sup> MDSR is thus an important quantitative and qualitative tool of any MNH

programme. MDSR is intended to be a continuous action cycle involving: (a) ongoing identification and notification of maternal deaths; (b) review by local maternal death review committees and short-loop response; (c) analysis at district and national levels to formulate multi-sectoral recommendations and actions; (d) implementation of responses and (e) monitoring and improving the entire action cycle. In countries that have implemented these approaches nationally or on large scale—Ethiopia, Jamaica, Morocco, Rwanda and South Africa—there is evidence of improvement in availability and quality of care and reduction of maternal mortality.<sup>7–11</sup> However, in most LMICs, where the most maternal deaths occur, MDSR efforts are often sub-national, limited to deaths occurring in health facilities, and hampered by lack of certification of deaths and their causes.<sup>5 12 13</sup>

Following the CoIA's Accountability Framework, a wave of regional consultations and workshops in 2012–2013 led to widespread national commitments to make maternal deaths notifiable and adopt MDSR.<sup>14</sup> Countries were encouraged to select monitoring indicators and set up targets,<sup>15</sup> including indicators and targets for national MDSR systems. MDSR efforts intensified globally after the launch of the 2013 technical guidance,<sup>6</sup> which paved the way for developing national MDSR policies. Since then, WHO and the United Nations Population Fund (UNFPA) have closely monitored countries' progress in MDSR implementation. At the global level, the only indicators that have been tracked are the estimated maternal mortality ratios (MMR) and number of maternal deaths developed by the UN Maternal Mortality Estimation Inter-Agency Group (UN MMEIG),<sup>5</sup> and indicators assessing system readiness (eg, existence of national MDSR policies, such as mandatory notification and reporting, and presence of sub-national and national committees).<sup>12 16</sup> A recent assessment<sup>16</sup> showed substantial gaps between the existence of national MDSR policies and the establishment of national and subnational review committees.

There is a need for monitoring and evaluation indicators that go beyond global maternal mortality estimates and assessments of system readiness. Examining the actual implementation and performance of national surveillance systems may inform strategies to strengthen these platforms for measurement and quality improvements. While some national policies recommend tracking maternal death notification and review rates, little effort has been made to harmonise the definitions of indicators of coverage across countries or to use them to improve MDSR performance.<sup>17</sup> In 2015, the number of notifications and reviews started to be collected annually by the UN<sup>12</sup> and have been recommended by WHO for global monitoring.<sup>18</sup> Other global monitoring efforts, such as the Countdown to 2030,<sup>19 20</sup> the Campaign on Accelerated Reduction of Maternal Mortality in Africa (CARMMA)<sup>21</sup> or the Global Financing Facility<sup>22</sup> do not track MDSR performance.

As tracking progress towards reducing maternal mortality is a priority function of MDSR, both global and

national monitoring of MDSR would benefit from indicators that are well defined, objective, reliable, easy to compute, and universally applicable and used.<sup>18</sup>

Because MDSR systems in different countries might use different data sources and transmission approaches to notify maternal deaths, the estimation of notification and review rates could be subject to non-ignorable variation between and even within countries. This introduces uncertainty when comparing performance of MDSR between countries or over time. It also impacts efforts to accurately estimate country and global maternal mortality levels. One approach to compute national comparable indicators is to replace country reported maternal deaths with its expected number of deaths that is based on a standard model with country specific parameters developed by MMEIG.<sup>5</sup> This 'standardisation' can be used for notification and review coverage rates that could be compared globally and over time as they are not influenced by fluctuations in reporting.

Building on definitions of notification and review rates<sup>6</sup> and the newly MDSR implementation guidance,<sup>18</sup> we demonstrate calculation and levels of alternative indicators that aim to capture maternal death notification and review coverage. These coverage rates are not affected by variations in registration practices, use clear operational definitions, and can be consistently measured across time and settings.<sup>23</sup> Several countries (ie, Benin, Myanmar, Niger, Sierra Leone, Togo) have already adopted these indicators.<sup>24–28</sup> Complementing the traditional MDSR indicators, the coverage rates allow for examination of the robustness of the national MDSR systems.

In this paper, we aim to provide estimates and trends of notification and review coverage in 30 countries that have been participating in UNFPA's Maternal and Newborn Health Thematic Fund (MHTF) initiative between 2015 and 2019. This demonstration is intended to inform country and global efforts for strengthening MDSR systems. Through the adoption of the proposed standardised coverage indicators, countries would be able to consistently and systematically track variations in maternal mortality and performance of national surveillance efforts.

## METHODS

### Maternal deaths notification rate

The WHO guidance defines notification rate as the proportion of maternal deaths identified in facilities and communities that are notified (ie, have an individual notification completed) and reported to the central level ( $R_n$  in table 1). The guidance recommends notifying all maternal deaths that occurred in health facilities and communities; the policies for notification, such as the forms completed, timeframe and chain of reporting, which may vary by country.<sup>6</sup>

The notification rate reflects the ability of the MDSR system to accurately capture the number of maternal deaths. It is recommended that at least 90% of the

**Table 1** Indicators of notification and review of maternal deaths

	Notification		Review	
	Notification rate	Notification coverage rate	Review rate	Review coverage rate
Definition	$R_n = \frac{d_n}{d_i}$	$CR_n = \frac{d_n}{E(d)}$	$R_r = \frac{d_r}{d_n}$	$CR_r = \frac{d_r}{E(d)}$
Data source for numerator	Deaths notified to central level	Deaths notified to central level	Deaths with reviews reported to central level	Deaths with reviews reported to central level
Data source for denominator	Deaths identified*	Deaths estimated†	Deaths notified to central level	Deaths estimated†

$R_n$  = notification rate (existing)  
 $R_r$  = review rate (existing)  
 $CR_n$  = notification coverage rate (new)  
 $CR_r$  = review coverage rate (new)  
 $d_i$  = deaths identified (all sources)  
 $d_n$  = deaths notified (country specific parameter)  
 $d_r$  = deaths reviewed (country specific parameter)  
 $E(d)$  = estimated deaths  
 \*The identification may vary by country (eg, hospitals only, all health facilities, health facilities and communities).  
 †We propose using the most recent country estimates available from global United Nations Maternal Mortality Estimation Inter-Agency Group estimation efforts.<sup>5</sup>

identified maternal deaths are notified and that countries continuously monitor their notification rate.<sup>6</sup> If the notification rate is below 90%, the implication is that the MDSR system missed some deaths, or the deaths were not notified at the central level.

