Effects of abortion legalization: Complications treated at a tertiary care center in Kathmandu, Nepal 2000-2007

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Introduction

Abortion was legalized in 2002 in Nepal and comprehensive abortion services were made available to women in 2004. The country legal code that once treated abortion as a criminal offence punishable by imprisonment, was changed to permit women to choose abortion for any reason up to 12 weeks of gestation; in the case of rape up to 18 weeks gestation; and with a physician's approval at any stage of pregnancy if the woman's health is threatened or a fetal anomaly is present (Ministry of Law 2002).

As a result of the illegal and criminal status of abortion in Nepal prior to 2002, the conditions under which poor women obtained abortion were often extremely unsafe. Maternal mortality in Nepal was among the highest in South Asia, and in the year 2000 the maternal mortality ratio was estimated at 740 deaths per 100,000 live births (World Health Organization 2004). Research showed that a large proportion of hospital admissions were for abortion complications (Ministry of Health 1998; Tamang and Puri 1999). In a hospital-based study of abortion in Nepal pre-legalization, deaths from abortion-related complications accounted for over half of all maternal deaths (Thapa, Thapa et al. 1992). Hospital-based data from the 1990s also showed that complications from septic abortion caused many deaths, and morbidity from abortion-related complications was four times higher than mortality (Rana, Pradhan et al. 2004). The recognition that illegal abortion was unsafe and contributed to Nepal's high maternal mortality was instrumental in the advocacy efforts to legalize abortion (Shakya, Kishore et al. 2004).

The government of Nepal set a goal of reducing maternal mortality by 66% from 1990 to 2015 (Central Bureau of Statistics 2006). Indeed, the maternal mortality ratio has improved measurably post-legalization, and was estimated in 2005 at a ratio of 540 deaths per 100,000

births (United Nations Development Programme 2005). The most recent estimates from the 2006 Nepal Demographic and Health Survey was 281 deaths per 100,000 births (with an estimated range of 178 to 384) (Ministry of Health and Population Nepal 2007). However, maternal mortality still remains among the highest worldwide and unintended pregnancy common. While contraceptive prevalence has increased markedly during the decade from 1996 to 2006 (26% to 44% with modern methods), prevalence would be as high as 73% if contraceptive needs of married women were met (Ministry of Health and Population Nepal 2007). Other factors underlying the high maternal mortality are poor access to care and quality of services. A community-based intervention for married women to increase health service usage (n=28,931) showed a large difference in use of health care in pregnancy and a concomitant improvement in a maternal mortality ratio of 69 in the intervention clusters compared to 341 in the control clusters (Manandhar, Osrin et al. 2004). Improvements in mortality were also measured from 2000 to 2004, from an initiative to upgrade care and increase the likelihood that women with pregnancy-related complications would seek care, The Women's Right to Life and Health Project (Rana, Chatuat et al. 2007). Efforts to increase access to care are still needed; the 2006 Demographic and Health Survey showed 81% of births were delivered at home, and while care for pregnant women from trained health workers has increased notably over the past ten years, one in four births still received no antenatal care (Ministry of Health and Population Nepal 2007).

The Nepali government, in partnership with non-governmental organizations, has launched a major effort to train abortion providers and regulate the safety and availability of services (Ministry of Health 2003; Family Health Division 2005). Trained and certified health care providers are the only providers allowed to offer abortion services, and manual vacuum aspiration, a safe technique, is promoted. However, the changes will only be notable after

implementation: a hospital abortion study conducted during the implementation phase of the new law, 2003-2004, showed that untrained providers were responsible for more than a third of the cases of abortion seen at over 12 weeks gestation. While the study does not show data over time, it does show that abortion complications accounted for 40% of gynaecological admissions (Ojha, Sharma et al. 2004). Research from South Africa has also showed that the process of establishing comprehensive, safe services can take a number of years: only 32% of the nationally designated facilities were functioning three years after legalization (Dickson, Jewkes et al. 2003). Additionally, women continued to visit traditional healers even when legal services were available, due to lack of knowledge of services or greater familiarity with the local provider (Jewkes, Gumede et al. 2005). As the law remains in place over time, health care providers in Nepal are likely to gain greater abortion skills and appropriate equipment. Expertise for medication abortion, a safe procedure, is also likely to increase among providers, who have shown acceptability in initial research in Nepal (Tamang and Tamang 2005).

