CHAPTER 11

Use of Health System Data to Study Morbidity Related to Pregnancy Loss

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Millions of women each year suffer from unsafe abortion and its complications worldwide. Measuring the level of abortion in countries where it is highly legally restricted is difficult, since procedures are generally carried out outside the formal health system and are not reflected in health records. Official health information systems in some countries, however, do provide regular data on deaths and hospitalizations due to abortions. Depending on the quality and completeness of coverage of these health information systems, they can be a very valuable source of data to analyze abortion-related mortality and morbidity.

Over the past 15 years, the World Health Organization (WHO), with inputs from other international organizations, has focused attention on estimating abortion ratios and rates and maternal mortality caused by unsafe abortion at global, regional and subregional levels. The most recent round of estimates are for 2003 (WHO 2007a). However, fewer efforts have attempted to study abortion-related morbidity, especially at the individual-country level. Most such studies are small scale and have been limited to measuring the number of women who are hospitalized for abortion-related complications.

A few, however, are large-scale national studies that use a variety of data sources. For example, an important source of aggregate data is hospital discharge data from national health information systems that detail diagnoses or causes for admission, including abortion-related morbidity. Documentation for the provision of health care services, including hospital-based care, usually includes use of the International Classification of Diseases (ICD), which categorizes reasons for admission and thus provides an indication of the type of care provided to patients (WHO 2007b). This classification system originated in France during the middle of the 19th century and has been used by the WHO since the organization's inception.

The ICD represents a global effort to systematize the documentation used in health care services worldwide. It uses standardized definitions of diseases that allow for comparisons of causes of mortality and morbidity across contexts, times and places. Version 10 of the ICD has been used since the late 1990s to the present. Using aggregate health data based on the ICD classification system, one can calculate the total number of hospitalizations related to abortion for a specific time period; additionally, if population data (number of women) are available for the same period, the numbers of hospitalizations can be converted into rates. Depending on the extent of data collection beyond ICD-10 codes, hospitalization rates can be estimated by health-system sector, patient age-group, year of hospitalization, type of procedure and gestational age. Where comparable data are available for several years, trends can be assessed. Moreover, such trends can serve as the basis for projecting future numbers by taking into account projected population growth and assuming that factors that affect hospitalization rates for abortion-related morbidity—such as contraceptive coverage, the legality of abortion, the procedure's safety and resulting severity of morbidity and access to services—remain unchanged. In turn, these projections may be used to estimate budgetary expenses for the public health care sector.

Another source of aggregate national data on abortion-related morbidity in countries where the procedure is highly legally restricted and that have inadequate national health system data is nationally representative sample surveys of facilities that provide postabortion care. The design of these surveys includes interviewing a key informant at each sampled facility to estimate the average number of patients treated annually. Since the symptoms of morbidity from miscarriages and induced abortions are similar and women are understandably reluctant to admit to having had an induced abortion and providers are often reluctant to expose patients to legal repercussions, such surveys are specifically designed to estimate the number of women who are treated for both spontaneous and induced abortions. Using a methodology developed in the early 1990s (Singh and Wulf 1994), spontaneous abortions are removed from the total (based on assumptions of the

biological constant of late miscarriages and the proportion of women who are likely to obtain hospital care for deliveries); the remaining hospitalized induced abortions then provide the basis for indirect estimates of the national incidence of *all* induced abortions, including the ones that do not require treatment.

This approach was first used in the mid-1990s in Nigeria and Bangladesh (Singh et al. 1997; Henshaw et al. 1998) and later in Uganda and Guatemala (Singh et al. 2005; Singh et al. 2007). Recently, a meta-analysis that relied on hospitalization data from both sample surveys of facilities and official health systems from 13 developing countries estimated an average annual rate of 5.7 hospitalizations for morbidity resulting from induced abortion per 1,000 women in all developing-country regions (Singh 2006).

Finally, some studies have obtained individual-level data on abortion-related morbidity using various approaches, including extracting data from medical records; interviewing postabortion patients; and combining record-based data and patient interviews. Data on individual patients can be obtained retrospectively (by using medical records from earlier years) or prospectively (by collecting data on all relevant patients admitted during a short period of time, such as a few weeks or a few months; see Chapter 10). Some of these studies are nationally representative and collect prospective data on all postabortion patients treated at a national sample of facilities that provide postabortion care. This design has been applied in South Africa (Rees et al. 1997; Jewkes et al. 2002), Kenya (Gebreselassie et al. 2005) and Cambodia (Fetters et al. 2008). An advantage of this design is that it can obtain individual-level data on the severity of abortion-related morbidity, as well as data on specific treatment and its cost.

Induced Abortion in Latin America

The region of Latin America and the Caribbean has one of the highest estimated levels of unsafe abortion in the world (WHO 2007a) despite also having laws that severely restrict the procedure (Sedgh et al. 2007; Katzive and Boland 2008). An estimated 3.9 million unsafe abortions take place each year in the region; unsafe abortion accounts for 11% of all maternal deaths in the region and for an unknown level of illness and disability, both acute and long-term (WHO 2007a).

In the specific case of Mexico, unsafe abortion remains an important source of maternal mortality: From 1990 to 2005, 7.2% (n=1,537) of all registered maternal deaths were associated with pregnancy losses. Even if these deaths cannot be ascribed to specific ICD-10 subcategories, most were likely related to severe complications from unsafely induced procedures. Despite a gradual decline in maternal mortality overall during this period, abortion-related mortality did not change in terms of the absolute numbers of women dying or the specific contribution of abortion to maternal deaths (Schiavon et al. 2007). Mexico's abortion laws vary among the country's 31 states and are generally highly restrictive. The exception is the Federal District (Mexico City), whose abortion law was reformed in 2007, making services legal on request there in the first trimester of pregnancy.

One recent study using Mexican health system data at two points in time (1990 and 2006) found that the rate of hospitalization from morbidity caused by unsafe abortion hardly changed over the 16-year period, increasing only slightly from an annual rate of 5.4 to 5.7 per 1,000 women (Juarez et al. 2008). However, the overall safety of abortion improved over time, probably because women increasingly used safer methods of inducing abortion, such as misoprostol (Lara et al. 2007). According to the indirect estimation methodology mentioned above, one in five women who had an abortion were hospitalized in 1990, but as the procedure became safer over time, the proportion hospitalized declined to one in almost six women in 2006. The estimated rate of induced abortion in Mexico increased between 1990 and 2006, going from 25 procedures per 1,000 women in 1990 to 33 per 1,000 in 2006 (Juarez et al. 2008). This increase was likely caused by desires to avoid pregnancy outpacing the adoption of effective contraceptive use, among other reasons.

