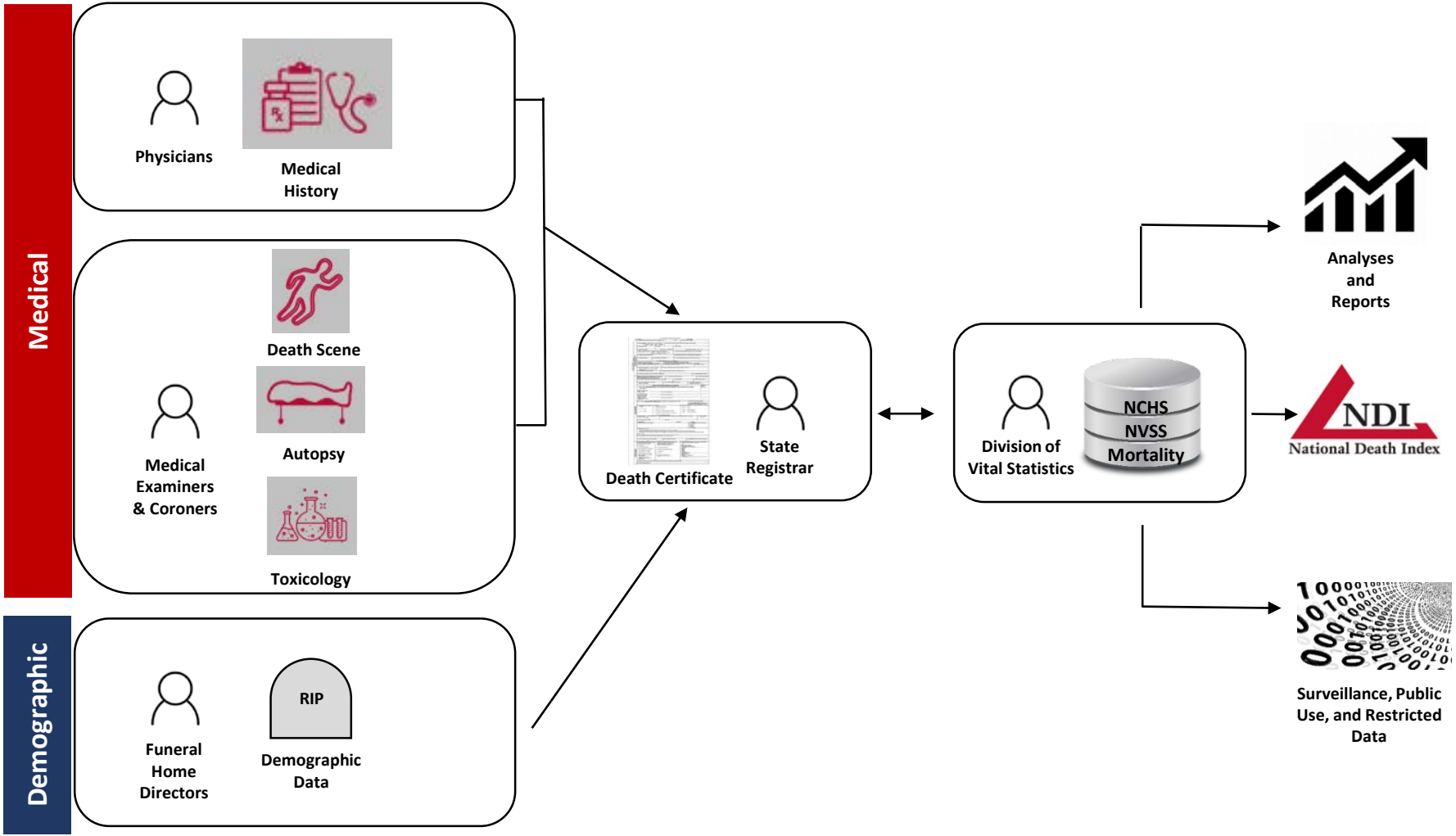
Maternal deaths in the National Vital Statistics System

Robert N. Anderson, PhD
Chief, Mortality Statistics Branch
Division of Vital Statistics