Historically, when the legal status of abortion has changed, the consequences of the shift have been dramatic, particularly in settings with well-developed health care services. For example, in the United States, the legalization of abortion was associated with a dramatic decrease in abortion mortality and morbidity among women of reproductive age (Seward, Ballard et al. 1973; Bracken, Freeman Jr. et al. 1982; Lawson, Frye et al. 1994; Cates, Grimes et al. 2000). Likewise, hospital-based data from South Africa showed that the legalization of abortion in the 1990s resulted in significant improvements in abortion morbidity within 5 years, especially among young women and teenagers who had the highest morbidity pre-legalization, and maternal mortality due to abortion also decreased by more than 90% (Jewkes, Rees et al. 2005). Conversely, when abortion was made illegal in Romania, after having been a legal

procedure for many years, negative health consequences were observed (Stephenson, Wagner et al. 1992).

Documenting changes from legalization presents myriad challenges, particularly obtaining reliable data of abortions and abortion complications during the time when it was still illegal. Estimates must be used, since available data only reveal part of the story (Barreto, Campbell et al. 1992). Many different methodologies can be employed to estimate abortion in illegal contexts (Rossier 2003). Modeling can help to reveal the impact of certain interventions to improve abortion-related mortality or morbidity (Harper, Blanchard et al. 2007).

Studies that rely on hospital-based methodologies in gynecology/obstetrics wards, particularly in hospitals with large catchment populations, can yield valuable information on unsafe abortions practices; these studies are likely to capture the cases with more severe complications (Figa-Talamanca, Sinnathuray et al. 1986; Huntington, Nawar et al. 1998). It is difficult to identify cases of induced abortion (WHO Task Force on Safety and Efficacy of Fertility Regulating Methods 1987; Barreto, Campbell et al. 1992), but researchers have made strides to improve methods and to piece together evidence in developing countries (Council 1989; Juarez, Cabigon et al. 2005). Singh (2006) estimated that 5 million women are hospitalized for abortion-related complications per year in the developing world (Singh 2006). While hospitalization rates reflect many of the costs of unsafe abortion, they are also affected by distance to a hospital, transportation, and the services offered at the hospital. Hospitalization data miss cases of women who do not make it to the hospital, and improvements in access to hospital care can result in increases in observed cases at hospitals in the absence of any real change in risks of complications from abortion (Singh 2006). Therefore, while evaluating abortion-related complications, it is also important to document improvements in access,

particularly since a similar effect of increased numbers of complications may be seen because more women are having abortions. Safer abortion methods should decrease the number of hospitalization for complications, unless of course accompanied by increased access to and use of care for complications. Research in Nepal has shown that in the Kathmandu area, living over an hour away from Maternity Hospital, as well as poverty, restrict access to hospital care for pregnant women for delivery (Wagle, Sabroe et al. 2004).

A national hospital-based study of incomplete abortion in South Africa before legalization found that few women admitted to having an abortion, and that using overlapping descriptive categories, such as unsafe and certainly induced, is a preferred approach to a more precise, but restrictive World Health Organization (WHO) protocol (Figa-Talamanca, Sinnathuray et al. 1986; WHO Task Force on Safety and Efficacy of Fertility Regulating Methods 1987) in identifying abortion cases. Furthermore, examining unsafe cases, rather than attempting to distinguish spontaneous from induced can help to capture the burden of disease more accurately (Jewkes, Fawcus et al. 1997). The categorization scheme proposed by Jewkes *et al*. (2005) in their study of hospital admissions for abortion complications in South Africa attempts to classify the degree of severity of complications using clinical signs of infection (Jewkes, Rees et al. 2005). The severity of the abortion complication is considered low if there is no sign of infection, medium if there are signs of mild infection, and high if there are signs of severe infection or any signs of injury from the abortion. These severity categories were applied to data that excluded all women reporting legal abortions.

