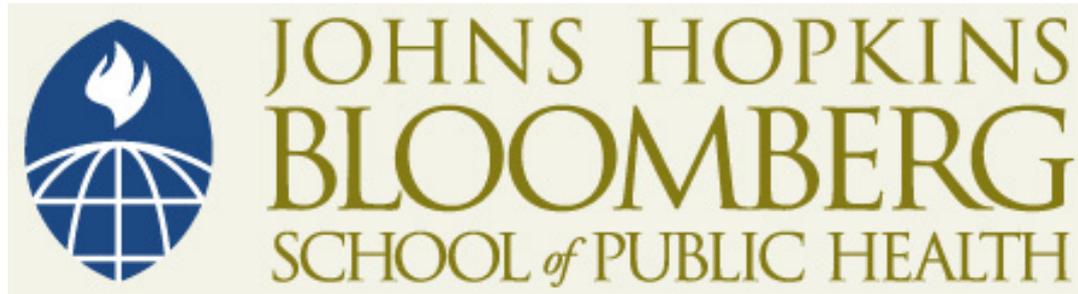


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# Maternal Mortality and Morbidity in the Developing World

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# Objectives:

- Describe
  - the magnitude,
  - distribution and
  - causes of maternal mortality worldwide;
- Discuss measurement issues re:
  - maternal mortality and
  - maternal/obstetric morbidity

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# Defining Maternal Death

According to the Tenth Revision of the ICD:

## **Maternal Death:**

*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 causes (WHO 1993).*

## **NOTE:** 2 criteria

- Temporal relationship to the pregnant state
- Causal relationship to the pregnant state

**Pregnancy-related death:** “time of death” definition;  
Irrespective of cause.

# Maternal Mortality Estimates by MDG Region (2000 estimates)

<b>Region</b>	<b>Maternal Mortality Ratio<sup>a</sup></b>	<b>Number of Maternal Deaths</b>
World Total	400	529,000
Developed Regions	20	2,500
Europe	24	1,700
Developing Regions	440	527,000
Africa	830	251,000
Northern Africa	130	4,600
Sub-Saharan Africa	920	247,000
Asia	330	253,000
Eastern Asia	55	11,000
South Central Asia	520	207,000
South Eastern Asia	210	25,000
Western Asia	190	9,800
Latin American & the Caribbean	190	22,000
Oceania	240	530

<sup>a</sup>Maternal mortality ratio: maternal deaths per 100,000 live births

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# What do we know about trends in developing countries in maternal mortality?

- Given limitations of practical methods of measurement, very little
  - Model-based methods not really appropriate for trend analysis
- It is suspected, that little has changed globally
  - There are success stories (example: Sri Lanka, Thailand, Malaysia, Honduras, Egypt)
  - Shows that substantial declines (~50%) can be achieved in less than 25 years

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# Medical Causes of Maternal Mortality

- Direct causes: 4 causes of death directly related to the pregnant state; hemorrhage, eclampsia, sepsis and obstructed labor, (abortion)
  - Indirect causes: pre-existing conditions which are exacerbated by the pregnant state (malaria, heart disease, anemia, HIV, etc)
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# 1) Hemorrhage: bleeding of more than 500 cc

## Antepartum

before 20 weeks:

- Ectopic Pregnancy
- Abortion

after 20 weeks (not abortion related)

- Placenta Previa
- Placental Abruptio

## Postpartum

Massive vaginal bleeding after delivery due to

- Uterine atony
- Retained placenta
- Genital tract lacerations
- Inverted uterus

Large loss of blood leads to shock and death

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# Ectopic Pregnancy

- Pregnancy which is outside the uterine cavity
- Can be in the tube, ovary, abdomen or other locations
- Treated surgically by removal of the pregnancy or tube
- Also treated medically, although not available in developing countries
- If ruptures can lead to hemorrhage and death

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# Antepartum Hemorrhage

- Placenta Previa
  - placenta is in front of the cervix
  - typically requires cesarean delivery to avoid maternal and fetal death

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# Antepartum Hemorrhage

- Placental Abruptio
  - placenta separates prematurely from the wall of the uterus
  - if happens during labor can be successful delivery, prior to labor can lead to death