NCHS Board of Scientific Counselors
Hyattsville, MD
May 9-10, 2019

Vital Statistics Cooperative Program

- Federal-State contractual arrangement
  - 50 States, New York City, District of Columbia and 5 US territories
  - Federal government provides funding, coordination, and standards
  - States maintain autonomy in their operations, but collect and provide data according to standard specifications and agreed upon timelines


Medical
Physicians
Medical History
Death Scene
Medical Examiners & Coroners
Autopsy
Toxicology
Demographic
Funeral Home Directors
RIP
Demographic Data
Death Certificate
State Registrar
Division of Vital Statistics
NCHS
NVSS
Mortality
Analyses and Reports
NDI
National Death Index
Surveillance, Public Use, and Restricted Data

WHO definition of maternal death

- Maternal death – 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
- Late maternal death – The death of a woman from direct or indirect obstetric causes more than 42 days but less than 1 year after the end of pregnancy.
- Maternal deaths coded to Chapter XV – Pregnancy, childbirth and the puerperium in ICD-10 (O00-O99)

ICD-10 Chapter XV – Pregnancy, childbirth and the puerperium

O00-O08 – Pregnancy with abortive outcome
O10-O16 – Edema, proteinuria and hypertensive disorders in pregnancy, childbirth and the puerperium
O20-O29 – Other maternal disorders predominantly related to pregnancy
O30-O48 – Maternal care related to the fetus and amniotic cavity and possible deliver problems
O60-O75 – Complications of labor and delivery
O80-O84 – Delivery
O85-O92 – Complications predominantly related to the puerperium
O94-O99 – Other obstetric conditions, not elsewhere classified

Direct vs. indirect maternal causes

- Direct maternal causes (conditions caused by pregnancy, childbirth or the puerperium)
  - Hemorrhage, embolism, eclampsia/preeclampsia, infection
- Indirect maternal causes (conditions complicated or aggravated by pregnancy, childbirth or the puerperium)
  - O98 – Maternal infectious and parasitic diseases classifiable elsewhere but complicating pregnancy, childbirth and the puerperium
    - E.g., tuberculosis, STDs, HIV, viral hepatitis
  - O99 – Other maternal diseases classifiable elsewhere but complicating pregnancy, childbirth and the puerperium
    - E.g., anemia, some diseases of the endocrine, circulatory, respiratory and digestive systems

Pregnancy-related vs. pregnancy-associated

- Pregnancy-related
  - Death to a woman which occurs during or within one year of the end of a pregnancy from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes
  - Includes both maternal deaths and late maternal deaths (direct and indirect)
- Pregnancy-associated
  - Death to a woman ***from any cause***, while she is pregnant or within 1 year of termination of pregnancy, regardless of duration and site of pregnancy
  - Includes both pregnancy-related and incidental causes

Maternal mortality data in the NVSS

- Research had showed underreporting of maternal deaths in the NVSS
- Some states introduced pregnancy checkbox items to capture pregnancy or recent pregnancy to improve reporting
- Lack of standardization among the various state death certificates
- Addition of a pregnancy checkbox item on the 2003 revision of the US Standard Death Certificate

Cause of death section of the standard death certificate (2003 revision)

CAUSE OF DEATH (See instructions and examples)

32. **PART I.** Enter the chain of events--diseases, injuries, or complications--that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.

Approximate interval: Onset to death

IMMEDIATE CAUSE (Final disease or condition ---------> resulting in death)
a. _____
Due to (or as a consequence of):

Sequentially list conditions, if any, leading to the cause listed on line a. Enter the **UNDERLYING CAUSE** (disease or injury that initiated the events resulting in death) **LAST**
b. _____
Due to (or as a consequence of):
c. _____
Due to (or as a consequence of):
d. _____

Causal sequence leading to death

PART II. Enter other significant conditions contributing to death but not resulting in the