Use of Health System Data: An Application in Mexico

This chapter focuses on measures of morbidity related to pregnancy loss from health system data, using Mexico as a case study. Since induced abortion is severely restricted by law and highly stigmatized in many countries, including Mexico, accurately classifying and registering the cause of hospitalization as "induced abortion" may be risky for the woman and the health professional. The standard IDC-10 system for coding diagnoses covers morbidity from all types of pregnancy losses, including induced abortions. However, induced abortions are generally incorrectly classified under codes that are less specific and less stigmatized, for the reasons indicated above. Therefore, we decided to not differentiate between specific types of pregnancy loss and to include all diagnoses of "pregnancy with abortive outcome" (ICD-10 codes O00-O08) over a six-year period, 2000–2005. These include diagnoses of spontaneous and induced abortions, ectopic pregnancies, trophoblastic disease and other unspecified abortions. The

chapter describes the source of these data in some detail; demonstrates the types of morbidity measures that are available in Mexico (such as state-specific hospitalization rates); and discusses potential advantages and limitations of the data.

It is essential to keep in mind that our chapter covers morbidity related to all pregnancy loss, not just morbidity related to induced abortion. As long as these inclusion criteria are clear, the method is a valuable and easily reproducible technique of generating a comprehensive measure of morbidity.

Descriptive Overview of the Method

Health Systems Used

In this chapter, we assess the utility of using health system data to measure morbidity from pregnancy loss. The objective of the method is to better document both the burden of morbidity from pregnancy loss borne by women who are treated in public-sector hospitals and the burden on health facilities that provide such care.

In Mexico, data on services provided by the public health sector are available through local and state hospitals that submit data to the central-level agency, the Federal Ministry of Health (MoH). The four main public-sector health institutions reporting to the MoH are the Secretaría de Salud (SSa); the Instituto Mexicano del Seguro Social (IMSS-Regimen Ordinario, or IMSS-RO); IMSS-Oportunidades (IMSS-O); and Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado (ISSSTE). The populations covered by each of these institutions are the following:

- all people who lack coverage in a social security system or private health insurance are eligible for coverage by the SSa through federal or state hospitals, or by the IMSS-O system in rural areas of 17 selected states;
- government employees are served by the ISSSTE; and
- private-sector employees are covered by the IMSS-RO, which is paid for by the government, employers and employees.

Each system has its own budget and operating rules, including ways of registering data on patient care (Londono and Frenk 1997). A new program, known as Seguro Popular (Popular Health Insurance) was put in place in Mexico during the previous federal administration (2000–2006); eventually, it will replace the SSa under a mixed insurance program (Frenk et al. 2007). During the time period of the analysis, the Seguro Popular program had not yet covered a significant percentage of women who were hospitalized for obstetric reasons.

Starting in the late 1990s, the MoH created a strong centralized health information system, which includes a mortality and morbidity database with subsystems for hospitalized/inpatient cases, outpatients and emergency care in the whole health sector.* With this new system, all admissions resulting in hospitalizations are recorded in the Sistema Automatizado de Egresos Hospitalarios (SAEH, or Automated System of Hospital Discharges). The above-mentioned public health institutions (SSa, IMSS and ISSSTE) and others must report their data to this system. Some systems, however, have been slow in incorporating their data into SAEH and still rely on their old parallel information system. For example, both IMSS institutions use the Sistema Único de Información (SUI, or Unified Information System), while ISSSTE uses its Anuarios Estadísticos (Statistical Yearbooks).

Some additional segments of the public health system did not report data to SAEH for the complete study period and are therefore excluded from the present study. These are Petróleos Mexicanos (PEMEX), Secretaría de la Defensa Nacional (SEDENA) and Secretaría de Marina (SEMAR). However, we were able to review data for a four-year period (2004–2007) whose first two years overlapped with our last two years; the data corroborated that these three minor health institutions contributed less than 1.6% of overall hospitalizations due to pregnancy losses over the four-year period. All the above-mentioned systems are managed by the Federal Ministry of Health's General Directorate of Health Information.†

We included in our analysis those IMSS hospitalizations that were registered in their information system (SUI) but not reported to SAEH, mainly pregnancy losses attended in health facilities (hospitals and health clinics) in IMSS-O. While such hospitalizations were not routinely recorded in the period analyzed here, they are now included in a separate system called SIS (Sistema de Información en Salud, or Health Information System, form SIS-SS-12-P), which was available for consultation starting in 2007.

All these sources of information, which feed into SAEH, are presently accessible to the public through an online system known as Multi-Dimensional Online Analytical Processing (MOLAP); data included in the MOLAP are statistical digests that are updated yearly,

*For more detailed information, see <http://dgis.salud.gob.mx/sidies/>.

†Information about the Health Information System is available at <http://www.sinais.salud.gob.mx/> and <http://dgis.salud.gob.mx/cubos.html>.

according to ICD codes. MOLAP does not contain raw data on the services that are provided to each individual patient but summaries of the care provided; accordingly, potential analysis of data is limited to the variables that are available in the system (e.g., diagnostic codes, health institution type, federal entity and patient age-group).

Through a separate database, MOLAP gives researchers access to data on outpatient ambulatory care provided by public-sector facilities. These data are not included in our study because they were not regularly provided for the period analyzed. Recently, we reviewed data for the most recent year available (2008) and found that outpatient care accounts for less than 0.5% of all pregnancy-loss cases attended in the SSa and for less than 5% in the IMSS, mainly among IMSS-O patients. Finally, MOLAP does not include services provided by private-sector facilities. Researchers wishing to carry out analyses using variables others than those directly available through MOLAP or who want to integrate diverse sources of information should request access to the system's primary databases.

We analyzed MOLAP data to calculate the numbers of hospitalizations for all types of pregnancy loss and the percentage of obstetric cases they represent in public-sector hospitals in Mexico during a six-year period (2000 through 2005). Data from national population surveys and corresponding population projections conducted by Consejo Nacional de Población (CONAPO 2006) on the number of women aged 15–44 were used to calculate the denominator for the rates.

Because the data in the systems refer to hospitalizations rather than women, the method does not allow us to identify repeat hospitalizations by individual women. Thus, our unit of analysis is "cases" rather than "women."

Input Data: Diagnosis Codes

We used the current version of the ICD-10, which was adopted by Mexico in 1998, to diagnose morbidity from pregnancy loss up to 20 weeks' gestation (WHO 2007b). First, we selected all cases involving women aged 15–44 who received hospital care and then identified those that were diagnosed as obstetric cases (ICD-10 codes O00 to O99). Next, we narrowed the obstetric cases to the "pregnancy with abortive outcome" categorization under the following ICD-10 codes: O00—ectopic pregnancy; O01—hydatidiform mole; O02—other abnormal products of conception; O03—spontaneous abortion; O04—medical abortion, which includes legal and therapeutic termination of pregnancy; O05—other abortion; O06—unspecified abortion; O07—failed attempted abortion; and O08—complications following abortion. As mentioned earlier, no systematic attempts were made in this analysis to separate out induced abortions from all pregnancy losses.

