Technical Papers

CORRECTING THE UNDERCOUNT IN MATERNAL MORTALITY

TABLE OF CONTENTS

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FOREWORD

Improvement of maternal and child health have been key objectives of public health and population programs in both developing and developed countries. Monitoring of such programs through the measurement of maternal and child mortality has occupied the attention of health statisticians and demographers in many countries. In the absence of a good civil registration system, monitoring changes in these two important indicators is at best difficult and much effort has been directed to developing indirect methods.

However, as this paper demonstrates, even in a situation where a good civil registration system exists, the traditional method of measuring maternal mortality, by counting as maternal deaths those deaths assigned to codes for Complications of Pregnancy, Childbirth, and the Puerperium of the International Classification of Diseases, can miss a sizeable number of deaths which should be counted as maternal deaths. "The paper illustrates a number of methods which may be used to obtain a better count of maternal deaths."

The views expressed in this report are those of the authors' and do not necessarily reflect those of IIVRS.

CORRECTING THE UNDERCOUNT IN MATERNAL MORTALITY*

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INTRODUCTION

The International Classification of Diseases, Ninth Revision (ICD-9), defines maternal mortality as:

> The death of any woman while pregnant or within 42 days of termination of pregnancy, irre-spective of duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. Maternal deaths should be subdivided into 2 groups: direct obstetrical causes which are those resulting from obstetrical com-plications of the pregnancy state (pregnancy, labor, or the puerperium) from interventions, omissions, incorrect treatment or from a chain of events resulting from any of the above, and indirect obstetri-cal causes which are those resulting from previous existing disease or disease that developed during the pregnancy and which was not due to direct obstetrical causes but aggravated by the physiological effects of pregnancy(1).

For statistical purposes, maternal death has traditionally been determined by examining the underly-ing cause of death reported on the cerificate of death and selecting those deaths assigned a cause of death in the ICD-9 range of codes 630-676. Based on these codes, state vital statistics indicate there were 300 maternal deaths among residents of New York State from 1980-86 (Table 1). The numbers have been relatively stable, averaging approximately 10 deaths per year in Upstate New York and 33 deaths per year in New York City. New York State is the last remaining state in the United States with two independent vital registration systems: New York City, and the rest of the state. Events occurring outside of New York City will be referred to in the remainder of this paper as occurring in Upstate New York.

Table 1. Total and Maternal Deaths Among Women 10 to 49 Years of Age, New York State: 1980-1986

YEAR	TOTAL DEATHS	MATERNAL DEATHS*	
		NUMBER	% OF TOTAL
1980	5721	52	0.91
1981	5636	43	0.76
1982	5395	45	0.83
1983	5547	52	0.94
1984	5623	35	0.62
1985	5826	36	0.62
1986	6061	37	0.61
ALL YEARS	39,809	300	0.75

* Maternal deaths are defined as those coded in categories 630 to 676 of ICD-9

Recent studies have indicated that the number of maternal deaths may be substantially greater than the number reported in vital statistics. A center for Disease Control report indicated that from 1974-78 the actual number of maternal deaths in the United States was 20 to 30 percent higher than the number reported in the national vital statistics system.(2) Similar studies in the states of Georgia and Washington resulted in maternal mortality rates 50 and 68 percent higher respectively than reported through the registration system.(3,4)

The limitations of vital statistics data in measuring maternal mortality have been documented. Death certificates often do not have adequate information reported to identify maternal deaths. A current or recent pregnancy may go unreported on the certificate, or the relationship of other disease conditions to a known pregnancy is not clearly stated. An alternative to reliance on cause

* This paper is based on an original article prepared by the authors in November 1988.

of death coding for ascertainment of maternal mortality is to identify all deaths to women in child-bearing ages, and to review their medical records to determine if the woman had been pregnant in the recent past and if the death was in fact related to a pregnancy. The time period for review related to ICD-9 cause of death coding is 42 days, and the recommendation by the American College of Obstetricians and Gynecologiest (ACOG) is 90 days.(6) The latter period was used in this study.