The numerator consists of the annual number of maternal deaths—female deaths from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes) during pregnancy, childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of pregnancy—that were notified according to the MDSR protocol and reported centrally. The notifications are usually sent to the Ministry of Health (MoH) Family Health Department or equivalent.<sup>6</sup>

The denominator is represented by the number of identified maternal deaths that occurred in health facilities and communities and were reported through the routine health management information system (HMIS) or civil registration and vital statistics (CRVS).

While this indicator has been described since 2013, few countries are using it to track MDSR performance.<sup>12 17</sup> Typically, countries monitor only the number of deaths notified, which misses the opportunity to assess the capacity of the surveillance system to identify all deaths. To address this, we propose the following notification coverage rate.

### MATERNAL DEATHS NOTIFICATION COVERAGE RATE

**Definition:** The proportion of *expected* maternal deaths that were notified/reported at the national level (eg, the MoH MDSR committee) within a year ( $CR_n$  in table 1).

We propose using the same numerator, the maternal deaths notified at the central level, as described by the

WHO guidance. The denominator, however, consists of the estimated number of maternal deaths expected to have occurred in a country in 1 year. As the annual number of maternal deaths is often incomplete in countries that lack robust CRVS systems, we propose using the most recent country estimates available from global UN MMEIG estimation efforts.<sup>5</sup>

### Maternal deaths review rate

The review rate is defined as the proportion of all maternal deaths notified that have been reviewed within a specified period, usually within a year<sup>6</sup> ( $R_r$  in table 1).

For maternal deaths that occurred in facilities, data from multiple administrative sources are compiled and case summaries are prepared prior to the review. Case notes, patient records, postoperative notes and laboratory results are valuable sources of information. Deaths that occurred in communities also need to be reviewed. Data collection for maternal deaths in communities is often conducted by review committees through verbal and social autopsies, which ask questions from the family and other community members about the circumstances that led to the maternal death. Multidisciplinary review committees, their roles, processes and frameworks of operation are generally regulated by national guidelines. Review outputs usually include a structured amount of information about each death that could be used for analyses, specific recommendations to prevent future deaths by addressing medical and non-medical contributing factors, and a plan of action to implement and follow-up those recommendations at community and facility levels.<sup>6</sup>

In addition to estimating the proportion of notified deaths that had been reviewed, we propose to assess the system's performance by estimating to what extent the expected maternal deaths have been reviewed.

### Maternal deaths review coverage rate

Definition: The proportion of *expected* maternal deaths in a country that have been reviewed within a year ( $CR_r$  in table 1).

The review coverage rate as a proportion of all expected maternal deaths is not affected by fluctuations in the notification rate. Using notified deaths in the denominator may provide a false sense of completion of reviews, in settings where there are inaccuracies in maternal deaths are notified. Conversely, it may mask an increase in the completion of reviews if the notification process improves over time. Using the expected number of maternal deaths in the denominator allows better tracking of review rates over time.

There are some advantages of computing review coverage rates in addition to review rates. First, they can be feasibly used for global comparisons and national trends. Second, they can be expressed as a product that allows determination of the contribution of each factor to the performance of the surveillance system. Third, they preserve the purpose of the original review rate indicator. The coverage review rate can be decomposed into a part about the ability of the system to identify all deaths ( $CR_n$ ) and one about the ability of the system to review the deaths that were notified ( $R_r$ ):

$$\frac{d_r}{E(d)} = \frac{\frac{d_n}{d_n}}{\frac{E(d)}{d_n}} = \frac{d_n}{E(d)} * \frac{d_r}{d_n} \quad \text{or} \quad CR_r = CR_n * R_r$$

### Data sources

We applied the above-mentioned definitions to compute annual maternal death notification and review coverage rates ( $CR_n$  and  $CR_r$ ) and the proportion of reviews among notified deaths ( $R_r$ ) between 2015 and 2019 for 30 LMICs.

### Numerators

The number of maternal deaths notified and maternal deaths reviewed were provided by each of the 30 countries as part of their reporting to the UNFPA's MHTF initiative. The MHTF was created in 2008 to support 32 high maternal mortality countries in their efforts to accelerate progress in MNH. It focuses on strengthening midwifery, emergency obstetric and neonatal care, maternal and perinatal death surveillance, and prevention and treatment of obstetric fistula and other obstetric morbidities. It remains the only UN global initiative dedicated to supporting MNH. MHTF includes annual surveys to document countries' efforts and progress on the main areas of focus. For MDSR, the surveys collect among other information the number of maternal deaths routinely identified in health facilities and communities that were notified to the central level, and the number reviewed and reported centrally. Survey questionnaires are completed by the MDSR focal point in the MoH. The source of information about maternal deaths available to the MoH focal point varies from country to country and may include the national HMIS, IDSR, or MDSR-specific

monthly or quarterly reports. National and UN maternal health experts review the data for consistency and completeness and transfer the data annually to the MoH and to the MHTF coordinating team at the UNFPA headquarters for compilation. The first round of surveys was implemented in 2016 to collect 2015 data. Between 2015 and 2019, 30 out of 32 MHTF-supported countries reported the number of notifications and reviews documented at the central level.

The number of maternal deaths notified includes the number notified in health facilities and in communities. However, in most of the countries analysed, the community notifications for maternal deaths were low or absent. Among the 30 countries analysed, only 12 countries notified maternal deaths in communities in 2019 and these notifications represented a small proportion of all deaths notified. Notable exceptions were Sudan, Bangladesh, the Democratic Republic of the Congo (DRC), where the community notifications represented 83%, 65% and 59%, respectively of the overall notifications.