ICD-10 data were combined from the four major public-sector institutions in Mexico: SSa, IMSS-RO, IMSS-O and ISSSTE. MOLAP was used to generate data tables for the three variables of interest: the number of cases diagnosed with codes for "pregnancy with abortive outcome" by health care institution, what percentage of obstetric admissions in public-sector institutions they account for; and the hospitalization rate per 1,000 women aged 15–44 for the country as a whole and by state, for the six-year period, 2000–2005.

National and state-specific rates were calculated for each year by dividing the total number of cases with the relevant diagnoses in all four institutions among the total female population aged 15–44 at mid-year (June 30th), and then multiplying by 1,000. The year-specific rates for each state over the period were summed and divided by six (the number of years in the study period) to arrive at an average, state-specific rate for the period 2000–2005; the same process was used to calculate the national-level hospitalization rate for the same time period.

We emphasize that we use the term "complications" in the strict medical sense denoted by the ICD-10 system. Although the abortion literature uses the general word "complications" to mean any morbidity serious enough to warrant hospitalization, we use the term to refer only to hospitalizations for pregnancy loss *other* than fourth-character decimal subcategories of .4 "incomplete, without complication" and .9 "complete or unspecified, without complication" (WHO 2007b).

These criteria give us the following diagnoses of "complicated cases": the fourth-character decimal subcategories of .0, .1, .2, .3, .5, .6, .7 and .8 for ICD-10 codes O03–O07 and the entire O08 category (see Appendix for the detailed ICD-10 categories used for complicated cases). Whether the woman was diagnosed upon arrival at the hospital or later during her hospital stay cannot be determined from this data set. The overall level of complicated cases was calculated as the proportion of cases with the above-mentioned ICD-10 subcategories among all pregnancy-loss hospitalizations.

Projections

We projected hospitalization rates and numbers for pregnancy loss for 2006–2010 based on rates observed in 2000–2005. We decided to use three mathematical models to project future hospitalization numbers according to prior trends. Time is the only factor considered in projecting future rates in this specific instance; we assume that no significant changes occur in the legal or public health context. The three models are:

1) Exponential model:

$$Y = \beta_0 \exp(\beta_1 time)$$

2) Second-grade polynomial model:

$$Y = \beta_0 + \beta_1 time + \beta_2 time^2$$

3) Third-grade polynomial model:

$$Y = \beta_0 + \beta_1 time + \beta_2 time^2 + \beta_3 time^3$$

where Y is the hospitalization rate due to pregnancy loss and time takes the following values: 0 = 2000; 1 = 2001; 2 = 2002; 3 =2003; 4 = 2004 and 5 = 2005 (observed rates); and where β0 , β1 , β2 and β3 are the parameters (rates) to be estimated.

After running these models and obtaining the parameter estimates, we projected hospitalization rates ($\hat{Y}$), substituting time = 2006 through 2010. Finally, after obtaining the projected annual hospitalization rates, we calculated the annual number of cases using population projections for 2006 to 2010 (Partida 2006), according to the following model: $X = \hat{Y} * WRA / 1{,}000$, where X is the absolute number of cases, the hospitalization rate is estimated as described above and WRA is the total number of women of reproductive age (15–44). These are arbitrary mathematical models that are frequently used to project indicators such as rates (Canavos 1998; Devore 2005). The specific models used can be adapted to researchers' needs and should be selected according to observed trends; however, their validity should always be tested against future empirical data.

The results from the models are reasonable given the assumption of unchanging national conditions, although they may not apply to Mexico City, where progressive legislation has been in place since 2007. However, should state abortion laws change dramatically or access to medication abortion become severely restricted, alternative scenarios would need to be constructed.

Results

National-Level Hospitalization Rates, 2000–2005

A total of 13,288,396 patient records for all women aged 15–44 who were hospitalized (with any diagnosis) were obtained for 2000 through 2005 (data for total hospitalizations were not available for IMSS-O); 9,922,860 cases involved a diagnosis related to pregnancy or delivery and of these, 1,010,212 were diagnoses of "pregnancy with abortive outcome" (i.e., ectopic pregnancies, molar pregnancies, miscarriages, unspecified and induced abortions). According to MOLAP data, one out of 13 cases of reproductive-age women attended in the public health sector were diagnosed with "pregnancy with abortive outcome"; these accounted for 10.2% of all obstetric admissions (see Table 1; all tables, figures and appendices are at the end of the chapter).

The annual number of hospitalizations for "pregnancy with abortive outcome" in the four major health systems rose from 162,732 in 2000 to 178,490 in 2005. The SSa experienced the greatest increase in hospitalizations with this diagnosis, growing from 72,124 cases in 2000 to 95,704 cases in 2005. The other health institutions experienced a slight decline in the number of cases, reflecting a similar decline in total hospitalizations among the insured population over the same period of time (data not shown). Discharges from IMSS-RO for pregnancy-loss morbidity declined from 72,556 cases in 2000 to 69,423 cases in 2005; the comparable numbers in the ISSSTE went from 9,295 to 7,025; and discharges from IMSS-O went from 8,757 to 6,338 (Table 2 and Figure 1).

Mexico's annual average rate of hospitalization for "pregnancy with abortive outcome" for 2000–2005 was 6.7 hospitalizations per 1,000 women aged 15–44. This national rate remained relatively constant over time, despite the increase in the absolute numbers of cases over the six years that occurred simply because of population growth.

As mentioned above, we did not attempt to examine the data by specific type of pregnancy loss since the accuracy of coding is likely undermined by many reasons, with the stigma associated with induced abortion being first and foremost. For example, we reviewed the diagnostic subcategories used in SSa institutions for the study period (data were unavailable for the whole health sector) and found that 9% of all hospitalizations for pregnancy loss were classified as miscarriages, a little less than 5% as ectopic and molar pregnancies, and the remaining 86% as "other abnormal products of conception (O02), "other abortion" (O05) and "unspecified abortion, which includes "induced abortion not otherwise specified" (O06). The extent to which this 86% includes actual induced abortions is unknowable.

State-Level Results, 2000–2005

The hospitalization rate for all abortive outcomes varies greatly across states, with the State of Mexico having the lowest rate (4.3 hospitalizations per 1,000 women) and Aguascalientes, the highest rate (10.9, Figure 2). Some of this variation is likely caused by differences in access to hospital care and in the numbers of women traveling across state lines for care. Such travel creates high spurious rates in "receiving" states and correspondingly low spurious rates in "sending" states. This situation is clear in Mexico City's very high rate, which likely reflects the influx of women from the surrounding State of Mexico, which has the lowest rate of any state. However, there are also important empirical differences across states. For example, the four states with the next lowest rates of pregnancy-loss hospitalization, the southern states of Guerrero, Puebla, Veracruz and Oaxaca, have especially big marginalized, rural and indigenous populations (Figure 3). Unsurprisingly, the large preferred family size in these states is likely associated with limited contraceptive use

and when unplanned pregnancies do occur, relatively few women are likely to resort to induced abortion. Moreover, in the event that women in these states attempt to interrupt a pregnancy and develop complications, lack of access to medical care means that the rates of hospitalization will be low.

