### Sibling History Module: Maternal (pregnancy-related) mortality & adult mortality

Maternal mortality, like infant and under-5 child mortality, is an indicator of socio-economic conditions. Its practical appeal, however, is its role as a 'sentinel indicator' whereby maternal deaths are largely preventable through adequate pre-natal and delivery care, and the level of maternal mortality reflects the effectiveness and quality of health care system. A high level of maternal mortality likely reflects sub-par functioning of the health care system.

Declining infant and under-5 mortality rates go hand-in-hand with an ageing population, and health specialists and demographers are turning more focus to the health and survival of adults. In particular, deaths under age 60 years are considered premature and have effects on society both economically as well as socially when families are devastated by the early death of spouse or parent. International organizations including the World Bank and World Health Organization (WHO) monitor adult mortality between 15 and 59 years.

The sibling history module is widely administered to estimate measures of maternal mortality and adult mortality. Regarding the former, technically, information from the sibling history generates pregnancy-related indicators which is used as a proxy for maternal mortality. In future, a change is terminology for survey estimates may (and should) reflect the correct measurement. In this presentation the term 'maternal' also refers to 'pregnancy-related', but the definitions are provided in order to clarify the difference.

The WHO definition of a **maternal death** is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, *but not from accidental or incidental causes* (WHO. 2008. ICD-10 Volume 2. Section 5.8). The cause may be due to a direct cause (e.g., obstetric complication or indirect causes) or an indirect cause (e.g., a pre-existing condition such cardiovascular disease, malaria, anemia, or HIV/AIDS). Strictly speaking, a maternal death is classified by one of the ICD-10 causes in Chapter XV Pregnancy, childbirth and the puerperium (codes O except for O96 and O97, and A34 for maternal tetanus).

In surveys using the sibling history module, however, the definition for a **pregnancy-related death** instead of a maternal death is used. A pregnancy-related death is the death of a woman while pregnant or within 42 days of termination of pregnancy, *irrespective of the cause of death* (WHO. 2008. ICD-10 Volume 2. Section 5.8). This definition is applied in order to simplify the collection of information without expectations that the respondent will know the true cause of death. The collection of information is further simplified in asking about deaths that occurred to reproductive age women within two months after delivery, which is about two weeks longer than the standard definition. The level of over-reporting of maternal deaths due to the inclusion of incidental deaths and due to the longer reference period is simply assumed to balance out the level of underreporting of deaths due to reasons described below (reference, Ken Hill??).

# I. Indicators

The main indicators are the maternal mortality rate (MMR) and adult mortality rate. The other indicators measured using the sibling history module are related to maternal mortality: Maternal mortality rate (MMRate); Lifetime risk of maternal death (LRMD); and Proportion of maternal deaths among all female deaths (PMDF)

### Main indicators

**Maternal mortality.** The Millennium Declaration adopted MMR as an indicator of maternal health and set the Millennium Development Goal (MDG 5) of reducing maternal mortality from the 1990 level by 75 percent before 2015. The MMR is the preferred measure maternal mortality because it measures the risk of death per risky event, or per birth. The best measure would be per pregnancy, but reliable information on pregnancies are not generally available. Although MMRs are not strictly comparable across countries because they not age-standardized (the probability of maternal death varies by age, with youngest and oldest mothers at the greatest risk), but it is more comparable than the maternal mortality rate (MMRate) since this measure is confounded by fertility levels.

The Maternal Mortality Estimation Inter-agency Group (MMEIG) was established to produce updated series for countries and territories using a standard approach. Inputs into their data models included estimates from the DHS using the standard sibling history module.<sup>1</sup>

Name	Maternal mortality ratio (MMR)
Definition	Number of maternal deaths per 100 000 live births
Numerator	Age-adjusted* maternal mortality rate times 100
Denominator	Age-adjusted* GFR
Reference period**	0-6 years prior to the survey, or 0-4 years if there are enough cases

\* Age adjustment for maternal mortality rate (numerator)— Age adjustment is made by multiplying the unadjusted age-specific maternal mortality rates by the percentage of female household members 15-49 in each 5-year age group between 15-49, where the sum of the percentages equals 100%. Similar adjustment is made for GFR, where age-specific fertility rates are multiplied by the percentage of female household members 15-49.