### Denominators

For both coverage indicators, we used the most recent UN MMEIG global estimates of maternal deaths<sup>5</sup> as denominators. These estimates use existing national-level empirical data (ie, death registration data, population-based household surveys using the sisterhood method, reproductive-age mortality studies, confidential enquires into maternal deaths, verbal autopsies, censuses and other specialised maternal mortality studies conducted at the national level) and complex statistical methods that aim to reduce the misclassification and under-reporting of maternal deaths. They use the predicted proportion of deaths of women of reproductive age due to maternal causes, and population data on deaths and births from the UN Population Division.<sup>29</sup> Although there have been several revisions of the methodology, each iteration of the global estimates clearly specifies the data sources, assumptions and statistical modelling techniques used; it also provides revisions of estimates published in previous editions. The most recent two rounds of the UN MMEIG estimates were based on the use of the Bayesian maternal mortality estimation model, which combines regression functions with time series models. The model predicts the proportion of deaths due to maternal causes in all countries, regardless of data availability and quality. Maternal deaths are modelled for each country-year using either primarily country data, or a combination of country data and predicted data based on covariates for countries with limited data, or covariate-driven estimates for countries without data. The modelled estimates include adjustments and uncertainty associated with the data points. As the source data used to derive the estimates are subject to sampling and non-sampling errors, and errors due to incomplete coverage or under-reporting, the estimated number of maternal deaths are reported with uncertainty intervals (UIs), which have an 80% probability of containing the true value of the number of maternal



deaths.<sup>5</sup> The 2019 UN MMEIG report includes historical data on maternal deaths and MMR (year 2000, 2005, 2010) and the most recent annual estimates (2015–2017). We used the published yearly data (2015, 2016, 2017) and kept the estimates for 2017 as denominators for 2018 and 2019.

### Statistical analysis

We computed the notification and review coverage rates as well as the review rate ( $R_r$ ) out of notified deaths by country and year. Because countries participating in the MHTF surveys only reported on the number of maternal deaths notified to the central levels, we were unable to compute the notification rates ( $R_n$ ). The review rate allows us to understand its relative contribution to the coverage review rate. We estimated the changes over time as percentage differences and averages, including SD for all countries combined and subgroups.

As a sensitivity analysis, for each country and year we compared the computed maternal death notification and review coverage rates with alternative pairs where the maternal deaths for denominators were projected using annual reduction rates (ARRs), also provided by MMIEG (online supplemental material 1).

### Patient and public involvement

None.

## RESULTS

The average  $CR_n$  for all countries increased from 17% ( $\pm$ SD of 15%) in 2015 to 28% ( $\pm$ 23%) in 2019 (table 2 and figure 1). The average  $CR_r$  increased from 8% ( $\pm$ 13%) in 2015 to 17% ( $\pm$ 23%) in 2018 and declined to 13% ( $\pm$ 15%) in 2019. These low values of  $CR_r$  contrast with the values of the average  $R_r$  that were 46%–57%.

The annual  $CR_n$  with ARR adjustments in 2015–2019 were slightly higher than those without adjustments in most countries, as the ARRs tend to have positive values (figure 2). The country differences in the annual  $CR_n$  calculated with and without an ARR-adjustment were generally negligible—1 percentage point or less in 70% of the countries in 2019. Similarly, the differences in the maternal death review coverage rates calculated with and without an ARR adjustment were small (figure 3). In 83% of the countries, the annual  $CR_r$  with and without an ARR adjustment differed by less than 4 percentage points or less in 2019.

As the differences between coverage rates with and without ARR adjustments were relatively small in most countries and unadjusted rates were more conservative, we examined the trends of  $CR_n$  and  $CR_r$  using unadjusted maternal death estimates for denominators.

Increases in the  $CR_n$  between 2015 and 2019 were reported by 22 countries (73%), with an average increase of 20 ( $\pm$ 18) percentage points. The remaining countries reported a decline in  $CR_n$ , with an average decline between 2015 and 2019 of 8 ( $\pm$ 7) percentage points.

In 2019,  $CR_n$  were the highest in Timor-Leste (100%), Benin (64%), Zambia (56%) and Bangladesh (54%). Rates were higher than average in DRC (43%), Lao PDR and Guinea Bissau (40%), Togo (32%), and Congo, Ghana and Mozambique (31%) (table 2).

While the rates had generally improved, some countries showed important variations from 1 year to another. For example, Benin and Bangladesh significantly increased their  $CR_n$  between 2015 and 2019, from 1% to 64% and from 8% to 54%, respectively. DRC had a  $CR_n$  of 2% in 2015 that increased to 67% in 2017 and decreased to 43% in 2019. Guinea's  $CR_n$  increased from 5% in 2015 to 30% in 2017, followed by a decrease to 17% in 2019. Conversely, some countries have seen a decline or fluctuating rates (table 2). However, most countries improved their  $CR_n$  and the number of countries with a  $CR_n$  of at least 35% more than doubled between 2015 and 2019 (figure 4). Only two countries reported  $CR_n$  below 5% in 2019, down from 11 countries in 2015.

The  $CR_r$  also increased between 2015 and 2019. Among the 24 countries (80% of the countries) that had increased  $CR_r$ , the average increase was of 7 ( $\pm$ 11) percentage points. The average decrease for the six countries with declining review coverage rates was 6 ( $\pm$ 7) percentage points. In 2019, Zambia and Bangladesh had the highest review coverage rates (56% and 54%, respectively). These countries were followed by Benin with 30%  $CR_r$ , and Ghana and Sudan with 29%. Two countries had significantly increased their  $CR_r$  (Bangladesh, from 7% to 54% and Benin, from 1% to 30%). In Zambia, the  $CR_r$  was as high as the  $CR_n$  in each year, indicating that all deaths that were notified were followed by reviews (table 2).

In 2019, the  $CR_r$  remained under 15% in 20 countries (about 70% of the countries) (figure 5). Only two countries reported  $CR_r$  of 35% or higher and three countries reported a rate between 25% and 34%.