Prevalence of Complicated Cases

Most women hospitalized for morbidity from all abortive outcomes of pregnancy were registered as "without complications" (i.e., as designated by use of .4 and .9 subcategories), which indicated that the symptoms, while requiring hospitalization, were not severe. However, approximately 9% of all cases were classified as "complicated" according to ICD-10 codes (see Appendix). Some differences by type of institution emerged in the prevalence of complicated cases, which ranged from 1% of pregnancy-loss hospitalizations in IMSS-O hospitals to almost 20% in ISSSTE facilities (Table 3).

Overall, the absolute numbers and percentages of complicated cases according to ICD-10 diagnosis subcategories are relatively low. In particular, when we analyze complicated cases in the entire subcategory of O08 (O08.0 through O08.9) for the whole health sector in the last two years of the study period, complicated cases involving trauma (coded as O08.6, which specifies damage to pelvic organs and tissues) accounted for less than 0.02% of all hospitalizations for pregnancy loss in 2004 and 2005. Further, three other specific types of complications—shock (O08.3), renal failure (O08.4) and metabolic disorders (O08.5)—together accounted for an additional 0.05% (data not shown). The extremely limited prevalence of trauma to the uterus and pelvic organs in 2004 and 2005 could be explained by current use of relatively safe and noninvasive methods to induce abortion, especially medication abortion. It is also possible that use of specific ICD codes is not entirely standardized and may vary across areas of the country and within health care systems. Unfortunately, we were unable to draw any conclusions about trends in complicated cases over time since we lack similar data for earlier years when reliance on misoprostol and manual vacuum aspiration were not widespread in the country. To our knowledge, similar data are also unavailable in other countries.

Projections for Future Years

As previously described, three mathematical models were used to generate projections of the number of pregnancy-loss cases that can be expected in the four major public-sector health institutions, given the trend in rates observed from 2000 to 2005 and the expected growth in the number of women of reproductive age. In all three models, projections resulted in increasing demand for services. The total expected number of cases in 2010 for the four public health systems ranges from 184,133 based on the exponential model to 333,400 based on the third-grade polynomial model.

Demand will likely vary by institution, as it has in the past. For example, for the SSa only, which had the highest number of pregnancy-loss cases in 2005, the projection based on the exponential model (which results in the most conservative scenario) yields an increase from 95,704 in 2005 to 98,729 in 2010. The projection based on the second-grade polynomial model shows an intermediate increase to 113,473 pregnancy-loss cases in SSa hospitals by 2010, and the projection based on the third-grade polynomial model yields the highest estimate of 178,764 cases for 2010 (data not shown). Increases would likely be less pronounced in the other three health institutions, which started out in 2005 with far fewer cases than the SSa.

When tested against an updated analysis of all hospitalized pregnancy losses in 2006–2008, these projections show that the actual case load lies very close to model 2, which would yield 211,629 cases for the whole health sector by year 2010 (Figure 4).

Discussion

Like any health system database, the Mexican database used in this analysis suffers from the limitations of incorrect diagnosis classification and underregistration of cases. As mentioned earlier, our data slightly underestimate the national total because they exclude hospitalizations in small public institutions (i.e., PEMEX, SEDENA and SEMAR) whose data were unavailable for the first three years of our study period (i.e., they started routine reporting only in 2004 and their records are still inconsistent). Our data also omit outpatient cases since such data are not reported under SAEH in the MOLAP system (they started being included in 2007); private-sector services are also excluded.

Nonetheless, Mexico's MOLAP system has become progressively more accurate and complete over time and provides researchers with access to a single national database without needing to go to each individual health system. This allows for relatively easy analysis that can be done repeatedly and has no need for fieldwork. The method thus saves time and money in research efforts.

The six-year data show interesting trends over time and important differences by state and health institution. The data obtained through this methodology clearly show no change in the absolute numbers or rates of hospitalizations for all pregnancy losses in Mexico over

a recent six-year period, with a mean annual rate of 6.7 hospitalizations per 1,000 women aged 15–44. Even though our data include *all* pregnancy losses, and are not solid enough to differentiate among the various types of losses, they do suggest that much, perhaps most, of the morbidity stems from unsafely induced abortion. As such, the data reflect the extent to which Mexican women resort to induced abortion to resolve unwanted/unplanned pregnancies.

The results of our study cannot be directly compared with those from other studies that have estimated numbers and rates of hospitalizations for induced abortion for the following reasons: a) we do not attempt to separate out induced abortions and include *all* hospitalizations with ICD-10 diagnoses of "pregnancy with abortive outcome," including miscarriages and pathological events, such as ectopic and molar pregnancies, which are most likely to require hospitalization; and b) our data exclude women who receive care in an outpatient setting. These reasons likely explain the difference between our data and those from a study that used the indirect Abortion Incidence Complications Method (AICM) and MOLAP data to estimate a rate of 5.7 hospitalizations for induced abortion per 1,000 women aged 15–44 in 2006 (Juarez et al. 2008).

Our projections of the expected demand for services in the five years following the analysis period show an upward trend, indicating that the Mexican health systems need to continue to invest in quality postabortion care. Investment includes training personnel and using cost-effective technologies and best practices that have been recommended by international health agencies. Of particular importance are the steps that need to be taken by the SSa, which provides health care for the largest and poorest sector of the population and will be responsible for the bulk of postabortion care in the future. In addition, national health programs must place continuous and strong emphasis on strategies to prevent the root cause of induced abortion—unplanned pregnancy—by continuing to invest in solid, accessible, user-friendly and high quality family planning programs.

Methodological Considerations

Data Needs

Obtaining the data

To apply this method in a given country, researchers need access to reliable information about services provided in hospital settings that are disaggregated by detailed ICD-10 codes and age-group. Depending on the country and the system, the data may be accessed as public information (i.e., available through printed reports or electronic files) or the data may need to be requested from the relevant health authorities. No representative sample needs to be selected, nor are time-consuming and costly data collection efforts required.

In addition to calculating absolute numbers of hospitalizations, rates should be calculated if population denominators are available. For comparisons with rates estimated by international organizations such as the WHO, reproductive age should be defined as ages 15–44; however, many countries consider women aged 15–49 to be of reproductive age.