Contributing conditions

33. WAS AN AUTOPSY PERFORMED? ☐ Yes ☐ No

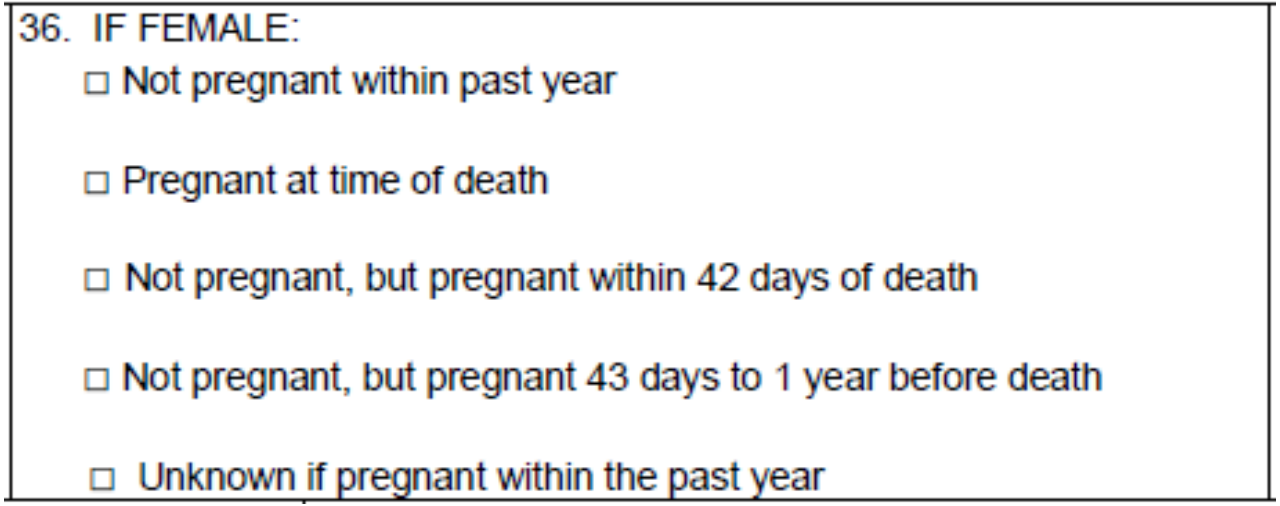
34. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? ☐ Yes ☐ No

35. DID TOBACCO USE CONTRIBUTE TO DEATH?
☐ Yes ☐ Probably
☐ No ☐ Unknown

36. IF FEMALE:
☐ Not pregnant within past year
☐ Pregnant at time of death
☐ Not pregnant, but pregnant within 42 days of death
☐ Not pregnant, but pregnant 43 days to 1 year before death
☐ Unknown if pregnant within the past year

37. MANNER OF DEATH
☐ Natural ☐ Homicide
☐ Accident ☐ Pending Investigation
☐ Suicide ☐ Could not be determined

Pregnancy checkbox item on the 2003 revision of the US Standard Death Certificate