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## 2) Pre-eclampsia and Eclampsia

- Disorder of late pregnancy (or post partum) characterized by:
  - elevated blood pressure
  - protein in urine
- Other symptoms:
  - headache, blurred vision, abdominal pain/tenderness, difficulty breathing
- Complications include:
  - liver rupture, stroke, seizure or death

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## 3) Infection

- Also known as puerperal infection or sepsis
- Defined as temperature of 38° C or more
  - during pregnancy,
  - during labour or
  - after childbirth
- Diagnosis is made by evaluating the patient for accompanying signs or symptoms

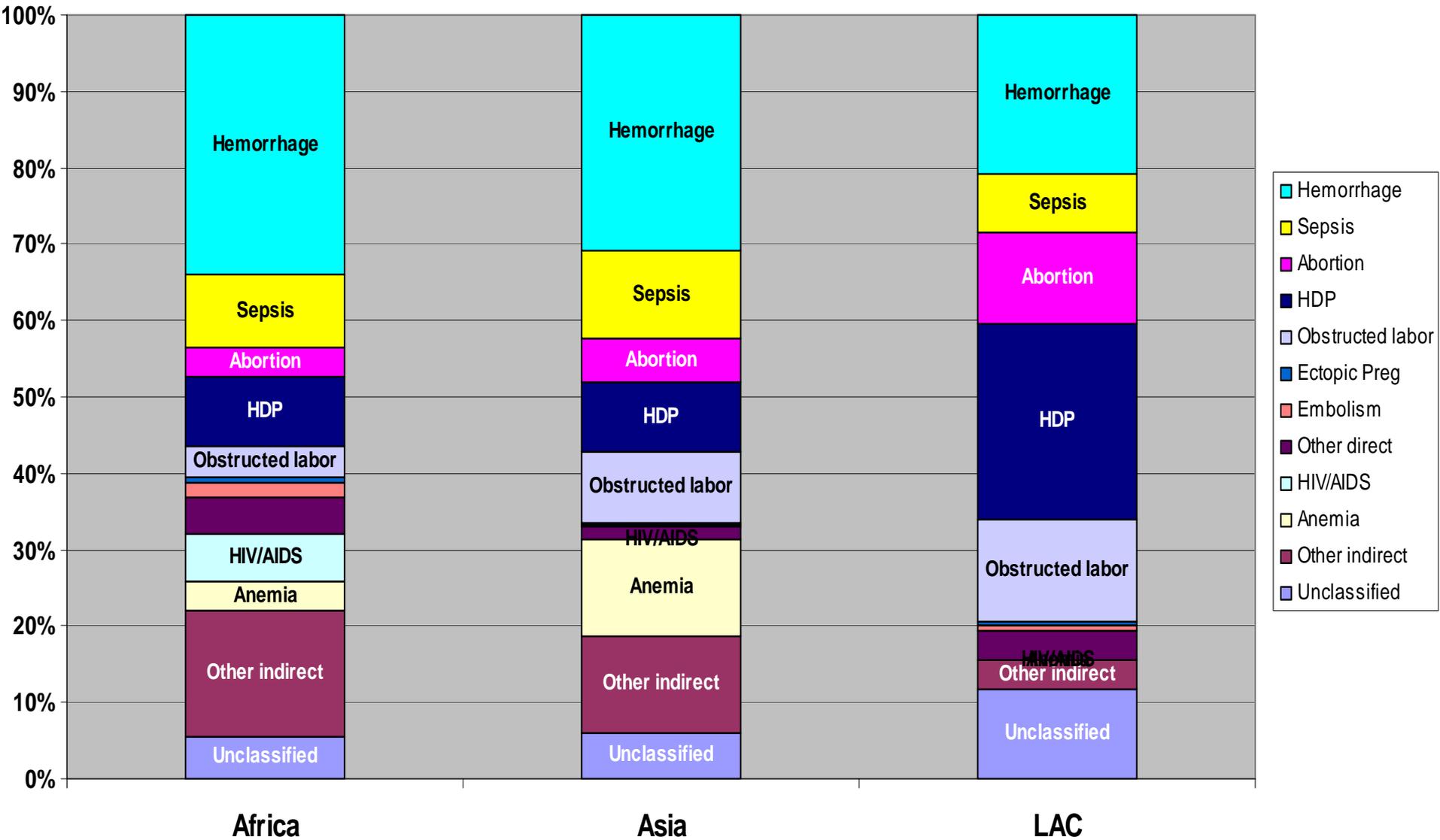
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## 4) Obstructed Labor