\*\* The reference period can be made shorter if the relative errors of the age-specific mortality rates are less than 15-20%. The reference period needs to be longer if the relative errors are more than 15-20%. The relative errors can be estimated by: the square root of the rate multiplied by one minus the rate, divided by the number of exposure years, all divided by the rate times 100. This approach does not adjust for complex sample design, which would increase the relative error.

**Adult mortality.**\_The internationally accepted definition of the adult mortality rate is the probability of dying between the ages of 15 and 60--that is, the probability of a 15-year-old dying before reaching age 60, if subject to current age-specific mortality rates between those ages.<sup>2</sup>

Name	Adult mortality

<sup>1</sup> Maternal Mortality Estimates, UN Maternal Mortality Estimation Inter-agency Group http://www.maternalmortalitydata.org/publication.html

<sup>&</sup>lt;sup>2</sup> United Nations Population Division. World Population Prospects. New York, United Nations, Department of Economic and Social Affairs

Definition	Expressed per 1000 population, probability of dying 15-59 years
	(45q15)
Numerator	Age adjusted* mortality rates times 1000
Denominator	
Reference period**	0-6 years prior to the survey (7-13 years)

\* Age adjustment for adult mortality– Age adjustment is made by multiplying the unadjusted sex and age-specific mortality rates by the percentage of household members age 15-49 in each 5year sex and age group between 15-49, where the sum of the percentages equals 100%. \*\* The reference period can be made shorter if the relative errors of the age-specific mortality rates are less than 15-20%. The reference period should be longer if the relative errors of the age-specific mortality rates are more than 15-20%. The relative error is the square root of the rate multiplied by one minus the rate, divided by the number of exposure years, all divided by the rate times 100. Note that the relative errors are usually substantially larger for age groups 50-54 and 55-59, simply due to the way the survey is designed i.e., age criteria for individual respondents is 15-49, so cases in older age groups are increasingly rare. These estimates are therefore bracketed in the report to indicate less reliability.

# **Other indicators**

The MMRate measures the risk of death per person potentially exposed to the risk, and is therefore not a pure measure of risk. For example, if the risk of maternal death per birth is the same in two countries but one country has a higher birth rate, then the MMRate will be higher than the other country with a lower birth rate. Similarly, the risk of maternal death per birth in a country could be low, but if fertility is high then the MMRate will be high.

Name	Maternal mortality rate (MMRate)
Definition	Maternal deaths per 1,000 woman-years
Numerator	
Denominator	
Reference period	

Name	Lifetime risk of maternal death
Definition	
Numerator	
Denominator	
Reference period	

Name	Proportion of maternal deaths among all female deaths (PMDF)
Definition	
Numerator	
Denominator	
Reference period	

# II. Module

The sibling history module from the DHS, last revised on August 6, 2013, is the standard sibling history module proposed (Figure 1).<sup>3</sup> In the DHS questionnaires from 1989-1995 there were some differences in the modules, for example, placing restrictions on data collection depending on the age that the sister that died. Such differences, however, do not constitute a short version of a standard module.

The sibling history method was developed by DHS as a direct method to estimate maternal mortality. It is an improvement of the original indirect method, the sisterhood method (WHO & UNICEF 1997). Since the 1990s the sibling history module is used as an add-on module in Demographic and Health Surveys (DHS), and more recently in Multiple Indicator Cluster Surveys (MICS). This module may be incorporated in both women's and men's individual questionnaires. The pooling of the data from male and female respondents yields a larger sample and therefore more precise estimates of maternal mortality (with smaller confidence intervals). The data collected from men and women were found to be equally reliable (Merdad et al. 2013).

Individual respondents are women or men 15-49 years of age and questions are asked about all of their biological siblings. The information is collected for all siblings reported, regardless of age and year of death.