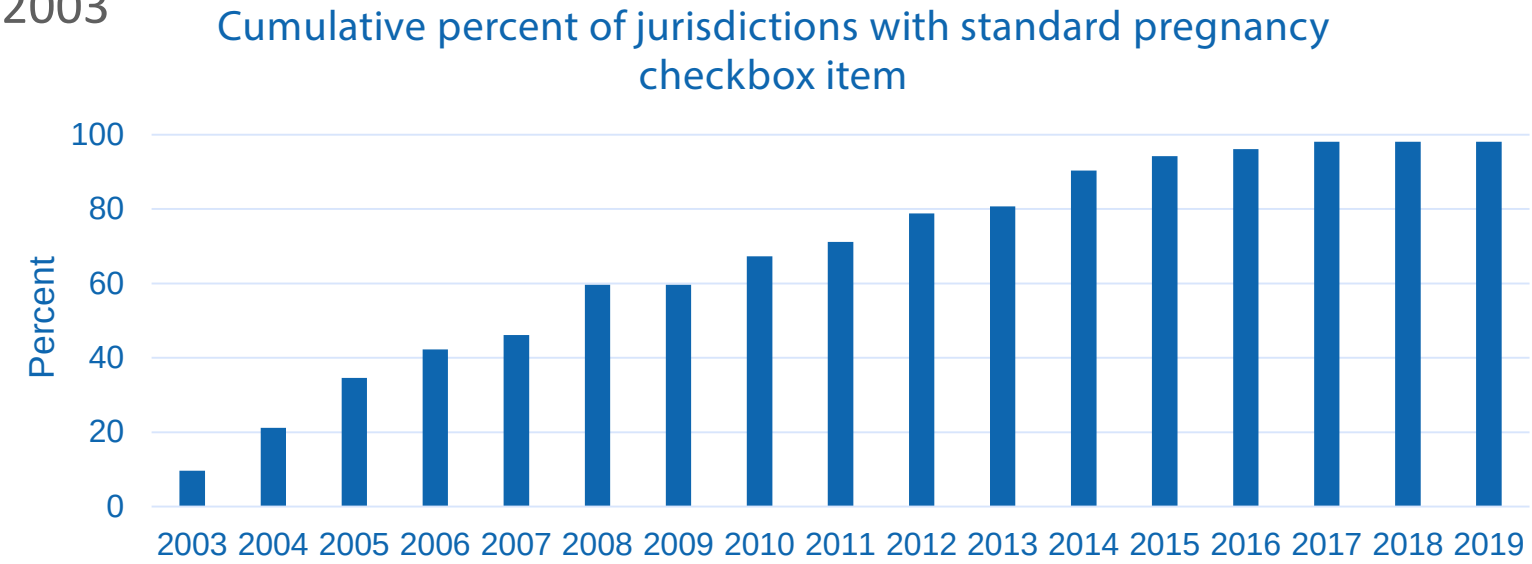


36. IF FEMALE:

- ☐ Not pregnant within past year
- ☐ Pregnant at time of death
- ☐ Not pregnant, but pregnant within 42 days of death
- ☐ Not pregnant, but pregnant 43 days to 1 year before death
- ☐ Unknown if pregnant within the past year

Implementation of the 2003 revision of the US Standard Death Certificate

- Only 5 jurisdictions had a checkbox item consistent with the standard in 2003



Note: Out of 52 jurisdictions (50 states, NYC and DC). CA implemented the 2003 certificate, but without the standard pregnancy item.

Current rules for coding maternal deaths

- For female decedents where there is an indication, either in the cause of death section (part I or II) or in the checkbox item, of a pregnancy or recent pregnancy, all medical conditions on the death certificate are coded to the O-chapter (Chapter XV) in ICD-10
  - Those conditions indexed in ICD-10 (i.e., found in the index or specified in volume 1) are coded to the appropriate O-code
  - Those conditions not indexed or not found in volume 1 are assigned to “other specified” categories:
    - For direct obstetric causes or complications of direct obstetric causes, code O26.8 (Other specified pregnancy-related conditions)
    - For indirect obstetric causes, code O99.8 (Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium)

Coding with and without checkbox

	Without checkbox	With checkbox
I a) Chronic renal failure	N18.9	O26.8
b) Hypertensive heart disease	I11.9	O10.1
c)		
II Coronary thrombosis	I21.9	O99.4
Underlying cause	***I21.9***	***O10.1***
I a) Hemorrhage	R58	O46.9
b) Dissecting aortic aneurysm	I71.0	O99.4
c) Arteriosclerosis	I70.9	O99.4
II Old myocardial infarction	I25.8	O99.4
Underlying cause	***I71.0***	***O46.9***

Coding external causes

- External causes of death (accidents, suicides and homicides) are not converted to O-codes
- However, in some instances, a maternal underlying cause may nevertheless be the result

	Without checkbox	With checkbox
I a) Anoxic brain injury	G93.1	O26.8
b) Fentanyl overdose	T40.4/X42	T40.4/X42
c)		
II Remote history of opiate abuse	F11.1 T40.4	O99.3 T40.4
Injury description: Fentanyl overdose		
Manner: Accident		
Underlying cause	***X42***	***O26.8***

Causes incidental to pregnancy

- Causes incidental to pregnancy should not be counted as maternal as they are inconsistent with the WHO definition
- WHO does not define what constitutes “incidental” other than injury-related causes
- Coders are not really qualified to make this judgment, especially given the limited information reported on death certificates
- To exclude incidental causes in the coding process, a list would be needed
- However, such a list is proving difficult to create
  - Are there diseases and conditions that are not complicated in some way by pregnancy?