Ethical issues

The MOLAP system data used in this methodology represent aggregated statistical information. Since their use does not require access to patients' clinical histories, the system contains no confidential information that could present ethical problems for women or researchers. Special care is taken by the MoH to ensure that this publicly available system lacks confidential information that could link the data to an individual patient. Institutional Review Board or other types of ethical review are not needed, since direct contact is never made with women and the data that are used do not contain any identifying information.

Data coverage considerations

This method uses data on all women who are hospitalized in public health facilities with diagnoses of "pregnancy with abortive outcome" (up to 20 weeks' gestation) according to the current ICD-10 definition. As mentioned above, since Mexico is a country where induced abortion is both highly restricted by law and highly stigmatized, women and health professionals are understandably reluctant to label a pregnancy loss as an induced abortion. Therefore, we decided to not differentiate between specific diagnostic categories and included all abortive outcomes, which encompass miscarriages, obstetric pathologies and incomplete or unspecified abortions. Having accurate and reliable data on specific diagnoses would permit analyses that differentiate among subcategories and that focus on specific patients (for example, those hospitalized after induced abortions or unspecified or incomplete abortions).

As mentioned earlier, the MOLAP data available through SAEH do not include outpatients (that is, women who are not hospitalized) nor do they include women who obtain treatment from private-sector providers. Clearly, for a full national total of all morbidity from pregnancy loss, the data need to include inpatients and outpatients in facilities in both the public and private sectors.

Considering these limitations and the explicit shortcoming of the methodology in including all abortive

outcomes (miscarriages and obstetric pathologies), we assume that any existing bias should be uniform across years, states and health institutions. Researchers who wish to apply the method to their specific context should be aware of the data specifics they are using and ensure that sources of data and diagnostic criteria are consistent and uniform across areas and over time, or know how to adjust for differences.

Subjects/study population

The population included in our analysis is women of reproductive age. As mentioned before, many countries define this age-range as 15–49 years; however, international organizations generally use the 15–44 age-range. Researchers could choose to use both ranges to optimize comparability with other studies. When calculating rates, care must be taken to use the same age criteria for both the women experiencing the event analyzed (hospitalization for pregnancy loss) and the population of women in the denominator.

Data quality considerations

Data quality depends on several conditions:

- Providers' accurate knowledge and use of the ICD-10 codes to classify diseases or conditions presented by patients.
- Health facilities' capacity to register and enter the data without bias or error and in a timely manner. Where stigma against induced abortion is great, it may influence which diagnostic code is used—that is, personnel may be more likely to diagnose a pregnancy loss as a spontaneous, incomplete or unclassified abortion, rather than as an induced abortion. In low-resource contexts, where researchers may lack access to computers and the Internet, the data may have to be extracted manually at first and then keyed into electronic files for analysis.
- The ability of the health system itself to detect possible errors and inconsistencies and to correct them.
- The ongoing assessment of data quality, with feedback to those who are responsible for data compilation and processing.

Past applications of similar methods

Analysis of data on hospitalizations for postabortion care is needed to estimate the overall incidence of induced abortion, as is done in the AICM developed by the Guttmacher Institute. Studies from 1990 through 2005 that measured abortion-related hospitalization rates for 13 countries have been recently synthesized (Singh 2006). Some of these studies used data from official data systems similar to Mexico's and others relied on aggregate data from nationally representative sample surveys of health facilities that provide postabortion care. However, these efforts differ fundamentally from our approach in their removal of hospitalized miscarriages and obstetric pathologies to yield a hospitalization rate for induced abortions only.

A similar national-level analysis was carried out using data from Brazil's information system (DataSUS) on postabortion care provided in public hospitals (Adesse and Montero 2008).

Strengths and Limitations

Robustness of results

The robustness of the resulting indicators and estimates depends directly on the quality of the data used. In the case of Mexico, health information systems in general and the MOLAP system in particular have evolved and been strengthened over the years. The information they contain has been increasingly used by researchers and is considered a valuable tool for decision making.

The overall data may be useful for the type of general analysis we describe but may become less robust for more detailed analyses, i.e., when specific diagnostic categories and types of morbidity are needed.

Application of the method in Mexico resulted in differences across states, pointing to possible data registration problems (such as those caused by movement across states for hospital care) or to real state differences in women's need for such care and their access to it, or a combination of both. To determine what really is happening at the state level, a specific in-depth study is required, such as an analysis using a subsample of hospitals to analyze the state of residence of women who seek care and/or to detect inconsistencies in documentation and data entry.

Most developing countries are increasingly improving and strengthening their official health system databases to improve evidence-based decision making and policy making. The approach described here takes advantage of that effort and provides a valuable resource for understanding patterns and trends over time in hospital-based care of pregnancy loss. Greater efforts are needed to improve the data quality, including ensuring that registration of the reason for admission is complete and that reporting is done accurately.

Extent of underestimation and other limitations

The stigma against induced abortion is so strong that even the estimates of pregnancy losses generated by this official database are likely underestimates since, for example, losses may not be registered as such but as

dysfunctional uterine bleeding. In general, patients can be misdiagnosed, resulting in an underestimation of the need for care. They can also be misclassified by receiving diagnoses that do not fall within the ICD-10 categories included here and that omit essential information about the final status of the fetus—i.e., with ICD-10 codes denoting hemorrhage in early pregnancy (code O20), threatened abortion (O20.0) and unspecified hemorrhage in early pregnancy (ICD O20.9).

It is also essential to make clear that ICD-10 classification defines "pregnancies with abortive outcome" as those that end before 20 weeks of gestation; thus, terminations of pregnancies after 20 weeks and late miscarriages are classified as fetal deaths (ICD-10 P95 and P96.4) or late hemorrhage, and would not be captured in the total counts presented here.

On the other hand, our inclusion of *all* ICD-10 categories for "pregnancy with abortive outcome" results in a certain degree of overestimation, since miscarriages and specific obstetric pathologies (molar and ectopic) are also counted. According to our analysis of SSa data only, these may account for approximately 14% of all pregnancy losses in our information system.

Again, the main weakness stems from our inability to distinguish between different types of pregnancy loss. The method does not separate out miscarriages from abortions, or even among induced abortion, it cannot distinguish those that were unsafely induced from those that were "safely" induced but led to more bleeding than the woman expected, as is often the case with misoprostol. Thus, specific analyses and comparisons between different types of pregnancy loss, which are grounded in complex social, clinical and biological experiences, cannot be made. The characteristics of the states' legal frameworks, their populations and the people using services at different health institutions could vary in ways that would benefit from a breakdown of the different types. Unfortunately, this is not possible with current data.