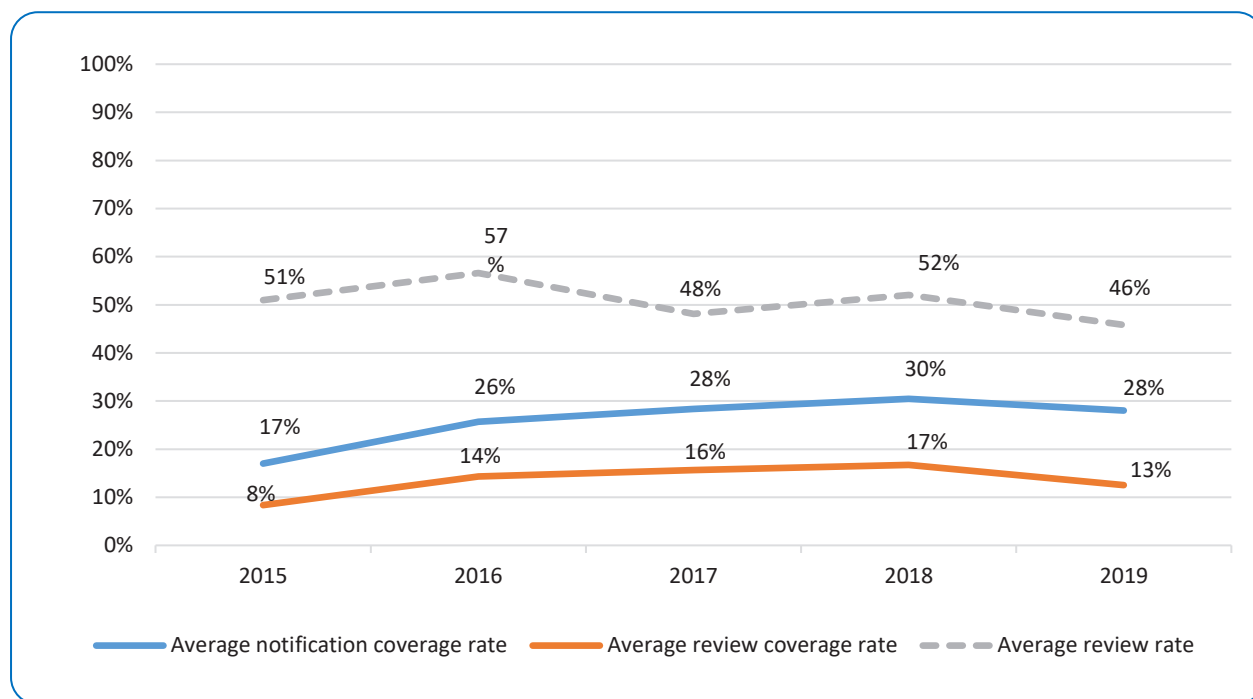
## DISCUSSION

Efforts to increase identification, notification and review of maternal deaths through MDSR were initiated in most LMICs in the past decade.<sup>30</sup> MDSR provides more complete and detailed information about maternal deaths in 'real time', so that public health programmes can act effectively and efficiently.<sup>31</sup> An increasing number of countries adopted new policies and practices in support of MDSR implementation<sup>32</sup> and started to monitor their MDSR systems. The WHO 2018/2019 policy survey<sup>30</sup> found that of the 150 reporting countries (response rate=77%), 81% reported a national policy/guideline or law requiring notification of all maternal deaths within 24 hours and 84% reported a national policy/guideline or law requiring review of all maternal deaths. Efforts to perform monitoring are hampered, however, by variable definitions of indicators and lack of global standards. We propose complementing the current indicators that assess the main functions of the MDSR system—notification rate and review rate—with corresponding coverage

**Table 2** Maternal death notification coverage rate ( $CR_n$ ), review coverage rate ( $CR_r$ ), and review rate ( $R_r$ ) for 30 countries, 2015–2019

Countries	2015			2016			2017			2018			2019		
	$CR_n$ (%)	$CR_r$ (%)	$R_r$ (%)	$CR_n$ (%)	$CR_r$ (%)	$R_r$ (%)	$CR_n$ (%)	$CR_r$ (%)	$R_r$ (%)	$CR_n$ (%)	$CR_r$ (%)	$R_r$ (%)	$CR_n$ (%)	$CR_r$ (%)	$R_r$ (%)
All countries	17	8	51	26	14	57	28	16	48	30	17	52	28	13	46
Bangladesh	8	7	98	6	1	9	58	29	49	65	65	100	54	54	100
Benin	1	1	100	42	23	55	45	22	50	54	30	56	64	30	47
Burkina Faso	31	13	41	40	16	40	39	13	34	38	13	34	23	9	40
Burundi	7	12	168	8	13	164	12	11	89	12	15	125	11	16	140
Chad	4	1	20	4	0	5	3	0	7	3	0	9	5	0	3
Congo Brazzaville	22	0	0	33	0	0	24	0	0	23	0	0	31	5	15
Côte d'Ivoire	4	0	0	16	0	0	26	0	0	14	0	0	19	0	0
Democratic Republic of Congo	2	0	0	7	2	33	67	12	18	42	11	27	43	12	28
Ethiopia	5	5	100	6	6	100	9	7	78	8	4	52	7	2	28
Ghana	34	27	79	35	29	82	0	0	0	33	31	95	31	29	93
Guinea Bissau	43	8	20	48	9	19	24	12	49	50	13	25	40	8	20
Guinea	5	3	56	13	5	39	30	0	1	19	7	36	17	5	33
Haiti	16	0	0	28	0	0	35	0	0	24	0	0	28	0	0
Kenya	19	10	52	25	16	64	21	15	70	21	19	92	22	18	84
Lao People's Democratic Rep.	40	36	90	33	18	56	49	33	67	42	21	51	40	22	54
Liberia	27	13	50	30	23	77	26	21	81	27	24	91	29	25	85
Madagascar	2	0	12	20	2	9	15	1	5	21	1	7	25	5	20
Malawi	35	0	0	31	0	0	22	0	0	19	0	0	14	0	0
Mauritania	0	0	0	4	5	125	8	3	30	5	11	221	12	4	30
Mozambique	25	0	0	25	25	99	27	24	91	23	0	0	31	0	0
Nepal	7	0	0	3	2	56	12	10	82	8	8	100	1	1	100
Niger	27	15	57	27	15	56	31	22	70	25	14	56	23	0	0
Senegal	2	2	100	25	8	30	23	17	75	31	3	10	24	8	33
Sierra Leone	15	0	0	25	24	95	19	18	95	21	0	0	20	19	97
Somalia	22	0	0	6	0	0	5	0	0	24	0	0	6	0	0
Sudan	27	27	100	29	29	100	32	32	100	32	32	100	29	29	100
Timor-Leste*	0	0	0	118	85	72	96	96	100	100	100	79	100	0	0
Togo	8	8	100	24	10	43	26	6	21	33	10	30	32	11	34
Uganda	8	6	74	4	7	170	6	5	80	9	6	66	10	9	90
Zambia	57	57	100	55	55	100	62	62	100	62	62	100	56	56	100

When notifications or reviews are not reported centrally, the country is classified as having zero national data on notification or review. Rates are rounded up or down to the nearest integer, but threshold analyses were performed with unrounded rates. \*No reviews were reported by the country in the 2019 annual survey, presumably because of late reporting to the central level.



**Figure 1** Trends in the average maternal death notification coverage rate ( $CR_n$ ), coverage review rate ( $CR_r$ ) and review rate ( $R_r$ ) for 30 countries from 2015 to 2019.