Result of:

- Malpresentation:
  - breech
  - transverse
  - Shoulder
- Cephalopelvic disproportion – inability of head to fit through pelvic canal

# Percent Distribution of Causes of Maternal Death



# % of births w/ medically trained attendant

	N of countries	% of births with a skilled attendant at birth		% increase in use of a skilled attendant 1990-2000
		1990	2000	
<b>MDG regions</b>				
<b>Northern Africa</b>	<b>3</b>	<b>40.6</b>	<b>67.0</b>	<b>65.0</b>
<b>Sub-Saharan Africa</b>	<b>31</b>	<b>39.4</b>	<b>39.8</b>	<b>1.0</b>
<b>Latin America/Caribbean</b>	<b>22</b>	<b>76.9</b>	<b>81.8</b>	<b>6.4</b>
<b>East Asia</b>	<b>1</b>	<b>53.4</b>	<b>72.1</b>	<b>35.0</b>
<b>South Asia</b>	<b>7</b>	<b>32.3</b>	<b>41.4</b>	<b>28.2</b>
<b>South-eastern Asia</b>	<b>3</b>	<b>42.1</b>	<b>64.4</b>	<b>53.0</b>
<b>Western Asia</b>	<b>4</b>	<b>77.1</b>	<b>88.6</b>	<b>14.9</b>
<b>Eurasia</b>	<b>2</b>	<b>99.5</b>	<b>96.6</b>	<b>-2.9</b>
<b>Developing countries</b>	<b>73</b>	<b>44.7</b>	<b>54.2</b>	<b>21.3</b>

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# Measurement of Maternal Mortality

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# Sources of data on maternal mortality

- Civil Registration
- Hospital-based Studies
- Reproductive Age Mortality Studies (RAMOS) ★
- Large Population-based Surveys ★
- National Population Censuses ★
- Statistical Models (Unicef/WHO estimates)
- New Variant Sisterhood method: a work in progress

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# Maternal Mortality Estimates based on Empirical Data

## Reproductive-Age Mortality Studies (RAMOS):

- Considered the gold standard
- **Defining characteristic:** rely on multiple sources of data to identify *adult female deaths*/maternal deaths:
  - explore civil registration, medical records, undertaker, TBA, mother's groups, market, newspaper, verbal autopsy
- Once adult female deaths have been identified, a team of physicians reviews each case, determines cause of death