<sup>&</sup>lt;sup>3</sup> Last revision (August 6, 2013) available from http://dhsprogram.com/publications/publication-dhsqm-dhs-questionnaires-and-manuals.cfm

		SE	CTION MM. MA	TERNAL MORT	ALITY		
NO.					CODING C/		6 Aug 2013 SKIP
MM01	Now I would like brothers and sis natural mother, i living elsewhere children did your	STO					
MM02	CHECK MM01: TWO OR MO	RE BIRTHS					
MM03	How many births born?						
MM04	What was the name given to your oldest (next oldest) brother or sister?	10	<b>7</b> (2)	<b>(</b> 3)	<b>(</b> 4)	7(5)	7(6)
MM05	ls (NAME) male or	MALE 1 FEMALE2	MALE 1 FEMALE2	MALE 1 FEMALE2	MALE 1 FEMALE2	MALE 1 FEMALE2	MALE 1 FEMALE2
MM06	Is (NAME) still alive?	YES 1 NO 2 GO TO MM08+JG DK 8 GO TO (2)+J	YES 1 NO 2 O TO MM08+0 DK 7 GO TO (3)+0	YES 1 NO 2 GO TO MM08+0 DK 78 GO TO (4)+0	YES 1 NO 2 GO TO MM08+0 DK 78 GO TO (5)+	YES 1 NO 2 GO TO MM08 - DK 18 GO TO (6) -	YES 7 NO 7 GO TO MM08+ DK 78 GO TO (7)+
MM07	How old is (NAME)?	GO TO (2)	GOTO(3)	GO TO (4)	GO TO (5)	GO TO (6)	GO TO (7)
MM08	How many years ago did (NAME) die?						
MM09	How old was (NAME) when hełshe died?	IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (2)	IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (3)	IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (4)	IF MALE OR DIED BEFORI 12 YEARS OF AGE GO TO (5)	IF MALE OR DIED BEFOR 12 YEARS OF AGE GO TO (6)	IF MALE OR E DIED BEFOF 12 YEARS OF AGE GO TO (7)
MM10	Was (NAME) pregnant when she died?	YES 11 - GO TO MM13 - 0 NO 12	YES 1 30 TO MM13+1 NO 12	YES 1 30 TO MM13 NO 2	YES 1 GO TO MM13 NO 2	YES 1 GO TO MM13+J NO 2	YES 1 GO TO MM13 NO 2
MM11	Did (NAME) die during childbirth?	ך YES ¶ GO TO MM13+ 0 NO 12	YES 1 30 TO MM13+1 NO 12	YES 1 GO TO MM13+J NO 12	ر YES ۲ GO TO MM13	ر YES ۲ GO TO MM13+J NO 2	YES 1 GO TO MM13 NO 2
MM12	Did (NAME) die within two months after the end of a pregnancy or childbirth?	YES 1 NO 2	YES 1 NO 2	YES 1 NO 2	YES 1 NO 2	YES 1 NO 2	YES 1 NO 2
MM13	How many live born children did (NAME) give birth to during her						