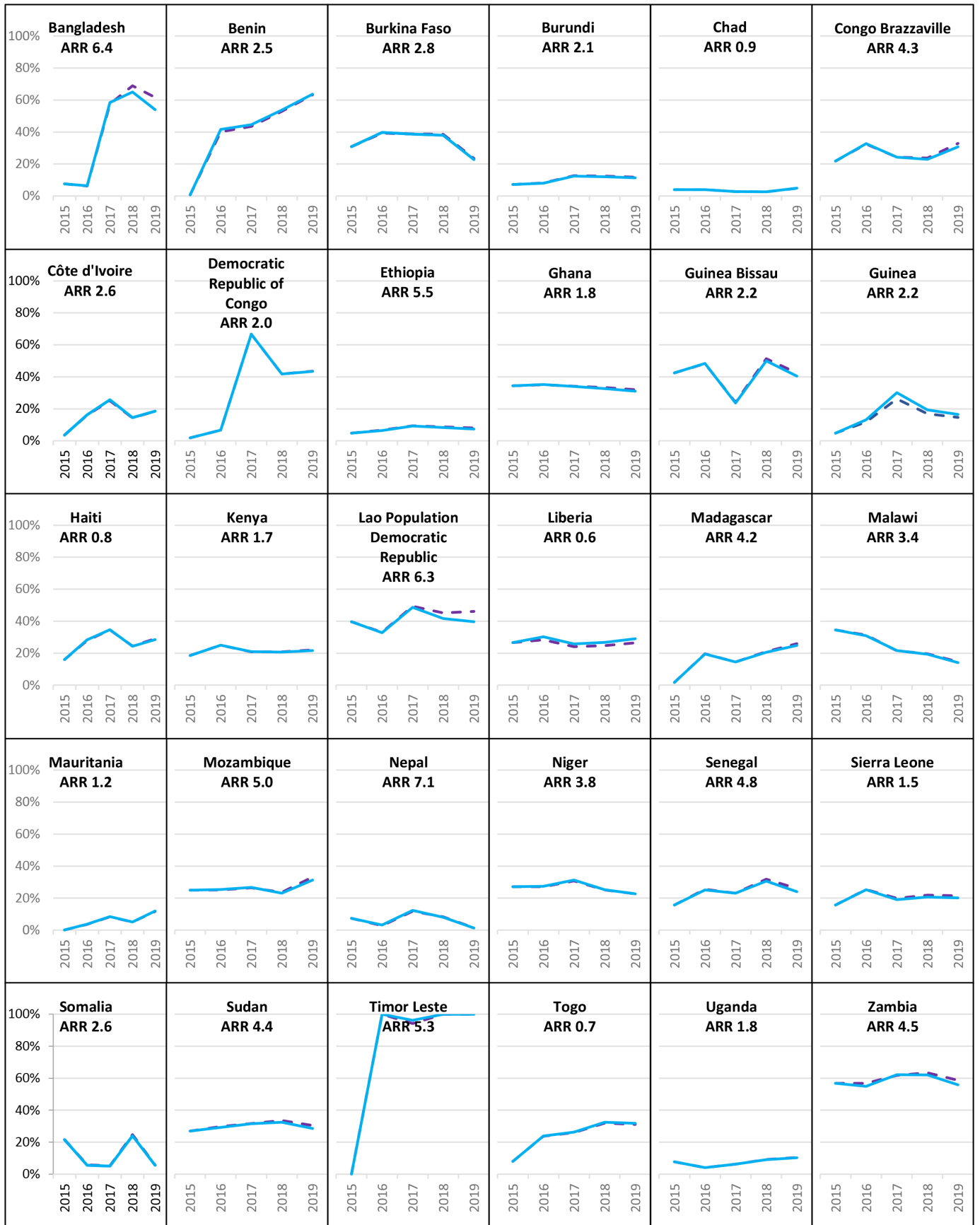
indicators. The notification coverage rate assesses how well a system is counting maternal deaths and the review coverage rate how often reviews occur. These functions are critical to the success of MDSR in calculating maternal mortality levels and identifying opportunities of prevention. Coverage indicators can inform MDSR system improvements as countries strive to scale-up maternal death notifications and reviews. If all maternal deaths are notified and reviewed, MDSR could become ‘a building block for a comprehensive, national-level data collection system’,<sup>5</sup> and timely and targeted interventions to prevent future deaths could be formulated and implemented. Our proposed coverage indicators build on existing indicators to assess MDSR performance across countries.

Coverage indicators increase the feasibility, reliability and objectivity of maternal and child health measures.<sup>23</sup> By incorporating expected number of maternal deaths in the proposed definitions, coverage indicators allow for monitoring of MDSR country efforts consistently and systematically over time and across countries. Because the expected annual number of maternal deaths is estimated with robust methods and published periodically, the process of calculating the proposed indicators is not affected by annual fluctuations in data completeness and reporting and may be more able to objectively capture the status of the MDSR system. These indicators can be tracked through the national HMIS such that MDSR

performance indicators are used to strengthen HMIS systems that capture deaths, and not as a separate process.

Countries base their maternal death notification and review analyses on the assumption that almost all maternal deaths are notified and, as such, that their data can reflect trends.<sup>33</sup> Annual MDSR reports rarely consider that there are inaccuracies in maternal deaths that are notified, particularly when deaths occur outside health facilities, which alters their assessments of maternal mortality levels and trends, or reviews performed. Facility-based maternal deaths represent only a subset of total maternal deaths in a population because they include only women who accessed obstetric care services. When a country monitors maternal mortality using facility deaths only, it may arrive to biased conclusions, as illustrated by the example from Burkina Faso (figure 6).