Feasibility and ease of use

One of the important characteristics of this method is that it uses health system data that are publicly available, free of charge and posted online, at least in the case of Mexico. Since no original data collection is needed, the method is highly cost-effective and can be extremely fast to implement. The technical skills needed to use the methodology include knowledge of the ICD-10 classification system and the country's official health information system, and the ability to navigate online and to generate tables and create crosstabs through MOLAP. No fieldwork is required, nor are surveys or interviews with providers, key informants or health authorities. In specific cases, the researcher may need access to primary sources of data that feed into the MOLAP.

The method is feasible as long as it is clearly understood that interpretation of the results, such as explaining why rates differ by states and by health institution, requires additional quantitative and qualitative research. Several hypotheses for the variation in rates across states and health institutions are possible and need to be empirically verified, such as differences in access to care according to women's socioeconomic status and place of residence and differences in the quality of data (classification and registration) according to institution.

Since no fieldwork is required and the staff involved is limited to professionals with public health, epidemiological and computer expertise, no training is needed. Analysis and interpretation of the data require a person familiar with the complex human event under study—abortion.

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TABLE 1. Among women aged 15–44, all hospital admissions, all obstetric admissions and admissions for "pregnancy with abortive outcome," public-sector institutions, Mexico, 2000–2005

Public health institution	*All admissions among women of reproductive age*	*Obstetric admissions (and % distribution by institution)*	*Obstetric admissions as % of all admissions among women of reproductive age*	*Diagnoses of "pregnancy with abortive outcome" (and % distribution by institution)*	*Diagnoses of "pregnancy with abortive outcome" as % of all admissions among women of reproductive age*	*Diagnoses of "pregnancy with abortive outcome" as % of obstetric admissions*
SSa	5,632,439	4,005,972 (40.4%)	71.1%	492,022 (48.7%)	8.7%	12.3%
IMSS-RO	6,982,395	4,820,578 (48.6%)	69.0%	424,611 (42%)	6.0%	8.8%
IMSS-O	u	680,579 (6.9%)	u	45,161 (4.5%)	u	6.6%
ISSSTE	673,562	415,731 (4.2%)	61.7%	48,418 (4.8%)	7.2%	11.6%
Total	13,288,396	9,922,860 (100%)	74.6%	1,010,212 (100%)	7.6%	10.2%

Sources: **for SSa**—Dirección General de Información en Salud (DGIS), Sistema Automatizado de Egresos Hospitalarios; **for IMSS**—Sistema Único de Información, Subsistema 13; **for ISSSTE**—Anuarios Estadísticos. *Note:* u = unavailable.

TABLE 2. Numbers and rates of hospitalizations for "pregnancy with abortive outcome" by year and public health institution, Mexico, 2000–2005

Year	*Public health institution*					*Mean no. of women aged 15–44**	*Hospitalization rate for "pregnancy with abortive outcome" (per 1,000 women)*
	SSa	*IMSS-RO*	*IMSS-O*	*ISSSTE*	*All*		
2000	72,124	72,556	8,757	9,295	162,732	24,290,547	6.70
2001	75,236	73,214	8,743	8,411	165,604	24,660,557	6.72
2002	79,331	71,046	7,841	8,426	166,644	25,012,935	6.66
2003	83,409	69,459	7,126	7,980	167,974	25,346,509	6.63
2004	86,218	68,913	6,356	7,282	168,769	25,660,064	6.58
2005	95,704	69,423	6,338	7,025	178,490	25,953,480	6.88
2000—2005	492,022	424,611	45,161	48,418	1.010,212	150,924,092	6.69

*Number of women at mid-year (June 30th).

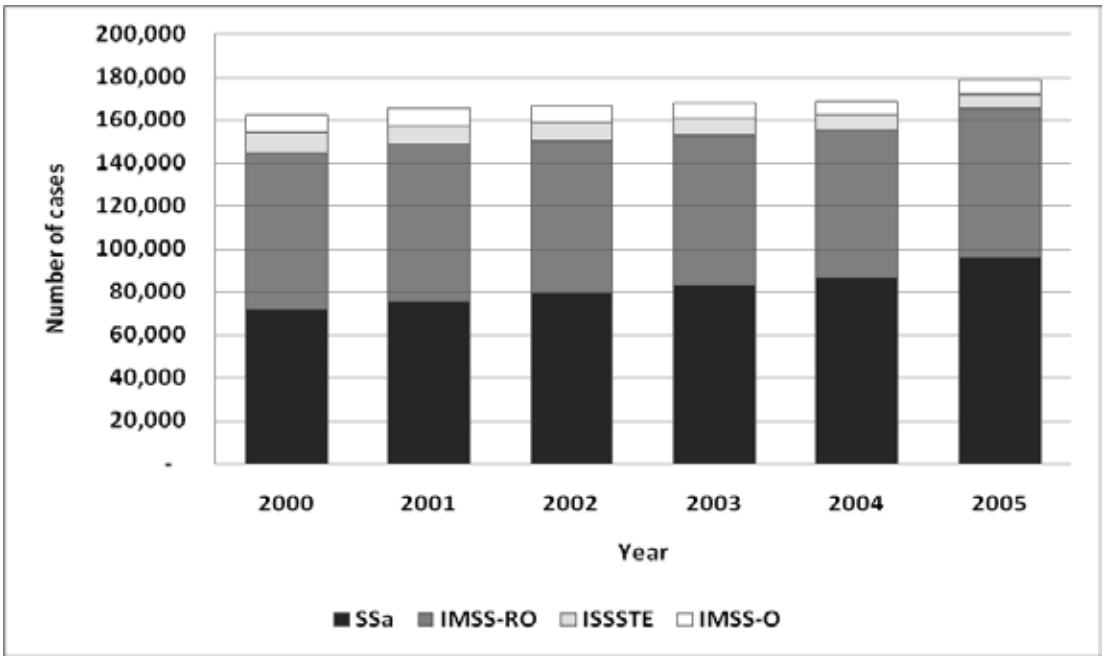
Sources: **For numbers of hospitalizations**—see Table 1. **For numbers of women**—http://www.conapo.gob.mx/index.php?option=com_content&view=article&id=36&Itemid=234.