# Figure 1. Sibling history module (DHS, August 6, 2013)

MM04	What was the name given to	(7)	(8)	(9)	(10)	(11)	(12)	
	your oldest (next oldest) brother or sister?							
MM05	Is (NAME) male or female?	MALE 1 FEMALE 2	MALE 1 FEMALE 2	MALE 1 FEMALE 2	MALE 1 FEMALE 2	MALE 1 FEMALE 2	MALE 1 FEMALE 2	
MM06	Is (NAME) still alive?	YES 1 NO 2 GO TO MM08 DK 8 GO TO (8)	YES 1 NO 2 GO TO MM08 DK 8 GO TO (9)	YES 1 NO 2 GO TO MM08 DK 8 GO TO (10)	YES 1 NO 2 GO TO MM08 DK 8 GO TO (11)	YES 1 NO 2 GO TO MM08 DK 8 GO TO (12)	YES 1 NO 2 GO TO MM08 DK 8 GO TO (13)	
MM07	How old is (NAME)?	GO TO (8)	GO TO (9)	GO TO (10)	GO TO (11)	GO TO (12)	GO TO (13)	
MM08	How many years ago did (NAME) die?			2				
MM09	How old was (NAME) when he/she died?	IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (8)	IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (9)	IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (10)	IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (11)	IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (12)	IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO (13)	
MM10	Was (NAME) pregnant when she died?	YES 1 GO TO MM13	YES 1 GO TO MM13 NO 2	YES 1 GO TO MM13 NO 2	YES 1 GO TO MM13 NO 2	YES 1 GO TO MM13 NO 2	YES 1 - GO TO MM13 NO 2	
MM11	Did (NAME) die during childbirth?	YES 1 GO TO MM13+ NO 2	YES 1 GO TO MM13 NO 2	YES 1 GO TO MM13 NO 2	YES 1 GO TO MM13 NO 2	YES 1 GO TO MM13 NO 2	YES 1 - GO TO MM13+ NO 2	
MM12	Did (NAME) die within two months after the end of a pregnancy or childbirth?	YES 1 NO 2	YES 1 NO 2	YES 1 NO 2	YES 1 NO 2	YES 1 NO 2	YES 1 NO 2	
MM13	How many live born children did (NAME) give birth to during her lifetime?							
I NO M	ONE DRUTHERS UP	CODIERO, GO TO	MEAT SECTION.					

#### Other survey approaches to measuring mortality

In addition to the sibling history module, there are other approaches to measuring mortality from surveys. An example of another direct approach—i.e. computation of estimates that does not depend on models or assumptions-- is to administer a set of questions about deaths in the household in a previous window of time prior to the survey e.g., 2 or 5 years. A larger observation period will yield a larger number of deaths for more precise estimates (although the reference period will be less precise, and the recall bias larger, hence a trade-off). Figure 2 shows an example of the standard Household Module adapted for the 2010 Afghanistan Mortality Survey. The deaths recorded may furthermore be linked to a verbal autopsy questionnaire, to collect information on signs and symptoms leading to death, and using this to assign a probable underlyng cause of death. This module can be used for estimating mortality by age and sex, including adult mortality. It is not appropriate, however, for estimating early

childhood mortality since information on exposure time of surviving infants is not collected. The Household death module may also serve to measure maternal mortality (and pregnancy-related mortality separately) if it is linked to the verbal autopsy questionnaire. WHO has produced a standard verbal autopsy tool, including three separate questionnaires depending on the age of the deceased, that can be adapted and incorporated into a household survey.<sup>4</sup>