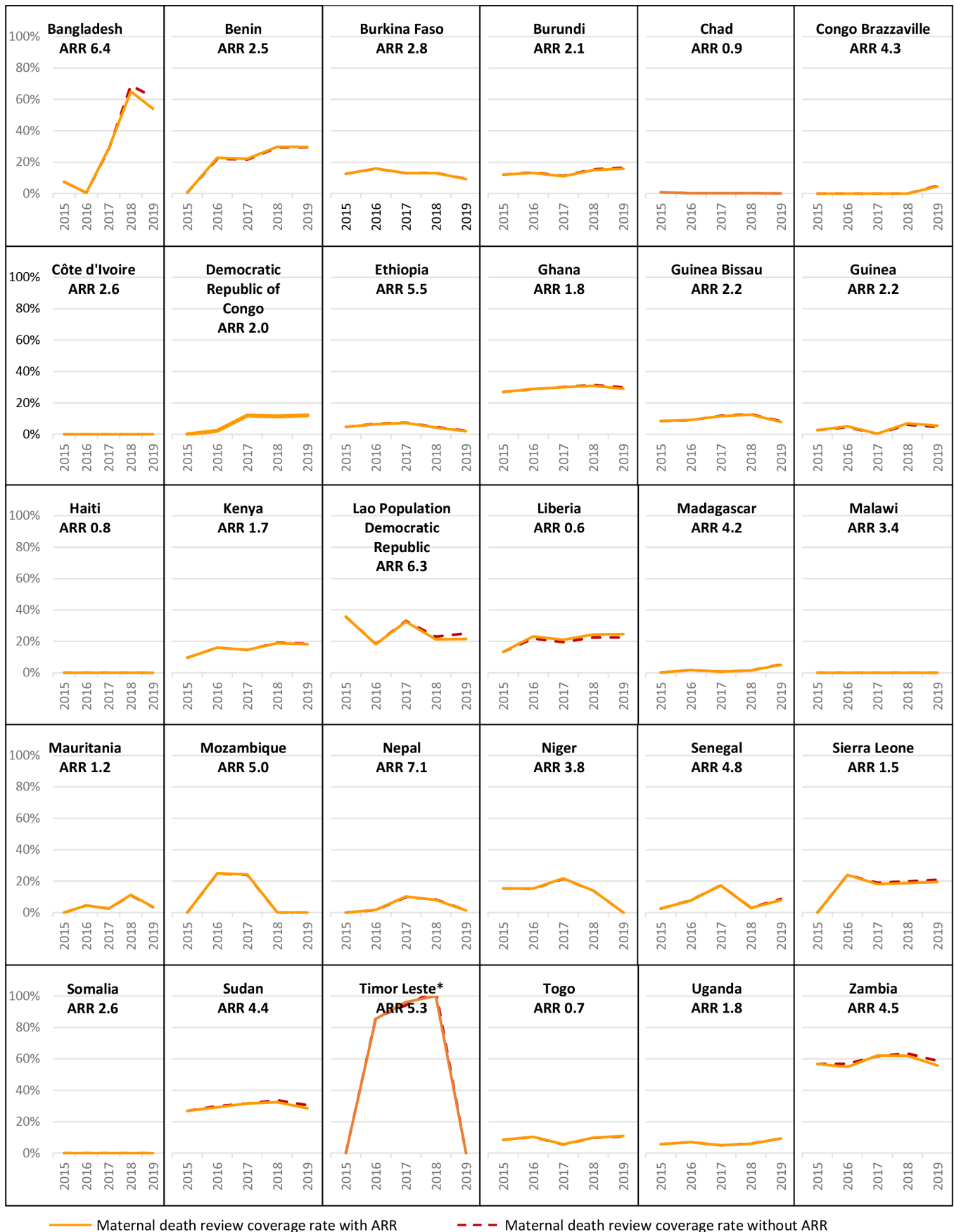
In 2019, the average notification coverage rate was 28% across 30 countries, ranging from 1% in Nepal to about 100% in Timor-Leste (a country with low maternal mortality compared with others). This proportion did not exceed 13% in 2019 for the review coverage rates, as reviews were generally confined to maternal deaths that occurred in health facilities. It is worth noting that Timor-Leste did not report their reviews conducted in 2019 on the MHTF questionnaire; a follow-up with the country in 2021 revealed that they conducted 32 reviews in 2019, which would have yielded a review coverage rate



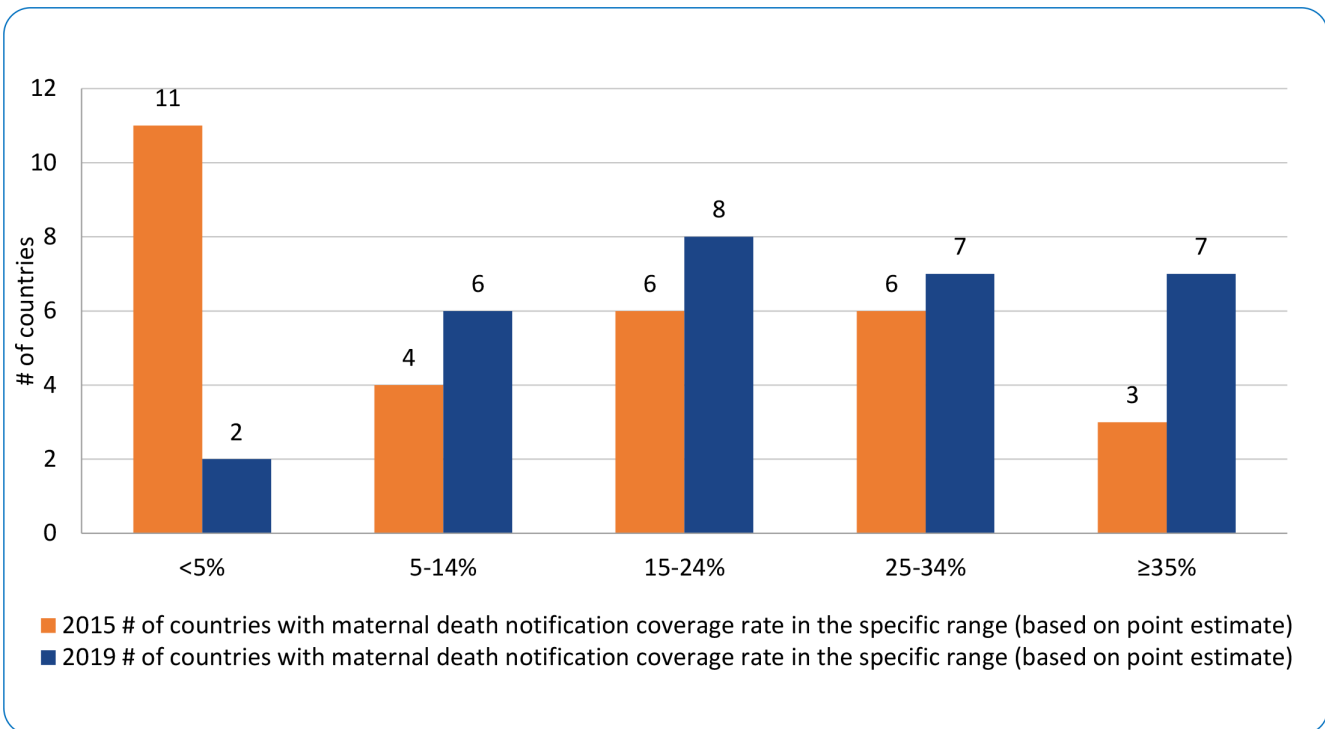
— Maternal death notification coverage rate with ARR    - - - Maternal death notification coverage rate without ARR

**Figure 2** Maternal death notification coverage rate ( $CR_n$ ) for 30 countries, 2015–2019, with and without average rate of reduction (ARR).