METHODS

In an effort to assess the completeness of maternal death reporting in New York State and to enhance the quality of these data, all deaths among women 10 to 49 years of age assigned to causes other than ICD-9 codes 630-676 for the years 1980-1986 were identified using vital records. A computer match of these cases was then made against live birth and fetal death (induced and spontaneous abortion) files to determine if the woman had terminated a pregnancy within 90 days of her death. Matching was done using several variables: social security number, name of deceased-to-surname, name of deceased-to-mother's maiden name. The availability of matching information varied between Upstate New York and New York City data. For example, in Upstate New York the live birth file, the fetal death file, and the abortion file were matched against the death certificate file using name of deceased to surname and name of deceased to mother's maiden name. In addition, in Upstate New York it was possible to match the live birth file against the death certificate file using social security number. In New York City, the information available for matching was more limited--for example, there is no identifying information contained on abortion certificates. Also, in New York City, the social security number could not be used for matching the death certificates against any file. Presumably the more identifying information available for matching, the more cases of potential maternal deaths would be identified.

Computerized matching resulted in the identification of an additional 193 deaths that occurred within 90 days of a pregnancy termination (Table 2). These 193 deaths were distributed by outcome of associated pregnancy as follows: (in Upstate New York) 78 births, 26 fetal deaths, 27 abortions; (in New York City 62 births).

Table 2. Number of Deaths of Women 10 to 49 Years of Age
Matched to Pregnancies Terminating within 90 Days
of Deaths, Upstate New York and New York City by
Type of Pregnancy Termination

TYPE OF PREGNANCY TERMINATION	UPSTATE NY	NEW YORK CITY
Births	78	62
Fetal Deaths	26	0
Abortions	27	N.A.

It may be assumed that more potential maternal deaths would have been identified in New York City, if more information had been available for matching.

Medical records of patients were obtained from hospitals where deaths occurred. A review of the 135 available medical records were conducted by two OB/GYN consultants to determine if the death was related to the pregnancy. The review of hospital records resulted in identification of an additional 73 maternal deaths--31 direct and 42 indirect maternal deaths (Table 3). No records were obtained for 58 of the 193 record matched deaths. The non-reviewed deaths predominately occurred out-of-hospital, or in emergency rooms.

Table 3. Number of Maternal and Non-maternal Deaths Identified in Chart Review
of Matched Cases (Death File vs. Pregnancy Termination Files) by Type
of Pregnancy Termination

IDENTIFICATION	BIRTHS	FETAL DEATHS	ABORTIONS	ALL TYPES
Direct maternal death	30	1	0	31
Indirect maternal deaths	36	3	3	42
Non-maternal deaths	37	16	9	62
No review*	37	6	15	58
Total	140	26	27	193

* Medical records unavailable for review.

2

RESULTS

The affect of these additional deaths on the maternal mortality rate differed between Upstate New York and New York City. When only death certificate ascertained events are considered, the maternal mortality rate in Upstate New York during 1980-1986 was 6.7 (deaths per 100,000 live births). This rose to 11.9 with the addition of record-matching direct and indirect maternal deaths. The additional deaths had less of an affect in New York City, with the rate changing from 29.0 to 31.9. Presumably, the paucity of information available for identifying potential maternal deaths in New York City is at least part of the explanation for the small impact on the maternal mortality rate for the city. The changes in rates in both areas was uniform over the seven year study period.

Maternal Race

The additional maternal deaths identified through record matching increases the maternal mortality rates among whites, blacks and Hispanics. The largest absolute increase caused by the addition of the record matching deaths occurred among blacks--from 41.3 to 48.5 over the seven year study period. The largest percent increase (41%) occurred among whites--from 7.7 to 10.9. The increase in the number of deaths based on record matching was spread uniformly between 1980 and 1986.