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## RAMOS - continued

### Advantages:

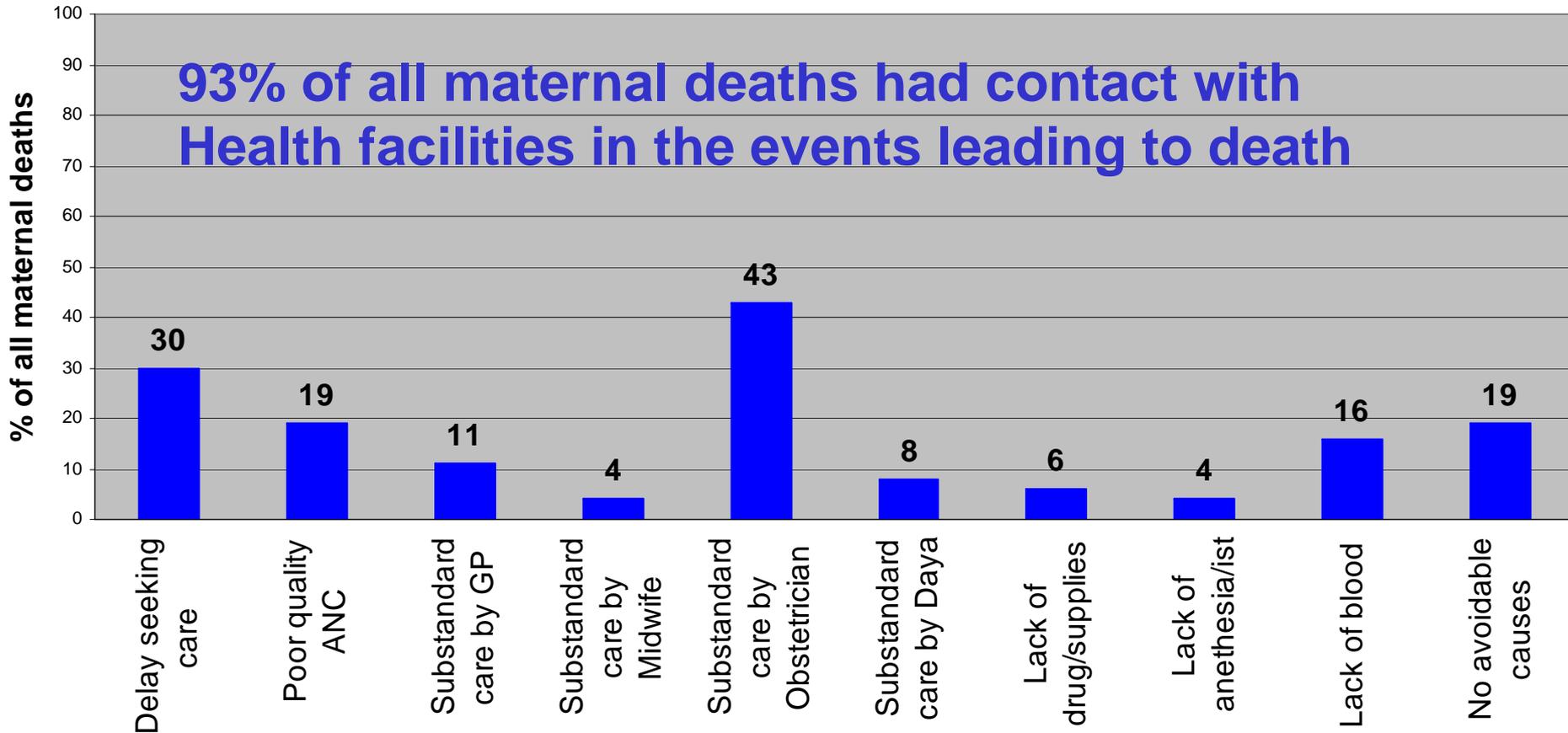
- More complete reporting of maternal deaths
- Obtain very useful information on care-seeking behavior, **avoidable causes of death (facility-based and social)**

### Disadvantages:

- Expensive and labor-intensive
- Rarely carried out at a national level  
(exceptions: Egypt, Honduras, Guatemala)
- Little attention paid to verification of the denominator
- Great variation in what gets called a “RAMOS”

# Summary of Avoidable Factors for Maternal Deaths; Egypt NMMS; 2000

93% of all maternal deaths had contact with Health facilities in the events leading to death



Avoidable Factors

81% due to avoidable factors

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# Maternal Mortality Estimates based on Empirical Data

## Large Population Surveys: 3 Methods of Data Collection for MMR Estimation:

- 1) The Original Sisterhood Method (indirect estimation)
- 2) Sibling-based method for direct estimation   
(DHS adaptation of the original sisterhood method)
- 3) Identification of all female deaths in the household - same as census

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# Sibling-based method for direct estimation (DHS adaptation)

Consists of an additional module added to women's individual questionnaire/household schedule

More demanding data requirements than the indirect method:

Additional questions which:

- identify all siblings in order, and determines
  - ✓ their sex,
  - ✓ vital status,
  - ✓ age if living,
  - ✓ age at death if dead **AND**
  - ✓ for adult female deaths: if death occurred during pregnancy childbirth or 2 mo following the end of pregnancy or childbirth

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## Sibling-based method - continued

- Statistic calculated is the M M Rate, converted to M M Ratio by dividing by the General Fertility Rate
- Reference period: because it is from direct estimation –
  - it is up to analyst
    - 0-6 years or 0-9 years prior to survey:
      - very dependent on sample size
      - trend data generally not possible