**Figure 3** Maternal death review coverage rate ( $CR_t$ ) for 30 countries, 2015–2019, with and without average rate of reduction (ARR). \*No reviews were reported by the country in the 2019 annual survey, presumably because of late reporting to the central level.

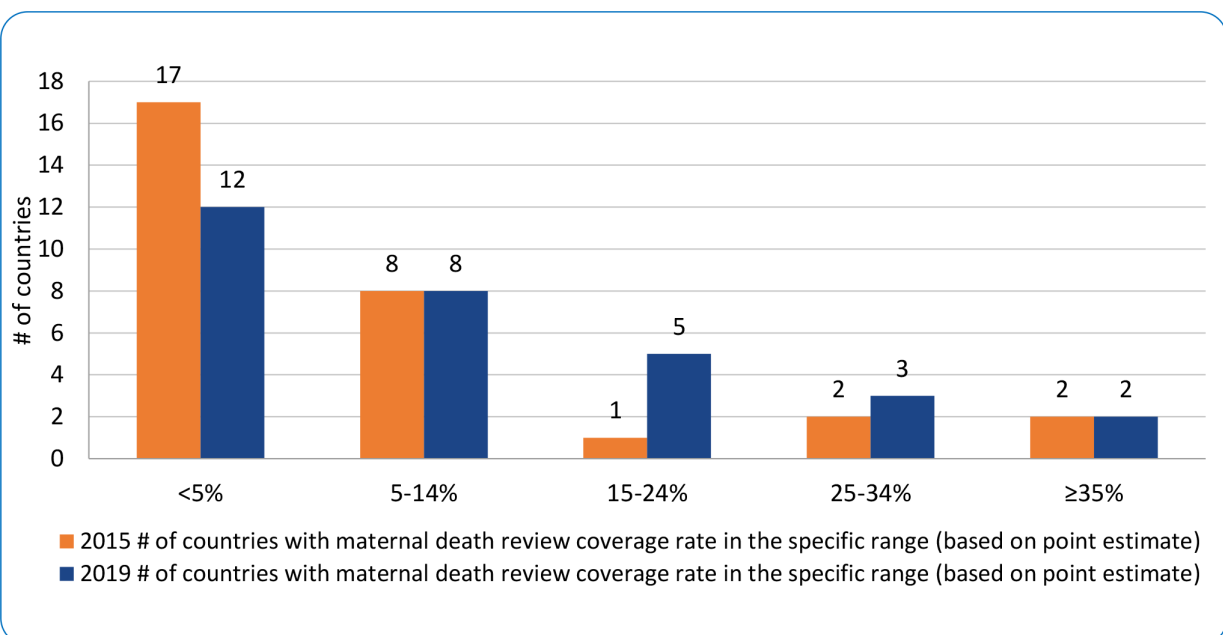


**Figure 4** Range of maternal death notification coverage rate ( $CR_n$ ) for 2015 and 2019 for 30 countries.

of over 90% and would have increased the overall rate for 30 countries in 2019 to 15%. In contrast, the proportion of maternal deaths reviewed among notified deaths in 2015–2019 was consistently higher (46%–57%), highlighting the importance of assessing review rates through the lens of expected maternal deaths.

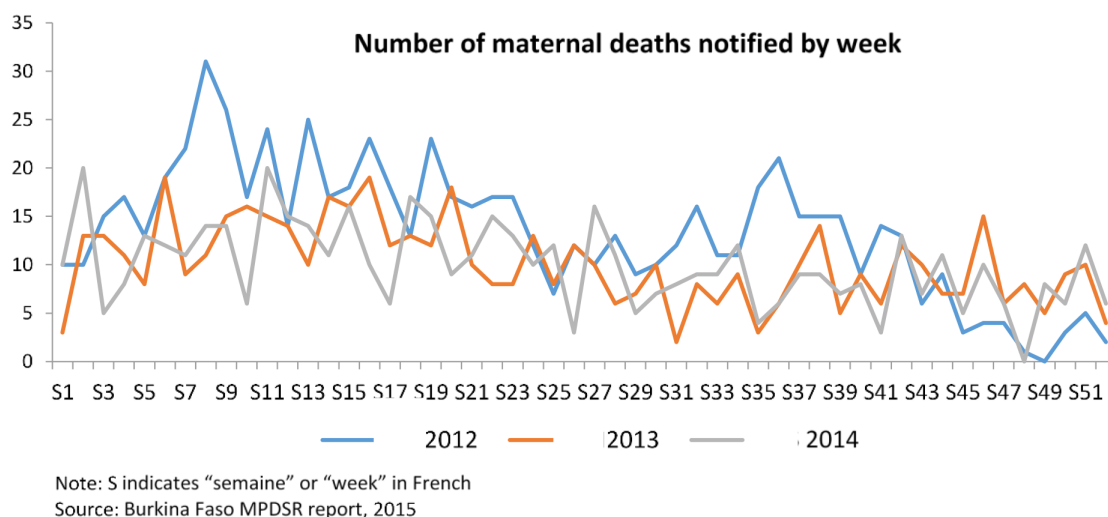
For MDSR to become a reliable data source on assessing maternal mortality levels, as recommended by WHO,<sup>6</sup> the notification coverage rate needs to reach 90% or more. In the context of countries where maternal mortality overall

is decreasing, the notification and review rate targets may be easier to reach, as observed in Malaysia, Mongolia and Timor-Leste. We explored the variation in coverage rates calculated with constant versus adjusted denominators and found that most countries had small differences in those rates. Using the maternal death MMEIG published estimates for the analysis of annual changes in maternal deaths notification and review rates would yield similar results as using adjusted denominators. Countries with large ARR, however, may want to perform sensitivity



**Figure 5** Range of maternal death review coverage rate ( $CR_r$ ) for 2015 and 2019 for 30 countries.

Burkina Faso's national MPDSR program was established in the early 2010s, with integration of maternal death notification and review data into the health information system in 2013. The department in charge of the epidemiologic surveillance unit within the Ministry of Health (MoH) took over the management of MPDSR data in 2014, resulting in an "epidemiological approach" that increased the speed of data availability and analysis, leveraging epidemiological expertise of the department. However, limitations remained in the analysis and interpretation of MPDSR data, as shown in the excerpt of Burkina Faso's MPDSR 2015 report below[47]. The figure below displays the number of maternal death notifications in health facilities by calendar week for the years 2012, 2013, and 2014.