NO.	QUESTIONS AND FILTERS		CODING CATEGORIES SKIP								
301A	Now I would like to ask you a few more ques household. Has any usual resident of your h Hammal 1384?	tions about your ousehold died since 1	YES								
301B	Was there any birth since 1 Hammal 1384 w signs of life at birth (such as crying, breathin died soon after?	here the baby showed g, or movement) but	YES								
301C	Was there any pregnancy since 1 Hammal 1 stillbirth- that is, where the baby never show (such as crying, breathing, or movement)?	384 that ended in a ed any signs of life		YES NO DON'T KNOW		1 2 8					
	CHECK Q.301A, 301B, and 301C: IF ANY YES CODE '1' CIRCLED			IF ALL NO OR DON'T KNOW CODE '2' OR '8' CIRCLED			<b>4</b> 01				
302	ASK Qx.304-308 AS APPROPRIATE FOR EACH PERSON WHO DIED. IF THERE WERE MORE THAN 3 DEATHS, USE ADDITIONAL QUESTIONNAIRE(S).										
303	COLUMN NO.	1		2	3	3					
304	What was the name of the person who died most recently (before him/her)?										
305	How old was (NAME) when he/she died? IF '1' YEAR PROBE: How many months old was (NAME) when he/she died? IF '1' MONTH PROBE:	DAYS 1 MONTHS . 2 YEARS 3		DAYS 1 MONTHS . 2 YEARS 3	DAYS MONTHS YEARS	1 . 2 3					
	he/she died? IF STILLBIRTH CIRCLE '1' AND RECORD AGE IN DAYS AS '00'. RECORD DAYS IF LESS THAN 1 MONTH: MONTHS IF LESS THAN 1 YEAR, AND COMPLETED YEARS IF 1 YEAR OR MORE										
306	Was (NAME) male or female?	MALE	1	MALE 1 FEMALE 2	MALE . FEMALE	1 2					
307	CHECK Q.305: WHICH VERBAL AUTOPSY QUESTIGNIARE SHOULD BE ADMINISTERED.	0 • 28 DAYS 29 DAYS TO 11 YRS 12 YRS AND ABOVE	1 2 3	0 • 28 DAYS 1 29 DAYS TO 11 2 YRS 12 YRS AND 3 ABOVE	0 - 28 DAY 29 DAYS	YS 1 2 TO 11 YRS 3 ND ABOVE					
308	NAME AND LINE NUMBER OF THE MOTHER FROM Q.101 AND Q.102 . IF SHE IS NOT LISTED IN THE HOUSEHOLD, RECORD '00'.				LINE NUMBER						
309	Has any other member of your household died since 1 Hammal 1384?	YES GO TO Q.304 IN NEXT COLUMN NO	1 	YES	YES . GO NEW NO DK	1 TO Q.304 ON + VQUEST. 8					
TICK	HERE IF ADDITIONAL QUESTIONNAIRES U	SED	]								
310	CHECK Q304 AND SUM ALL PERSONS LE CONTINUATION SHEET, IF ANY. TOTAL NUMBER OF PERSONS IN HOUSE	STED HERE AND ON	•								
311	SINCE 1 HAMMAL 1384.										
	READ TO THE RESPONDENT: After this in that the government can provide health serv	terview we would like to g ices to help reduce these	et more i deaths.	information on the circumstances s	urrounding this	s/these death(s) so					

Figure 2. Household death module (2010 Afghanistan Mortality Survey)

<sup>&</sup>lt;sup>4</sup> The 2012 WHO verbal autopsy instrument.

http://www.who.int/healthinfo/statistics/verbalautopsystandards/en/

An example of an indirect adult mortality is the orphanhood method, also called the parental survivorship method (Figure 3, Column header 8). During data collection, the method involves recording information in the household roster from two simple questions on whether the household member's biological mother and father was alive: "Is your (biological) mother still alive?" and "Is your (biological) father still alive?" The proportion of mothers (or fathers) surviving among respondents of a given age then represents an average of survival probabilities from the mother's age at the birth (or father's age at the conception) to the age of the respondents. The procedures used to assess the orphanhood data are described in detail in the United Nations Methods for Estimating Adult Mortality (UN 2002) and the Manual X Indirect Techniques for Demographic Estimation (UN 1983).

								SECTION 1.	HOUS HOLD	SCHEDULE				relative error	
LINE NO.	USUAL RESIDENTS AND VISITORS	RELATIONSHIP TO HEAD OF HOUSEHOLD	SEX	RESI	DENCE	AGE	ELIGIBILITY	SURVIVOR	RSHIP OF PARENTS	MIGRATION	TO HOUSEHOLD	INPATI	ENT	OUTPATIE	ËNT
	Please give me the names of the persons who usually live in your household and guests of the household who stayed here last night, starting with the head of the household. AFTER LISTING THE NAMES AND RECORDING THE RELATIONSHIP AND SEX FOR ALL PERSONS, ASK QUESTIONS 102A-102C TO BE SURE THAT THE LISTING IS COMPLETE. THEN ASK APROPRIATE QUESTIONS IN COLUMNS 105-116 FOR EACH PERSON.	What is the relationship of (NAME) to the head of the household? SEE CODES BELOW.	Is (NAME) male or female?	Does (NAME) usually live here?	Did (NAME) stay here last night?	How old is (NAME)? IF AGE 95 OR MORE, RECORD 95: IF AGE LESS THAN 1 YEAR RECORD 007	CIRCLE LINE NUMBER OF ALI WOM N AGE 12-49	Is (NAME)'s natural alive?	ls (NAME)'s natural father alive?	Hus (NUME) liven here since 1 Harmal 13847	In what morth and year did (NAME) move in?	In the last 12 months, was (NAME) admitted overnight to stay at a health facility?	CIRCLE LINE NUMBER OF PERSON ELIGIBLE FOR IN- PATIENT SECTION	In the last 30 days, did (NAME) receive care from any source, without staying overnight?	CIRCLE LINE NUMBER OF PERSON ELIGIBLE FOR OUT- PATIENT SECTION
(101)	(102)	(103)	(104)	(105)	(106)	(107)	(108)	(109)	(110)	(111)	(112)	(113)	(114)	(115)	(116)
01		0 1	M F 1 2	Y N 1 2	Y N 1 2	IN YEARS	01	1 2	Y 1 1 2	Y N 1 2 ↓ GO TO Q.113	MONTH YEAR	Y N DK 1 2 8 GO TO Q.115	01	Y N DK	01