## DHS M M Ratios 0-6 yrs before survey

95% CI

C. A. R.	1451	(1194-1709)
Madagascar	663	(523-803)
Malawi	752	(497-1006)
Morocco	380	(255-506)
Namibia	395	(259-582)
Niger	672	(511-833)
Senegal	569	(359-779)
Zimbabwe	393	(269-517)
Indonesia	454	(378-529)
Philippines	208	(141-275)
Bolivia 1	580	(380-800)
Bolivia 2	396	(237-555)
Peru	218	(148-288)

Source: Stanton et al. 2000 Studies in Family Planning

## DHS M M Ratios

0-6 yrs  
before survey

C.A.R	1451
Madagascar	663
Malawi	752
Morocco	380
Namibia	395
Niger	672
Senegal	569
Zimbabwe	393
Indonesia	454
Philippines	208
Bolivia 1	580
Bolivia 2	396
Peru	218

7-13 yrs  
before survey

775
543
408
438
154
779
406
159
292
212
385
315
296

Percent  
change

87
22
84
-13
156
-14
40
147
55
-2
51
26
-26

Significant  
change

p<0.05
p<0.05
p<0.05
p<0.05
p<0.05

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# Sibling-based method - continued

## Strengths:

- Provides all 4 indicators of maternal mortality
- Is relatively inexpensive if DHS is planned

## Weaknesses:

- Larger sample sizes required, generates large sampling errors
- Results are interpreted assuming similar precision as other DHS estimates
- Only produces a national level estimate
- Requires complex data processing
- May replace other modules of interest
- Evidence of under-reporting of adult deaths in recent period – unclear how to adjust

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# Measuring maternal mortality in the National Population Census

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# How is pregnancy-related mortality measured via a census?

- All live births in the household in the last 12-24 months are recorded
- All household deaths (plus sex and age at death) for the last 12-24 months are recorded
- Only for adult female deaths:
  - Did the deceased die:
    - during pregnancy?
    - during childbirth?
    - within 42 days (6 weeks) of the termination of pregnancy?
- **REMEMBER:** only ask these questions of ~ 1% of households;
- The issue is space on the page;

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## Optional/Supplemental question:

- Where did she die (in hospital, at home, en route to hospital; other outside home)?
- Follow up questions using a verbal autopsy/medical record review to discern maternal from pregnancy-related death could be added for all or a sub-sample of adult female deaths (a very interesting, but major additional undertaking)

# Results from 5 country experiences

Country	Benin (1992)	Islamic Rep of Iran (1996)	Lao People's Dem Rep (1995)	Madagas- car (1993)	Zimbabwe (1992)
Adjust- ment Factor: births	1.34	1.30	1.65	1.0	1.0
Adjust- ment Factor: deaths	2.7	3.0	1.6	2.5	1.0

NOTE: Adjustment for deaths almost always > than for births. Must be prepared for this magnitude of adjustment. Can be hard to accept.

Source: Stanton et al. 2001. Bulletin of the WHO 79(7)

# Results from 5 country experiences

Country	Benin	Islamic Rep of Iran	Lao People's Dem Rep	Madagascar	Zimbabwe
Unadjusted MMR	168	39	821	NA	395
Adjusted MMR (high, low variants)	338 (250-375)	88 (58-95)	796 (746-871)	NA (NA)	395 (NONE)
MMRs from external sources	498 (DHS)	NA	NA	NA	393 (DHS)

NOTE: Some adjustments are very large. The benefit of no sampling error should be judged against unmeasurable non-sampling error, plus the validity of assumptions underlying the high/low variants. IN SUMMARY: there are many advantages, but this is far from perfect.