Maternal Age

No additional maternal deaths were found by record matching in the 10-17 year old age group. However, the maternal mortality rates among women 18-34 years of age and 35-49 years of age both incrase about 25% when record matching deaths are included. The trend data show that the increase due to record matching deaths is uniform over the study period. The erratic behavior of the trend line for 10-17 year old women is due to the low number of deaths among this age group.

ICD-9 vs. ACOG Interval Definition for Maternal Mortality

The ICD-9 and ACOG definitions of maternal mortality differ in the number of days allowed to intervene between termination of a pregnancy and maternal death. The ICD-9 interval is 42 days, while the ACOG interval (the one used in this study) is 90 days. The effect of this difference was examined (Table 4). Eighty percent (58/73 of the combined direct and indirect obstetric deaths occurred within the 42 day ICD-9 limit. Fifteen of these deaths occurred on the same day as pregnancy termination, yet were not identified as maternal deaths on the death certificate. In all 15 cases, there was information in the hospital chart concerning pregnancy outcome, and in 7 of these cases, the death certificate also contained information as to the pregnancy of the deceased but not written in the medical certificate of cause of death. Fifteen of the combined direct and indirect obstetric deaths occurred within one week of pregnancy termination. Thus, 41 percent (30/73) of the maternal deaths found by record matching occurred within a week of pregnancy termination. However, none of these deaths were assigned an ICD-9 cause of death indicating maternal mortality due to inadequate reporting on the death certificate.

Table 4. Maternal Deaths and Non-maternal Deaths Identified in
Chart Review by Interval Between Pregnancy Termination
and Death (for matched records receiving chart review)

INTERVAL	TOTAL DEATHS MATCHED	PERCENT IDENTIFIED AS MATERNAL DEATHS (%)
0 to 7 days	48	62
8 to 28 days	39	56
29 to 42 days	10	60
42 to 90	42	36
43 to 70 days	26	42
71 to 90 days	16	25
ALL INTERVALS	139	53

Cause of Death

The major causes of death among the 289 death certificate-based maternal deaths recorded in New York State were ectopic pregnancy and obstetrical pulmonary embolism, each with 46 deaths during 1980-1986, and hypertension, with 38 related deaths. The distribution of the cause of death among the 135 records reviewed in the record matching portion of the study shows that the majority of the

3

73 deaths classified as either direct or indirect obstetric deaths were related to diseases of the circulatory system (Table 5). There were six maternal deaths attributed to external causes, with four direct obstetric deaths related to some complication of surgery, and two indirect deaths from suicide related to post-partum depression.

Table 5. Cause of Death Among Maternal Deaths Identified in Chart Review of Matched Cases (Death File vs. Pregnancy Termination Files).

CAUSE OF DEATH	ICD-9 CODE	NUMBER OF CASES IDENTIFIED
Infectious and parasitic diseases	001-139	1
Neoplasms	140-239	6
Endocrine, nutritional, metabolic diseases and immunity disorders	240-279	2
Blood forming organs	280-289	4
Defibrination syndrome	286.6	3
Other		1
Nervous system	320-389	2
Circulatory system	390-459	32
Pulmonary embolism	415.1	5
Other primary cardio-myopathies	425.4	2
Subarachnoid hemorrhage	430.1	7
Intracerebral hemorrhage	431.0	3
Other		15
Respiratory system	460-519	6
Bronchopenumonia	485.0	2
Other		4
Digestive system	520-579	6
Congenital anomalies	740-759	3
Unknown	799	5
External causes	800-999	6

The leading causes of death among the 73 maternal deaths identified through record matching were: subarachnoid hemorrhage (7 deaths), pulmonary embolism (5 deaths), and cause unknown (5 deaths) (Table 5). The cause unknown represents what was coded from information on the death certificates, not the result of hospital record review.