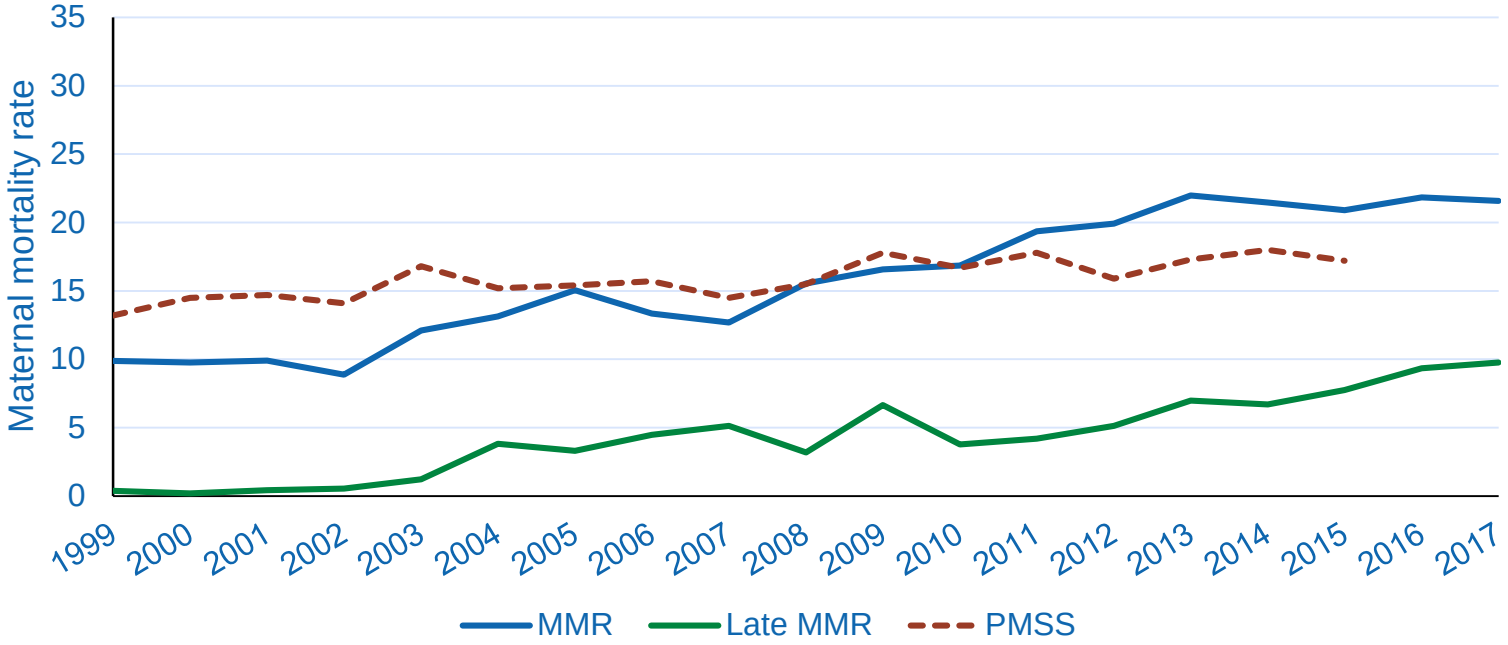
Consequences of current coding procedure

- In some cases, this procedure has had unintended consequences
  - Some deaths due to external causes were coded as maternal
  - In some cases, an underlying cause is selected that does not reflect the disease process and actual underlying cause
  - Because the procedure casts a wide net, some deaths due to incidental causes, which should be excluded, are likely coded as maternal
  - Many specific conditions are coded to ill-defined O-codes (e.g., O26.8 and O99) resulting in a loss of information for analysis

Pregnancy checkbox errors

- Recent research has shown errors in the checkbox item
  - Some maternal deaths are missed
  - Some non-maternal deaths are misclassified as maternal
- It is unclear exactly why the errors occur, but it may be simply random error in selecting the appropriate category
- Most errors occur in the older ages (i.e., over 40)
  - If the errors are random, they would tend to concentrate in the older population simply because there are more deaths among older women
  - Assuming the error rate is constant across age groups, about 70% of errors would occur in the over 40 category
- Net result is over-ascertainment of maternal deaths and a maternal mortality rate that is too high

Trend in maternal mortality rates: United States, 1999-2017



Note: MMR = maternal mortality rate. MMR includes all deaths coded to A34, O00-O95, O98-O99. Late MMR includes all deaths coded to O96-O97. PMSS (Pregnancy Mortality Surveillance System) includes pregnancy-related deaths (i.e., both maternal and late maternal deaths).