Advantages of the approach include its reliance on objective data that is generally collected consistently in hospitals, such as body temperature, pulse, and clinical observations of infection, and the morbidity and mortality likely to result when a woman arrives at the hospital in

each level of complication severity. Women in the medium severity category can be treated with antibiotics and will often recover fully. High severity patients are more likely to experience lasting effects of the complication, including possible loss of fertility or death. Distinguishing between low and medium severity of abortion complications based on the Jewkes criteria requires accurate temperature readings and records, and consistent recording of specific signs of mild infection (tender uterus, offensive discharge, or localized peritonitis). The Jewkes study used data capture sheets completed by clinicians prospectively to collect this data. A hospital-based study in Kenya also relied on the Jewkes classification, and used a methodology combining prospective data collection and chart review (Gebreselassie, Gallo et al. 2005). The performance of the measure using other methodologies has not been examined.

The objective of our study is to document the change over time in the volume and characteristics of abortion complications treated at a sentinel hospital in Nepal, similar to studies undertaken in the United States following legalization (Cates et al. 1978). We will document the number and severity of abortion complications over a seven year span covering a period before and after safe, legal services became available in 2004. We hypothesize that there will be a decline over time in the most severe complications that are commonly associated with unsafe abortion practices common in illegal settings.

Methodology

Medical chart review

The study is a retrospective medical chart review of women admitted to a large maternity hospital for abortion or complications from abortion from April 2000 through December 2007 (charts are organized by the Nepali calendar and are destroyed after 5 years). Data were collected at Paropakar Maternity Hospital in Kathmandu, the largest obstetric care center in the country.

The 350-bed public tertiary care center provides comprehensive reproductive health services to a low-income population, including in-patient services for obstetrics, gynecology, neonatal care, postabortion care (PAC), gynecological and post-partum sterilization surgery, and maternal and neonatal intensive care. Nearly 20,000 obstetric and 3,600 gynecological cases are admitted annually, with more than 40 deliveries each day on average. In March 2004, hospital services expanded to include a comprehensive abortion care (CAC) facility as a separate out-patient unit, which also serves as the country's primary abortion training facility. Review and abstraction of charts was initiated in March 2007 and is ongoing.

All medical chart review and abstraction for the study was performed by three research assistants. Research assistants were either nurses or medical assistants and participated in an intensive 3-day training on the study objectives, protocol, research ethics, and data quality assurance. The research coordinator and senior research advisor provided close supervision and monitoring, including manual checks of all chart registries and abstracted forms. Throughout data collection, a random sample of registry entries and abstracted forms were compared to the original medical charts to ensure all eligible cases were identified and abstracted correctly.

All patient charts for women treated for gynecological problems and mortality cases were screened for eligibility. This included women presenting to all parts of the hospital, including the emergency department, post-abortion care unit, gynecology and obstetric departments, if the admission was classified as a gynecological admission or maternal or neonatal death. Patient charts were obtained from the hospital statistics department, which stores charts organized by discharge date and the type of admission. Cases were sorted and identified manually since no computerized system exists. All charts filed under the following admission types were reviewed for eligibility: gynecology (general), H-mole, ectopic pregnancy, cancer, choriocarcinoma, HIV

positive, blind vagina, endoscopy, admission to Maternal Intensive Care Unit, septic induced abortion, maternal death, neonatal death, and stillbirth. Obstetrics admissions were not screened (except during the pilot study); charts for patients receiving CAC services were not screened (since CAC is provided on an outpatient basis only) unless the patient was later hospitalized.

When reviewing each chart, a detailed flow chart was used to identify cases of abortion or complications or treatment related to abortion (see Appendix). To determine eligibility, first the diagnostic fields were reviewed and all abortion cases (threatened, inevitable, incomplete, complete, and septic; spontaneous and induced) were abstracted. When the diagnostic field did not specify abortion, but included a diagnosis or treatment suggestive of abortion, other fields such as *history* and *operation record* were also reviewed for documentation of abortion. In addition, cases with surgical treatments highly suggestive of abortion, such as repair of uterine perforation, were abstracted even when abortion was not written. Finally, in cases of questionable eligibility, a senior Obstetrician/Gynecologist or senior nurse involved in post-abortion care at the hospital reviewed the chart to make a final determination.

All charts screened for eligibility were entered into a study registry, and all eligible cases were abstracted using a standardized form. The abstraction form included information on demographic characteristics, reproductive history, contraceptive use, clinical assessment on admission and during hospitalization, treatments received, and outcome. Charts were reviewed and abstracted in a designated room at the hospital, after which they were returned to the statistics department.