Source: Stanton et al. 2001. Bulletin of the WHO 79(7)

# Most recent censuses w/ MM measurement

Country	Female Deaths		Prop. Maternal	Births '000		Estimated MMRatio
	Obs.	Adj.		Obs.	Adj.	
Honduras	2,195	3,899	0.105	170.4	200.5	204
Nicaragua	1,867	1,716	0.088	123.2	123.1	123
Paraguay	3,120	2,337	0.107	116.8	126.5	200

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# In summary:

- Using the census to measure pregnancy-related mortality offers many advantages to traditional approaches
- BUT, it is not a magic bullet. It comes with its own limitations and results should be interpreted accordingly
- The Measure/Evaluation project has produced step by step Guidelines in English/French/Spanish on the evaluation/adjustment of such data. See: [www.cpc.unc.edu/measure/publications/index](http://www.cpc.unc.edu/measure/publications/index)

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## In summary: *continued*

- The draft UN Principles and Recommendations for National Population Censuses now recommends:
  - Measurement of adult, maternal and injury-related mortality
  - Soon to be ratified
- Funding is being assembled to assist ~30 countries with preparation and data evaluation

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# Overall conclusions regarding maternal mortality measurement:

- All practical M M R data collection techniques generate approximate levels of M M;
- Different data collection techniques embody different strengths and weaknesses and reference periods which should not be overlooked;
- It is difficult, and therefore, unwise, to compare M M indicators collected via different methodologies;
  - But everybody does it;
- M M R is very effective advocacy tool – It is an MDG with targets. It is prone to serious misinterpretation;

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# Defining and Measuring Maternal Morbidity

- Terms and definitions; Acute or long-term sequelae?
  1. Women experiencing *major obstetric complications*
    - non-specific list of direct complications used in the UN process indicators
  2. Women experiencing *life-threatening complications*
    - Term is often used and often not defined
  3. Women experiencing *absolute maternal indications*
    - Very specific list of conditions for which the woman will not survive without surgical interventions
  4. Women experiencing *near-miss events*
    - Several different approaches to definition (criteria-based; organ failure; management-based (admission to ICU); all focus on extreme end of continuum between life/death

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# Obstetric morbidity, what do we expect?

- Is there a “natural” level for obstetric complications? Or, does it vary by population?
- What should one monitor:
  - Incidence?
  - Severity?

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# What do we currently “know” about obstetric complications *in the population?*

*WHO estimates  
that 15% of  
births/pregnancies  
experience “major  
obstetric  
complications.*

Source: Koblinsky, Timyan  
Based on scant  
epidemiological data,  
some of which is from  
developed countries.

MOMA Study in West  
Africa:  
prospective follow up  
of  
~4,000 women from 7  
mo.  
gestation to  
postpartum period

*Result: 7.5%  
experienced major  
obstetric complications*  
Source: de Bernis et  
al, BJOG, 2000

Unmet Obstetric  
Need Network

Shows ~1 – 1.6%  
of pregnancies  
associated with  
Absolute  
Maternal indications  
In 6 country study

Current reference  
Rate: 1.4%

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# Example: Survey-based questions

## re: symptoms

### Hemorrhage:

- Did you lose a lot of blood during labor or delivery, or within 1-2 days after? By this I mean dark red, fresh red, clotted blood?
- Did you bleed so much you thought you might die?

### Eclampsia:

- Did you have a fit (trembling, not caused by fever) during pregnancy or around delivery?
- During this pregnancy, did you have a problem with severe swelling in your face and hands?

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# Population-based measurement: Validating Women's Self-Reports of Symptoms of Major Obstetric Complications:

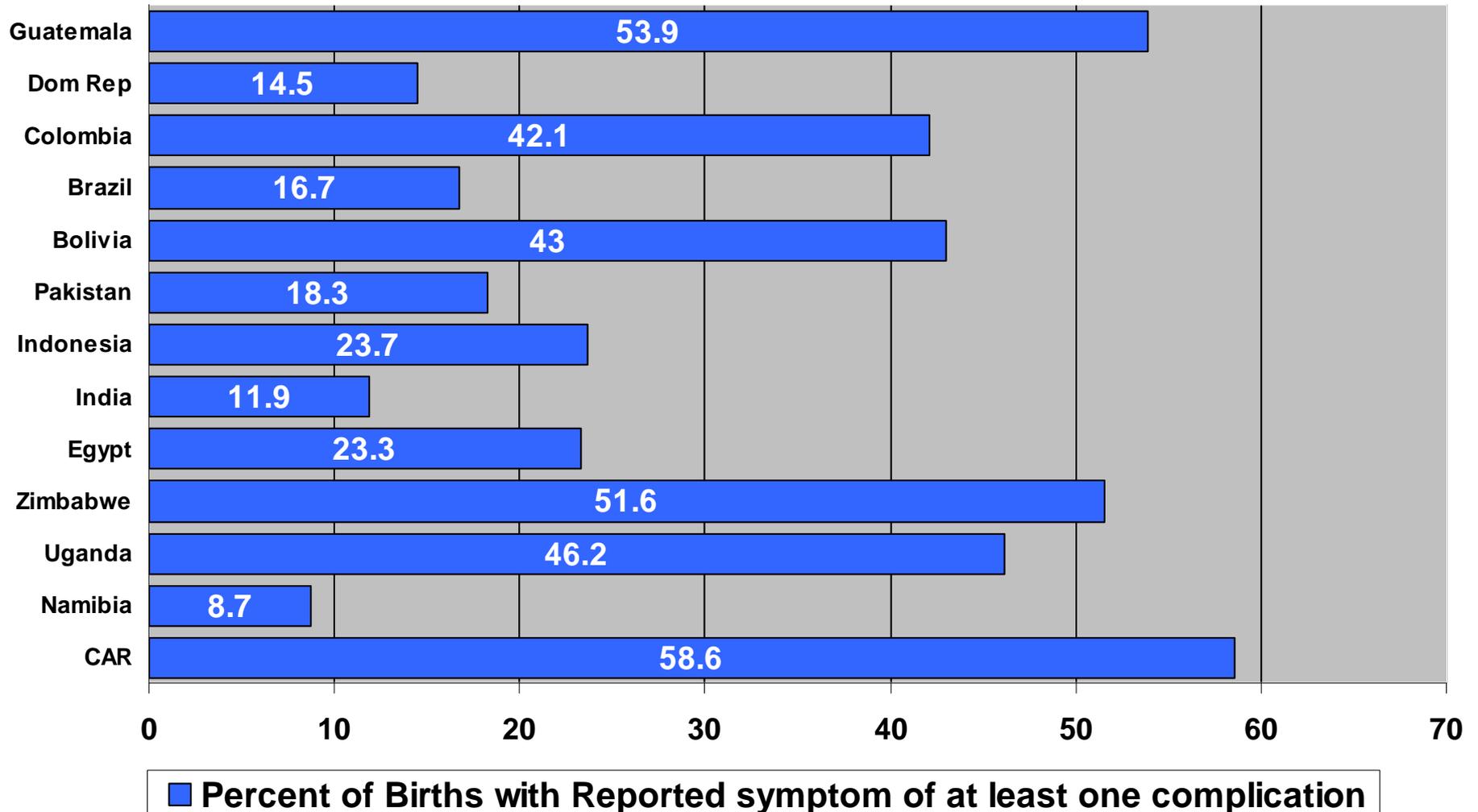
- 6 studies conducted in Bolivia, Ecuador, Ghana, Philippines, Indonesia, Benin
- All 6 studies were hospital-based, relied on medical records as the gold standard;
- **Assessment of Validity:** calculated sensitivity and specificity to determine how closely answers to individual questions re: symptoms (a combination of questions) matched medical records (gold standard)
- **Questionnaire development:** some did qualitative studies to assist in formulating the questions used to describe the various complications

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# Conclusions of the Task Force:

- Estimating prevalence from self-reported data is not possible in large-scale surveys. Sensitivity and especially specificity is too low;
  - *But everyone does it anyway. STILL – ALMOST 10 YRS LATER*
- It is possible and valuable to ask about women's *perceived problems* in order to ask about health care seeking behavior in the context of a perceived problem.
- **Indicator\***: Women who sought care/ Women with a perceived problem
- \* Must construct questionnaire so that you know order of events

## Reported symptoms of birth-related complications in 13 DHS surveys



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## Thus, interest in combining facility with population-based data

- Near-miss (regardless of definition), which is measured at facility-level, can be considered population-based by default
  - If a woman had such a serious complication in the community and did not receive medical care, she would have died

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# Conclusions re: measurement of maternal/obstetric morbidity

- Near-miss:
  - reality check re: functioning of hospitals;
  - good choice for audits;
  - very complicated to collect/define;
- Self-report – what to do? Surveys will not die
- Story to be continued...