Citing this figure, the 2015 MPDSR report concluded that "...the above data analysis shows steadily maternal mortality decrease between 2012 and 2014. The total number of maternal deaths notified was 702 in 2012, 527 in 2013, and 517 in 2014" in the national MDSR report for 2015. However, this assessment only considered the number of maternal deaths notified from health facilities, representing a fraction of expected maternal deaths. This number is not necessarily a representation of the national maternal death trend and may be influenced by other factors such as the capacity of the MoH to collect data.

Discussing with senior officers in Burkina Faso, the UNFPA MHTF team understood that this conclusion was based on the fact that the MoH did not take into consideration that maternal deaths notified in facilities (517 in 2014) were only a fraction of the estimated number of maternal deaths (2,500 in 2014, according to the global estimates). This is a common inference in analyses reported by several Western African countries. The review of Burkina Faso's MPDSR report was an entry point for UNFPA to propose maternal death notification and review coverage rate indicators in its 2018–2022 strategic plan recommendations [41] that have been adopted by 72 UNFPA country offices.

**Figure 6** An incomplete picture: trends in maternal death notification over time in Burkina Faso.

analyses using the estimated number of maternal deaths with an ARR adjustment.

Reviews are essential in examining the three delays to obstetric care,<sup>6</sup> identifying causes of death and understanding quality of care.<sup>34</sup> The performance, conclusions and ability to follow recommendations of maternal death reviews are uneven.<sup>35–37</sup> For reviews to provide a true sense of coverage, it would be important to complement

them with indicators that would specifically monitor their quality. Conducting qualitative assessments of the reviews on a sample of maternal deaths—as is the case in Senegal, which classifies their sample reviews as 'satisfactory or not satisfactory', based on an analytic tool<sup>38</sup>—may be a first step toward formulating such indicators.

In settings where the notification of community deaths is limited or non-existent, the reviews are generally

confined to maternal deaths that occurred in health facilities. Therefore, it would not be possible in these countries to set a 100% target for a coverage review rate. Target-setting in these countries may first consider an estimation of the percentage of maternal deaths that occur in health facilities and an adjustment factor for community deaths that are not being reviewed. Whenever possible, all maternal deaths should be reviewed.<sup>6</sup> The 2013 MDSR guidance recommends to review all confirmed maternal deaths at the facility or district level. Where maternal mortality is high, reviewing all facility and community deaths may incur large financial and operational costs. It may also jeopardise the quality of the reviews. Considering these realities, countries may establish their own national targets and milestones for improving the quality of the reviews.

With the current state of MDSR implementation in countries, the maternal death notification coverage rate is a relevant indicator for measuring the performance of the system to notify every maternal death. Coverage indicators have already been used in selected countries (Bangladesh, Côte d'Ivoire and Togo) for planning, resource allocation, formulation of targeted interventions for improvements and preparation of annual reports.<sup>28 39 40</sup> Further, UNFPA has included them in country strategic planning<sup>41</sup> since 2015, and they were recently recommended for global monitoring.<sup>18</sup> Global and national monitoring of MDSR is geared toward assessing the ability of the system to perform core functions (identification and notification of maternal deaths, maternal death reviews and response). The notification and review coverage indicators are key indicators of system performance that may improve surveillance efforts and in turn foster responses at the community, facility and country level. Indicators to assess other core functions of the surveillance efforts are also urgently needed. For example, it is critical to also measure the accuracy of the maternal death reviews that occur in MDSR—as they directly lead to recommendations and strategies on improving quality of care—and the ability of the health systems to formulate adequate responses and implement those responses, as only concrete and prompt action can prevent future maternal deaths.

This study is not without limitations. In general, there are inherent limitations to the use of repeat cross-sectional data from MHTF and global maternal mortality estimates. The number of notified and reviewed deaths from MHTF are those known at the central level, and more events may be recorded at subnational levels that failed to be transmitted upwards, rendering our coverage rates as conservative estimates. All approaches for measuring maternal mortality have essentially two limitations in estimating the true levels of maternal mortality: identifying adult female deaths; and correctly determining whether such deaths are maternal. As the MMIEG estimates use country empirical data, some of the limitations of the original data are influencing the estimates even after adjustments. Maternal deaths from MMIEG are 'best estimates' with

UIs and guidance on how these were derived.<sup>5</sup> For most countries, the UIs of the maternal death estimates had little impact on the values of the notification coverage rate (online supplemental material 2). While global and country consultations improved modelling methods and facilitated their acceptability over time, there are still reports of over-estimation or under-estimation of UN-statistically derived maternal mortality data when compared with country-generated primary data.<sup>42</sup> Thus, coverage rates in these countries may be too low or too optimistic. Substantial UIs of the MMIEG estimates reflect the need for strengthening the capacities of national CRVS and HMIS to obtain robust primary mortality and cause of death data on a continuous basis. Coverage indicator-specific limitations include: (a) inability to be generated at subnational levels, though researchers have proposed subnational estimations built on the global estimates' methodology (Bangladesh, Ethiopia)<sup>43 44</sup> and (b) lack of granularity between community and facility coverage of reporting, as data on where deaths occur are not estimated globally. Conducting special national or subnational studies on all maternal deaths may provide information on the proportion of maternal deaths that occur in communities and facilities<sup>45 46</sup> that could help derive community and facility expected deaths for estimating coverage rates.

## CONCLUSION

MDSR programme implementation remains challenging but is improving in most low-resource settings. Ongoing assessment and evaluation of the surveillance process is key for improving implementation and data-driven programmes and policies. Including notification and review coverage rates as part of the national HMIS and global reporting may accelerate efforts to strengthen the indicators and more accurately track maternal mortality and efforts to reduce it. These indicators are easy to collect and already recommended by WHO for global MDSR monitoring. Adding them to the core list of indicators used by large initiatives that track progress in maternal, newborn and child health (eg, Countdown 2030, CARMMA, and other global and regional monitoring efforts) may promote consistent monitoring and strengthen MDSR programme implementation. In countries with limited vital registration, the burden of maternal mortality and the resources needed to avert preventable deaths cannot be accurately assessed. The adoption of universal indicators that could be traced over time and across countries could be used by programmes to measure progress.

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