A pilot study was conducted to test the data collection instruments, as well as to determine the most accurate and feasible procedure for identifying abortion cases treated at the hospital. All gynecology charts for five 15-day periods (2001-2005) and all obstetric cases for

three 2-day periods (2002-2004) were reviewed. A total of 725 charts were reviewed and 428 charts were eligible and abstracted.

Completed abstraction forms were stored, coded and entered into a database at the study research office. Each form was manually edited and coded prior to entry using a coding manual based on pilot data and the initial 300 abstraction forms. Computer software dBase IV was used for data entry and to perform consistency checks. Abstracted forms found to have inconsistent information were compared with the original medical chart, and data entry errors were physically checked and re-entered. Cleaned data were transferred into Stata (version 10) for analysis.

Measures

The primary outcome for our analysis is the proportion of severe abortion complications to the total number of abortion cases. Two measures of the severity of the abortion complications are constructed and, information from each is used to create a combined measure based on information from both the severity and treatment measures.

Symptom Severity Index

The first measure is adapted from Jewkes et al. (1997) and categorizes cases as low, medium, and high severity based on signs of infection and mechanical injury. Low severity cases are those with no sign of infection; a normal body temperature and no clinical signs or symptoms of peritonitis. Medium severity cases show evidence of mild infection; a temperature of 37.3-37.9°C and/or signs of mild infection (e.g., cervicitis, foul discharge). High severity cases are those with a temperature of 38.0°C or above, a pulse of 120 bpm or above, signs of organ failure, septic shock, generalized peritonitis, signs of foreign body or mechanical injury from the abortion, or death. The index was coded hierarchically.

Two fields were used to assess body temperature. The temperature on admission was recorded qualitatively (febrile, afebrile) for 8,832 cases and quantitative temperature was recorded for 856. When available, the peak temperature values charted were used to categorize the cases (n=256). For cases with missing information on temperature, if fever was documented elsewhere in the medical record (e.g., as fever/chills) the case was coded at the medium severity level. Heart rate (beats per minute) was recorded for all but 593 cases. The medical record fields examined to identify signs of infection and injury were *final diagnosis*, *chief complaints*, and *history of present illness and clinical notes*.

Treatment Severity Index

The second measure of severity was developed by investigators in consultation with clinicians from the research team based on their experience in the treatment of abortion complications in developing country settings. The low, medium, high categorization employed by Jewkes was replicated, but with *treatments* rather than clinical symptoms used to approximate the level of severity of the underlying abortion complication for which the woman sought care. Cases coded as low severity were those treated conservatively, with manual vacuum aspiration (MVA), repeat MVA, referral to abortion provider (post 2004), D&C/D&E, or repeat D&C/D&E. Medium severity cases were those receiving intravenous fluids, tetanus toxoid inoculation, and/or antibiotics administered orally (or rarely, intramuscularly, n=12). High severity cases received surgery, intravenous antibiotics, and/or a blood transfusion, and/or spent time in the maternal intensive care unit. The variable was coded hierarchically.

Complication Severity

A combined variable was constructed by imputing the values for treatment severity where data was missing on the symptom severity index. Missing values remained for 6 cases and these were given the low severity code.

Induced abortion

A measure of induced abortion was constructed using information documented in the medical chart. The measure is certainly an undercount of induced abortion cases, and approaches for estimating actual rates of induced abortion have been subject to substantial criticism (Rossier 2003). In our study, cases were identified as induced if induced abortion was documented in the chart (some of these were noted in the chart to have been reported by the woman, others were noted by the physician and may have been based on clinical opinion rather than direct evidence) or when a foreign object or injury from instrumentation was documented.

Demographic variables used to describe the population of women presenting with abortion or abortion complications are age, parity, admission ward, season of admission, permanent residence, marital status, and ever use of contraception.

Analysis

Prior to analysis the cases that did not explicitly refer to abortion in the chart were examined to assess the likelihood that they were abortion related complications. Some of the cases captured by our chart eligibility protocol, such as uterine-vaginal prolapse and polypectomy, did not specifically mention abortion, but were abstracted. Where an alternate diagnosis explained the case's original selection (for example, a case of surgery for vaginal prolapse would be captured because the surgery was described as a uterine repair) the case was dropped. Finally, cases of threatened abortion treated conservatively that were not noted to be induced (n = 305) and all cases of hydatidiform mole (n = 170) were excluded. (Twelve of the

threatened abortion cases that were treated conservatively were induced according to the chart). Of 12,820 cases abstracted, 11,101 cases of abortion and abortion complication cases are included in the final analytic sample.