TABLE 3. Among all hospitalizations for "pregnancy with abortive outcome," percentage diagnosed as complicated cases per ICD-10 codes,* Mexico, 2000–2005

Health institution	%
IMSS-O	1.4
IMSS-RO	4.8
SSa	9.9
ISSSTE	18.7
Total	8.9

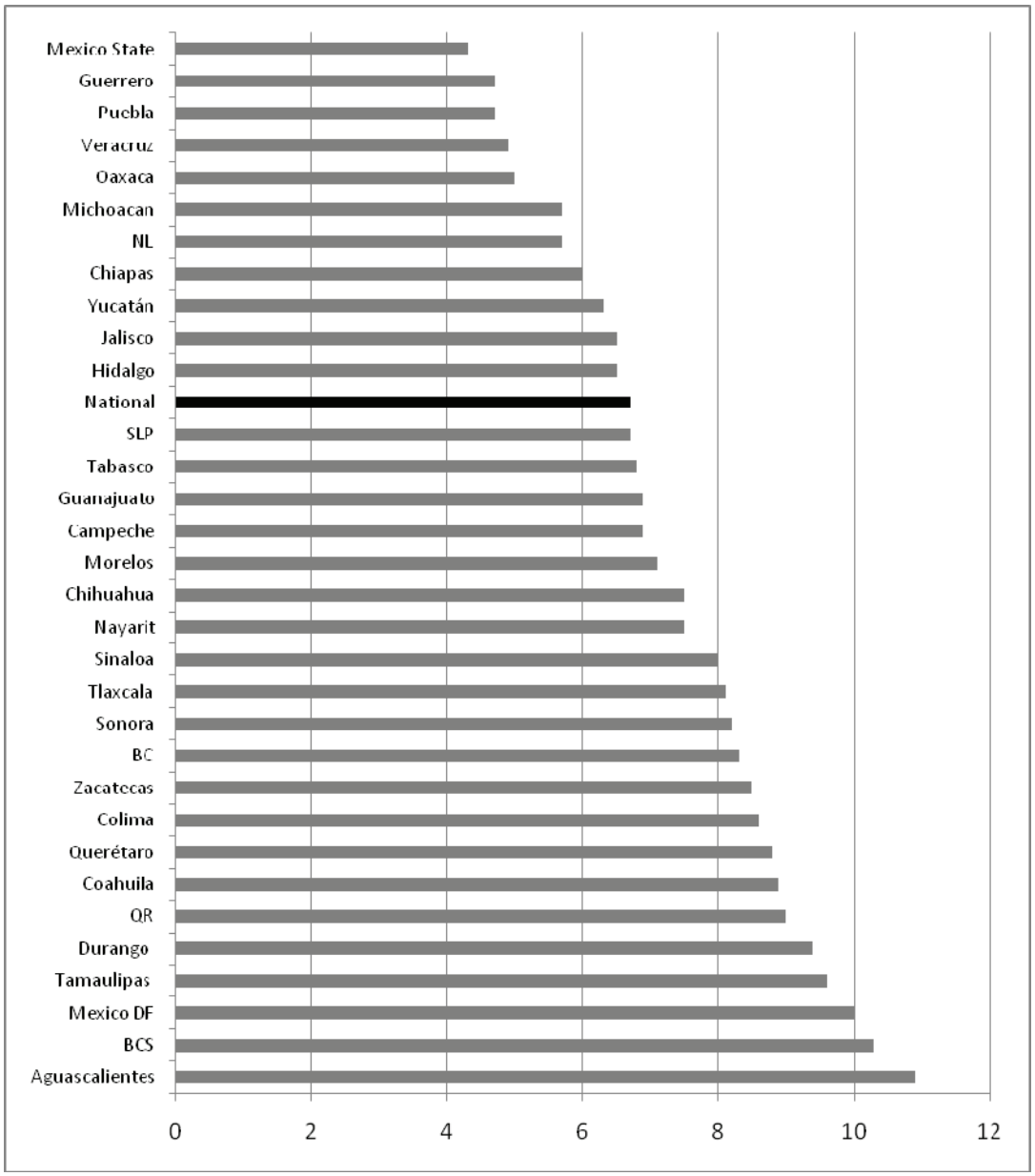
*See Appendix for diagnostic codes denoting complicated cases. *Sources:* see Table 1.

FIGURE 1. Number of admissions for diagnosis of pregnancy loss, by public health institution, Mexico, 2000–2005



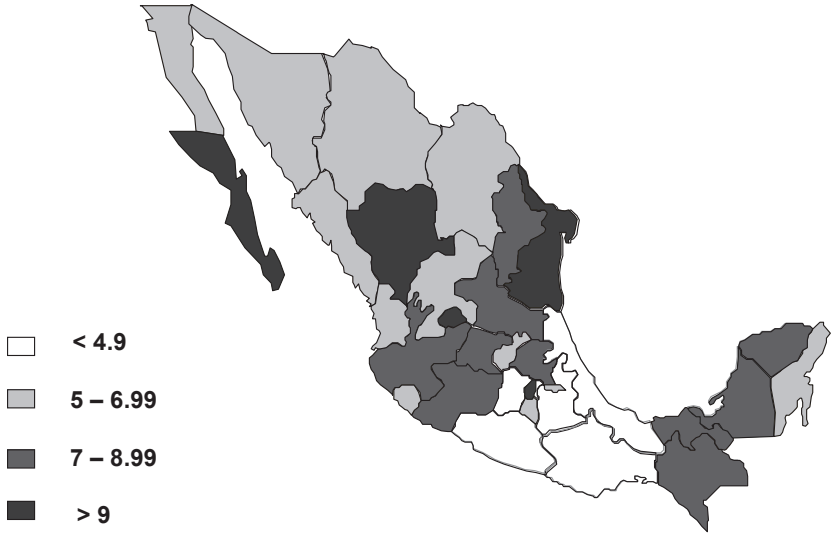
Sources: **for SSa**—DGIS, Sistema Automatizado de Egresos Hospitalarios; **for IMSS**—Sistema Único de Información, Subsistema 13; **for ISSSTE**—Anuarios Estadísticos.

FIGURE 2. State- and national-level hospitalization rates per 1,000 women aged 15–44 for "pregnancy with abortive outcome," Mexico, 2000–2005