Publication of national maternal mortality rates

- Largely because of concerns arising from the incremental implementation of the standard pregnancy checkbox item, NCHS ceased publication of national maternal mortality rates after 2007.
- Plans were to resume once all jurisdictions had implemented the new certificate
- More recent information regarding the checkbox errors have raised additional concerns about the accuracy of the data

Current strategy and plans

- Plans are to resume publication of national maternal mortality rates with the release of the 2018 mortality data
- This will involve the development of new rules for the coding of maternal deaths that mitigate errors
- For maternal deaths, we also will change the way the multiple cause fields in the data file are organized so as to allow the analyst maximum flexibility in dealing with checkbox-only cases

Recoding maternal deaths as if there were no checkbox item

- We have already recoded data for 2015 and 2016 as if the checkbox item did not exist
  - A report is in preparation with an analysis of the effect of the checkbox on the maternal mortality rate
- Plans are to recode data in the same way for 2003-2014, 2017-2019
- These recoded data for 2003-2019 will be released and made available to researchers
- This will increase the availability of trend data to evaluate the addition of the checkbox as there will be several years where all or most deaths will be coded under both sets of rules

Proposed changes in coding procedure (beginning 2018)

- In checkbox-only cases, information from the checkbox will only modify the underlying cause…not other causes reported on the certificate
- Further age restriction for application of the checkbox
  - Currently, the age restriction is from age 10-54, i.e., the checkbox is only applied if the decedent is in this age range
  - Plans are to further restrict this age range to 10-40 or 10-44 (decision has not yet been made)
  - The age restriction will only affect the checkbox-only cases
  - When obstetric conditions are reported on the death certificate, there will be no restriction in terms of age, i.e., maternal deaths due to an explicit obstetric condition will be counted regardless of age

Proposed changes in multiple cause fields (beginning 2018)

- For checkbox-only cases that are coded as maternal deaths, only the underlying cause field will reflect an O-code
- Multiple cause fields (entity and record axis) for these cases will reflect the data as reported
- This will allow the analyst to identify the checkbox only cases in the data file and will avoid problems with ill-defined O-codes (e.g., O26.8 and O99.8)

Example of proposed checkbox-only record

I a) Hemorrhage	R58	Pregnancy checkbox = pregnant at time of death
b) Dissecting aortic aneurysm	I71.0	
c) Arteriosclerosis	I70.9	
II Old myocardial infarction	I25.8	
Underlying cause	***I71.0*** → ***O99.4***	

- Entity axis codes (first 2 positions indicate where the condition was reported, i.e., which line and where on the line)

11R58 21I710 31I709 61I258

- Record axis codes (underlying cause is listed first with other codes listed alphanumerically after that)

O994 I258 I709 I7101 R58

"1" in the fifth position indicates that this code would be the underlying cause assuming no checkbox

Publication and data release plans

- Report on the effect of the checkbox on 2015 and 2016 data is in preparation for publication this summer
- Report on the new methodology for coding maternal deaths will be published along with the release of final 2018 mortality data
  - Will show the trend coded with and without checkbox
  - Will show differences in the two coding approaches
- Final 2018 mortality data will include maternal deaths coded according to the new methodology
- An official maternal mortality rate will be published in our annual report “Deaths: Final data for 2018”, which will include tables showing maternal deaths and mortality rates.

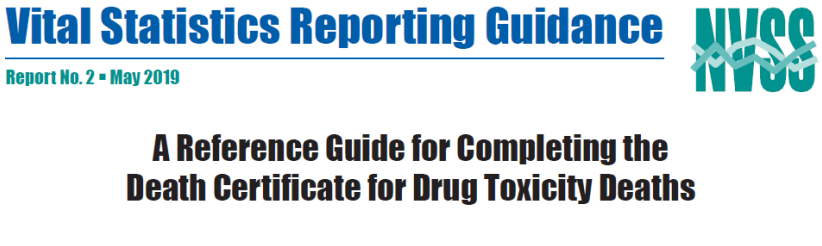
Tabulating maternal deaths and mortality rates