The measures of severity are described with counts and frequencies. The relationships of the combined severity index and selected characteristics of the study population are presented with the Pearson χ^2 used to test for categorical bivariate differences, oneway ANOVA for mean differences, and the Kruskal-Wallis test for nonparametric variables in cases where the assumption of unequal variance is not met.

The test for a trend over time was based on a log-linear Poisson model. Flexible polynomial Poisson models were also generated using spline basis specifications for selected time periods to explore potential change points in the trend. The count of cases per month or year is the dependent variable and time, divided into monthly and yearly intervals for the respective models, is an independent variable representing the incidence-rate ratio (IRR), interpreted as the change in the log count of severe cases for a one month increase in the time increment. The log of the total number of cases is included as an offset variable with a coefficient fixed at 1. The Poisson model is specified as the log of a ratio where the denominator is moved to the right hand side of the regression equation to produce the count model. Predicted counts based on the models are graphed over time along with the raw counts.

Results

Combining information from the symptom and treatment severity indices, the combined severity index categorized all cases in the sample, with 16.4% of women showing signs of infection or injury related to abortion.

The symptom severity index based on the Jewkes classification relies heavily on temperature readings for low severity and for differentiation between low and medium severity cases. Missing data on temperature made it impossible to classify 1,772 of the women presenting with abortion complications (Table 1). The intake protocol at the hospital does not require quantitative measurement of temperature for all patients. Instead, a qualitative judgment based on visual, tactile, and reported signs of fever is made and when a fever is suspected, it is measured quantitatively. Heart rate was more consistently measured, and contributed cases to the high severity classification. A medium severity classification relies on clinical signs of "mild infection", such as tender uterus, offensive discharge, and a low grade fever. The clinical notes did not distinguish clearly between abdominal cramping and abdominal pain, and the data field was thus collapsed in our abstraction tool. As a result, nearly half the cases were found to have the symptom and it likely represents normal cramping that would accompany a spontaneous abortion rather than signifying mild infection. Therefore, the "tender uterus" symptom used in the Jewkes scheme was not available in this study. The medium severity cases, therefore, are those with a low fever, cervicitis, or offensive discharge (n=373).

The distinction between local and generalized peritonitis that was made for the Jewkes scheme could not be implemented in our study because the final diagnosis and clinical notes fields often indicated peritonitis without further specification. The decision to include all cases of peritonitis in the high severity category was made based on the observation that very few cases, overall, had this diagnosis, and nearly all of these cases (n=12) were reported to be induced in the medical charts. Using diagnoses and clinical readings, 651 (8.2%) cases were coded as high severity complications.

The treatment index was developed to classify the severity of abortion complications based on the procedures and medications provided for the patient rather than symptoms and diagnoses (Table 1). Missing data was substantially lower for this measure, with only 50 cases that could not be classified. The low severity category included over one-third of the cases (38.9%), medium severity nearly half (47.5%), and high severity (13.6%). The majority of cases received an abortion procedure at the hospital (86.6%), and approximately half of admitted cases received intravenous fluids (50.4%). Intravenous antibiotics were the most commonly provided treatments included in the high severity category (7.1% of all women).

Descriptive data on the women admitted with abortion complications are presented in Table 2. The associations of all key demographic characteristics with the severity measure are highly significant and in the expected direction. Nearly a quarter of the induced abortion cases had high severity complications. A disproportionate number of older women had more severe complications, unmarried women were more likely to have high severity complications, and women who had used contraception were more likely to experience severe complications. Not surprisingly, women traveling from outside the Kathmandu Valley may have arrived at the hospital in poorer condition and with more severe trauma than women living in the local area. Higher parity was also associated with higher severity abortion complications. Finally, lower socioeconomic status, roughly captured by admission to the general rather than the more expensive private hospital ward, was associated with greater severity.