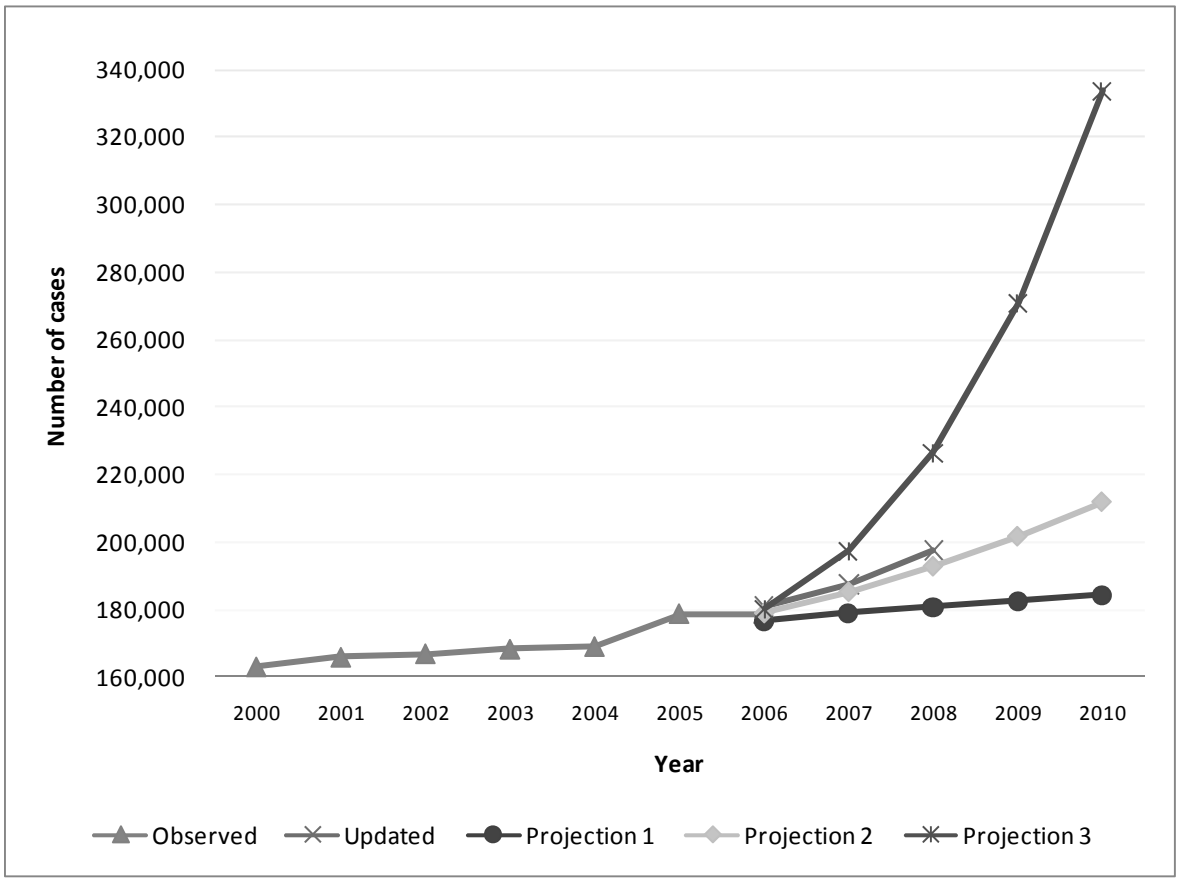
Sources: See Table 1.

FIGURE 3. Map of Mexico showing state-level hospitalization rates per 1,000 women aged 15–44 for "pregnancy with abortive outcome," 2000–2005



Sources: See Table 1.

FIGURE 4. Health system data on admissions for pregnancy loss for 2000–2005 and projected admissions for the period 2006–2010, public health institutions, Mexico



Notes: Observed cases refer to health system data for 2000–23005; data were updated using 2006–2008 health system data. Projected cases were calculated using the following models: 1: Exponential model: $Y=\beta_0 \exp(\beta_1 \text{time})$. 2: Second -grade polynomial model: $Y=\beta_0 + \beta_1 \text{time} + \beta_2 \text{time}^2$. 3: Third-grade polynomial model: $Y=\beta_0 + \beta_1 \text{time} + \beta_2 \text{time}^2 + \beta_3 \text{time}^3$.

APPENDIX. ICD-10 diagnostic codes used to classify hospital admissions for complicated cases of "pregnancy with abortive outcome"

O03	**Spontaneous abortion**
O03.0	Incomplete, complicated by genital tract and pelvic infection
O03.1	Incomplete, complicated by delayed or excessive hemorrhage
O03.2	Incomplete, complicated by embolism
O03.3	Incomplete, with other and unspecified complications
O03.5	Complete or unspecified, complicated by genital tract and pelvic infection
O03.6	Complete or unspecified, complicated by delayed or excessive hemorrhage
O03.7	Complete or unspecified, complicated by embolism
O03.8	Complete or unspecified, with other and unspecified complications
O04	**Medical abortion**
O04.0	Incomplete, complicated by genital tract and pelvic infection
O04.1	Incomplete, complicated by delayed or excessive hemorrhage
O04.2	Incomplete, complicated by embolism
O04.3	Incomplete, with other and unspecified complications
O04.5	Complete or unspecified, complicated by genital tract and pelvic infection
O04.6	Complete or unspecified, complicated by delayed or excessive haemorrhage
O04.7	Complete or unspecified, complicated by embolism
O04.8	Complete or unspecified, with other and unspecified complications
O05	**Other abortion**
O05.0	Incomplete, complicated by genital tract and pelvic infection
O05.1	Incomplete, complicated by delayed or excessive hemorrhage
O05.2	Incomplete, complicated by embolism
O05.3	Incomplete, with other and unspecified complications
O05.5	Complete or unspecified, complicated by genital tract and pelvic infection
O05.6	Complete or unspecified, complicated by delayed or excessive haemorrhage
O05.7	Complete or unspecified, complicated by embolism
O05.8	Complete or unspecified, with other and unspecified complications
O06	**Unspecified abortion**
O06.0	Incomplete, complicated by genital tract and pelvic infection
O06.1	Incomplete, complicated by genital tract and pelvic infection
O06.2	Incomplete, complicated by embolism
O06.3	Incomplete, with other and unspecified complications
O06.5	Complete or unspecified, complicated by genital tract and pelvic infection
O06.6	Complete or unspecified, complicated by delayed or excessive haemorrhage
O06.7	Complete or unspecified, complicated by embolism
O06.8	Complete or unspecified, with other and unspecified complications
O07	**Failed attempted abortion**
O07.0	Failed medical abortion, complicated by genital tract and pelvic infection
O07.1	Failed medical abortion, complicated by delayed or excessive haemorrhage
O07.2	Failed medical abortion, complicated by embolism
O07.3	Failed medical abortion, with other and unspecified complications
O07.5	Other and unspecified failed attempted abortion, complicated by genital tract and pelvic infection
O07.6	Other and unspecified failed attempted abortion, complicated by delayed or excessive haemorrhage

APPENDIX. ICD-10 diagnostic codes used to classify hospital admissions for complicated cases of "pregnancy with abortive outcome" (continued)

O07.7	Other and unspecified failed attempted abortion, complicated by embolism
O07.8	Other and unspecified failed attempted abortion, with other and unspecified complications
O08	**Complications following abortion and ectopic and molar pregnancy**
O08.0	Genital tract and pelvic infection following abortion and ectopic and molar pregnancy
O08.1	Delayed or excessive haemorrhage following abortion and ectopic and molar pregnancy
O08.2	Embolism following abortion and ectopic and molar pregnancy
O08.3	Shock following abortion and ectopic and molar pregnancy
O08.5	Metabolic disorders following abortion and ectopic and molar pregnancy
O08.6	Damage to pelvic organs and tissues following abortion and ectopic and molar pregnancy
O08.7	Other venous complications following abortion and ectopic and molar pregnancy
O08.8	Other complications following abortion and ectopic and molar pregnancy
Source: http://www.who.int/classifications/apps/icd/icd10online/.	