Methods for Maternal Death Ascertainment

In addition to the two methods for ascertaining maternal deaths referred to thus far, i.e. death certificate coding and recording matching, there are two other possible methods: special interest codes and a direct question concerning pregnancy.

The special interest code is used in New York State to identify all those death records where pregnancy was indicated on the death certificate (either directly or through some keyword), and the cause of death was not assigned a maternal death code. When those deaths found through record matching in Upstate New York are compared to those where the special interest code indicated pregnancy, there are only twelve records common to the two methods (Table 6). There are an additional twelve deaths where the death certificate mentioned pregnancy, but were not found with record matching. This is most likely due to there being no outcome of pregnancy (birth or fetal death certificate filed) for record matching detection.

Table 6. Potential Maternal Deaths Detected by Various
Methods, Upstate New York

Method of detection	Number
Detected by record matching only	120
Detected by special interest code only	12
Detected both by record matching and by special interest code	12
Total	144

In addition to the special interest coding, the death certificate used in New York City contains a question as to whether the deceased was pregnant within the last six months. When all three sources of information (record matching, special interest code, and direct question) are compared for the New York City records only one record was found common to all three sources (Table 7). This points to the need for examining all possible sources of information when trying to ascertain the 'true' rate of maternal morality.

Table 7. Maternal Deaths Detected by Marious Methods,
New York City

Method of detection	Number
By all methods	127
By record matching	61
By record matching only	55
By record matching and special interest code	0
By record matching and direct question	5
By record matching and special interest code and direct question	1
By special interest code	18
By special interest code only	2
By special interest code and direct question	15
By special interest code and direct question and record matching	1
By direct question	70
By direct question only	49
By direct question and record matching	5
By direct question and special interest code	15
By direct question and record matching and special interest code	1

The latest version of the death certificate used in Upstate New York (as of January 1, 1988), contains a direct question on the death certificate concerning recent pregnancy. This question was added in the hope of finding more 'unknown' maternal deaths. The data gathered from this question point out another feature of using vital records. No matter what the instrument used to gather the information, if the questions are not answered, the instrument is useless.

A recent examination of death certificates from other states also points to a problem (Chart 1). There is no uniformity as to the time limit used among the states. If a true nationwide estimate of maternal mortality is to be made, not only will as many sources of information as possible have to be used, but also a common definition of a time frame for record matching will have to be established. The Center for Disease Control has recommended a one-year period for record matching.

5

Chart 1. Time Frame for Question on Pregnancy Among States with Question on Death Certificate Concerning Pregnancy at Time of Death

Alabama	6 months
Arizona	90 days
Florida	3 months
Georgia	Births within 90 days
Illinois	3 months
Iowa	6 months
Kentucky	Dropped in 1988
Maryland	3 months
Missouri	90 days
Nebraska	3 months
New Jersey	90 days
New Mexico	6 weeks
New York City	6 months
New York State	6 months
North Dakota	18 months
Virginia	3 months (1989)

REFERENCES

1. National Center for Health Statistics: Instructions for Classifying the Underlying Cause of Death, 1979. Vital Statistics, part 2a. Washington, D.C.: U.S. Govt. Printing Office, 1978.

2. Smith J.C., Hughes J.M., Pekow P.S., Rochat R.W.: An assessment of the incidence of maternal mortality in the United States. Am J Pub Hlth 1984; 74:780-3.

3. Rubin G, McCarthy B., et al: The risk of childbearing re-evaluated. Am J Pub Hlth 1981; 71:712-6.

4. Misclassification of maternal deaths - Washington State. MMWR 1986; 35:621-3.

5. Zemach R.: What the vital statistics system can and cannot do. Am J Pub Hlyh 1984; 74:756-8.

6. American Academy of Pediatrics (AAP) and American College of Obstetrics and Gynecology (ACOG): Guidelines for Perinatal Care. AAP and ACOG, 1983.