Visual inspection of the trend in cases of abortion and severe complications across time does not suggest a precipitous decline (Figure 1). Using the combined severity measure, a very slight significant downward log linear trend in the rate of severe complications treated at the hospital during the time period is detected with the test for linear trend (IRR = 0.9959, $p<.001$)

(Figure 3). A test on the yearly data indicate a 0.04 reduction in the risk of high severity complications each year (IRR= .95995, p<.001) (data not shown). Slight increases in uterine perforation and peritonitis and decreases in cases of sepsis/septicemia were found (Table 1). [Tests for changes in treatments over time to be added.]

Discussion

The symptom-based approach for constructing a measure of severity built on work by Jewkes *et al*. was developed for their study of abortion complications treated at public hospitals in South Africa (Jewkes, Fawcus et al. 1997; Jewkes, Gumede et al. 2005). The record-keeping techniques in the high-volume, urban hospital in our study are not highly standardized and the absence of data in important fields was noted throughout the planning and data collection process. While the diagnoses recorded in the medical charts provide some information about the severity of the case in its clinical presentation, the treatment based severity index capitalizes on information that is more frequently recorded in medical charts due to its importance for patient care and billing. In addition, providers may have been hesitant to record information that would reveal an induced abortion, particularly prior to legalization, but less hesitant to record what was done for the patient. A combined measure that uses information on both symptoms and treatments may be useful in other settings where record keeping is variable and there are legal restrictions or social considerations that could motivate clinicians to conceal information about abortion cases.

Methodological challenges

Measurement error and misclassification bias are well-known and substantial in abortion research (Barreto, Campbell et al. 1992; Rossier 2003). The quality of data abstracted from medical charts is directly affected by the completeness of clinical record-keeping, the

organizational systems for chart storage, the physical characteristics of the chart storage system, and the resources and skills of the research staff involved in chart abstraction. To capture as much of the relevant data as possible, the research team developed an in-depth understanding of the records and record-keeping systems at the hospital before beginning chart abstraction. The process for identifying charts was developed to capture the most complete and comparable information possible. The training and monitoring of research staff was conducted with great diligence. The chart review took place in the hospital, and study staff had access to clinicians when questions arose about abbreviations or handwritten notes. Despite these efforts, missing data is substantial in this study, primarily from incomplete information recorded in the medical charts, and contributes to misclassification of cases.

The influence of missing data on the classification of patients is unlikely to be random. Missing chart data could tend toward lower severity classification. For example, a chart missing the page charting a fever that would have been categorized as severe might be in the low category without that information. However, more severe cases may have more complete information in the chart since the patient would be in the hospital longer, require more intensive care and documentation, and would involve more clinicians in management of the case. The combined severity measure helps to overcome some of the problems of classification bias by drawing information from multiple sources. The expected associations with the measure of induced abortion, and with demographic characteristics of the population lend some validity to the measure. The measure also improves upon the Jewkes measure in that it captures cases of hemorrhage, as indicated by blood transfusion, that were not accounted for in the Jewkes classification. Difficulties assessing the seriousness of infection posed by the Jewkes criteria were also addressed by distinguishing between orally and intravenously administered antibiotics.

The extent of missing data is difficult to ascertain because the absence of information arises either from the absence of the symptom or treatment or incomplete record-keeping. The most problematic aspect of missing information is the possibility that the completeness of records may have been affected by abortion legalization, which could confound our study results. The criminal status of abortion prior to legalization likely provided incentive to record less rather than more information about abortion cases. Information about whether or not the abortion was induced is available in many charts, but is certainly an undercount particularly for the time prior to legalization. As hospital personnel become aware of a chart review study taking place at the hospital, they might also become more thorough in their charting, a Hawthorne effect. Increased completeness of record-keeping would bias the study toward the null hypothesis or, if pronounced enough, could mask the true trend in abortion complications over time. To evaluate the extent to which this methodological challenge influences our study results, a qualitative study of hospital personnel is underway to examine how the change in abortion policy has influenced practices and record-keeping in the hospital. The strength of a possible Hawthorne effect is more difficult to measure, but the qualitative study will also inquire as to the degree of familiarity and interest in our chart review among hospital personnel. Effects of possible record-keeping changes over the time period may have less influence on the treatment-based index of severity. Information on treatments is less likely to change before and after the legalization of abortion because this aspect of clinical record-keeping is important for billing and may be more neutral in meaning since the same treatments are applied across a wide array of medical conditions, and in general objective measures (e.g., body temperature, administration of antibiotics) would presumably be less affected by the policy change.