Figure 3. Household roster with questions on survivorship of biological parents (2010 Afghanistan Mortality Survey)

### Methodological considerations: analytical issues

#### **Re: Precision**

Relatively speaking, the estimates of adult mortality tend to be much sharper than the estimates of maternal mortality. However, the sibling history module using in standard DHS and MICS surveys, where the age criteria for individual respondents is 15-45 years, is not ideal for measuring adult mortality. That is because relative errors are very uncertain for ages 35+ and increasingly so with each 5-year age group. The estimates of adult mortality suffer from a downward bias.

#### Re: Sample size

Due to the large margin of error around the estimate, a relatively large sample size is needed especially in countries where the number of births is low.

### Re: analysis

For analytical purposes, it is important to understand that information related to maternal deaths is limited to the information captured in the module and cannot be linked reliably to other household or individual-level information. In other words, it cannot be linked to other determinants hypothesized to influence maternal mortality, such as antenatal or delivery care, or socio-economic determinants; it cannot even be evaluated in terms of rural and urban since the module does not collect information on the place of residence of the siblings. In the 2010 Afghanistan Mortality Survey, however, the standard was slightly adapted to obtain information on residence: Where does he/she usually live (urban or rural residence)? When was the last time you had contact? This was an attempt to establish maternal mortality by residence, and to ascertain the reliability of the information by the time since last contact between the respondent and the respondent.

**Difficulties in measurement.** Maternal mortality is a **statistically rare** event. For this reason, it is expressed in terms 100 000 live births compared to, for example, 1000 live births like for childhood mortality measures. It is also one of the most difficult indicators to measure accurately. In order to generate an accurate estimate there needs to be a precise assessment of the number of deaths among woman of reproductive age due to a pregnancy-related cause, and an accurate assessment of the number of live births.

**Under-reporting** in surveys of deaths to a women of reproductive age for different reasons may occur for several reasons: 1) the respondent did not know that the deceased woman was pregnant, especially if the death happened early in the pregnancy; 2) the respondent feels the event of death was too sensitive to report; or 3) lack of recall of an event in the past.

### Evidence base

### Validation studies

- There have been a few validation studies (REFS NEEDED, small search). Positive results.
- Effective coverage refers to immunizations resulting in seroconversion and eventually full protection of the individual against the targeted disease. A few studies with serological testing have assessed seroconversion, such as following tetanus or measles vaccination (REFS). The results of these studies however assess both the accuracy of the recorded or reported vaccination as well as the efficacy of the vaccine. It is noted that the latter is usually below 100%.

#### Quality assessments

- Many comparisons have been conducted between health facility based estimates and population survey data. Quality issues are more likely to occur with the health facility-based estimates. In general, however, there is reasonable consistency between the two methods.
- Studies have been conducted to assess the quality of mother's recall with card information (REF from paper Barton). The results showed fairly good accuracy of mother's recall of specific vaccinations.

# Plausibility

- Hundreds of survey applications have shown consistency of results in space and over time in multiple settings.
- This includes comparability of results across populations.

# 7 Applications / uses –

DHS, MICS, national immunization coverage surveys, socioeconomic surveys Economic surveys tend to use very short sets of questions and may not including retrieval of the child health card during the interview. This affects the comparability of such immunization coverage estimates.

# References

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