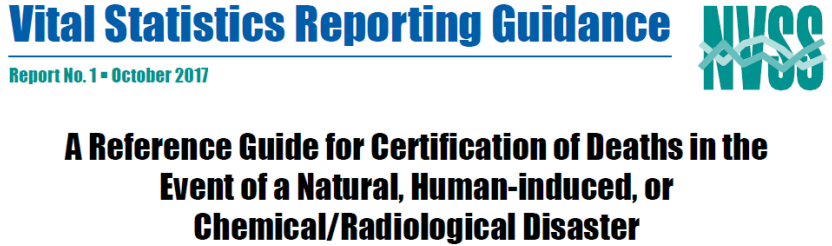
(from Deaths: Final data for 2007 – *National Vital Statistics Reports* vol 58, no 19)

Cause of death (based on ICD–10, 2004)		Number					Rate				
		All origins[1]	Hispanic	Non-Hispanic[2]	Non-Hispanic white[3]	Non-Hispanic black[3]	All origins[1]	Hispanic	Non-Hispanic[2]	Non-Hispanic white[3]	Non-Hispanic black[3]
Maternal causes	(A34,O00–O95,O98–O99)	548	95	453	242	178	12.7	8.9	14.1	10.5	28.4
Pregnancy with abortive outcome	(O00–O07)	31	5	26	8	17	0.7	*	0.8	*	*
Ectopic pregnancy	(O00)	14	1	13	2	11	*	*	*	*	*
Spontaneous abortion	(O03)	9	2	7	3	3	*	*	*	*	*
Medical abortion	(O04)	–	–	–	–	–	*	*	*	*	*
Other abortion	(O05)	1	–	1	–	1	*	*	*	*	*
Other and unspecified pregnancy with abortive outcome	(O01–O02,O06–O07)	7	2	5	3	2	*	*	*	*	*
Other direct obstetric causes	(A34,O10–O92)	362	67	295	153	117	8.4	6.3	9.2	6.6	18.7
Eclampsia and pre–eclampsia	(O11,O13–O16)	64	13	51	29	19	1.5	*	1.6	1.3	*
Hemorrhage of pregnancy and childbirth and placenta previa	(O20,O44–O46,O67,O72)	41	12	29	18	9	0.9	*	0.9	*	*
Complications predominately related to the puerperium	(A34,O85–O92)	93	15	78	35	31	2.2	*	2.4	1.5	4.9
Obstetrical tetanus	(A34)	–	–	–	–	–	*	*	*	*	*
Obstetric embolism	(O88)	33	6	27	12	8	0.8	*	0.8	*	*
Other complications predominately related to the puerperium	(O85–O87,O89–O92)	60	9	51	23	23	1.4	*	1.6	1.0	3.7
All other direct obstetric causes	(O10,O12,O21–O43,O47–O66,O68–O71,O73–O75)	164	27	137	71	58	3.8	2.5	4.3	3.1	9.2
Obstetric death of unspecified cause	(O95)	20	4	16	7	7	0.5	*	*	*	*
Indirect obstetric causes	(O98–O99)	135	19	116	74	37	3.1	*	3.6	3.2	5.9
Maternal causes more than 42 days after delivery or termination of pregnancy	(O96–O97)	221	39	181	92	70	5.1	3.7	5.6	4.0	11.2
Death from any obstetric cause occurring more than 42 days but less than 1 year after delivery	(O96)	215	38	176	92	66	5.0	3.6	5.5	4.0	10.5
Death from sequelae of direct obstetric causes	(O97)	6	1	5	–	4	*	*	*	*	*

Guidance to certifiers

- The Council of State and Territorial Epidemiologists (CSTE) has formed a workgroup on maternal mortality with the goal of producing a reference guide for certifying deaths associated with pregnancy
- This effort involves staff from NCHS, CDC's Division of Reproductive Health, CSTE, NAPHSIS and several states
- The goal is to write and publish a reference guide in our *Vital Statistics Reporting Guidance* series in a format similar to those produced for drug overdoses and disasters by the end of 2019





Long term solution

- Ideally, some effort to investigate all deaths to women of reproductive age is needed
  - Linkages with birth and fetal death records to verify recent pregnancies
  - Review of medical records for those where a recent pregnancy is reported to identify errors and determine whether the pregnancy was a factor or whether the cause was incidental
- It is important that information from such investigations is reported on death certificates in a timely fashion so correct information can be included in national statistics

Robert Anderson

Phone: 301-458-4073

RNAnderson@cdc.gov