The treatment-based measure is sensitive to variations in medical practice and institutional protocols (e.g., antibiotics, tetanus toxoid). If used in other settings, preliminary work to determine whether, for example, antibiotics are provided to all post-abortion patients is needed to determine whether the treatment is worthwhile to include in the categorization scheme. The variability in the meaning of treatments from setting to setting reduces its applicability in a standardized form. Secondary analysis of data from other studies may provide insight into the universality of treatments for particular complications. A hospital-based study in Kenya reported greater use of blood products and intravenous fluids in more severe cases (using the Jewkes symptom-based measure), but unlike our study, nearly all patients admitted for incomplete abortion were given antibiotics (Gebreselassie, Gallo et al. 2005). Further comparisons of the symptom-based measure of severity and a treatment-based measure of severity should be undertaken to determine which is most optimal, and how best to employ the measures across different settings.

The study design does not ensure that trends in abortion complications at the sentinel hospitals are solely due to the change in abortion policy (Cook and Campbell 1979). Complementary data help with the interpretation of the absence of a pronounced trend following legalization. An increase in complications could indicate greater utilization of abortion services, safe and unsafe, a shift in the age structure in the population, an increase in access and utilization of health services, declining contraceptive prevalence, and other population level effects. Similarly, a downward trend could be accounted for by opposite changes in many of the same factors. For example, access to health care could decline over the study period due to the unstable political conditions accompanied by violence, strikes, and blockades, making travel throughout the region difficult. Alternatively, access to health care could improve if a new

transportation service or additional hospitals opened during the study timeframe. Adjusting the trends for the overall number of admissions to the hospital over time can help to correct for changing patterns of utilization to some extent, but because the legal status of abortion changed so dramatically women's willingness to seek care for complications from abortion could rise at a faster rate than general increases in health care utilization.

Summary data on hospital admissions show that gynecological conditions have stayed relatively stable over the study period, while the number of live births at the hospital has risen (Figure 4). The reasons for the increased number of live births at the hospital are important to consider. If the age structure of the population is changing such that there are more women of childbearing age in the population (and the fertility rate is constant), we would expect rising rates of abortion complications in the population. Indeed, a shift toward desire for smaller family size and higher contraceptive prevalence in the population suggest that the underlying need for abortion in the population may be rising. It is possible that the availability of safe abortion services does not yet adequately serve the need in the population. The increase in obstetrics admissions could also represent increases in the utilization of formal health services for labor and delivery, perhaps motivated by the Safe Motherhood campaign ongoing in Nepal. Most important to the interpretation of our data on abortion complications, the relatively flat trend in gynecologic admissions could be due to rising levels of health care utilization for abortion complications in the midst of an overall decrease in the number of complications actually occurring. In other words, few complications may be occurring, but the ones that happen are more likely to present at the hospital than in past years. Further population-based studies are necessary to examine this source of confounding.

If rates of induced abortion rise in the population and willingness to seek care rises with legalization, unsafe abortion providers working outside of the government's Safe Abortion Services Program may experience an increase in utilization. Expanded availability of trained providers and certified clinics has the potential to reduce the most detrimental injuries from unsafe, illegal abortion. However, even with widespread availability of safe abortion and an attendant decline in the risk of complications from abortion, if the volume of women seeking abortion doubles or triples, the absolute number of women experiencing complications, even from "safe" providers could remain stable or rise. The legal abortion program in Nepal includes centralized reporting on the number of women seeking abortions and the complication rates from certified providers (Figure 5, Figure 6). Studies based on data from the Safe Abortion Services clinic at Maternity Hospital reveal a complication rate of 2.1% (Thapa et al., 2007; Malla et al., 2006), which is somewhat higher than the WHO guidelines for safe abortion (1.5%). If these complication rates are applied to the total number of abortions received in the Central Development Region of Nepal, which includes Kathmandu, nearly 7,000 complications may have been generated through from these providers. It is highly likely that induced abortion levels have increased substantially in Nepal following the shift from criminal to legal status, particularly if reductions in family size are desired and the contraceptive prevalence are relatively low (2001, 40%; 2006, 50% in the Central Development Region and lower in all other region, *Source: NDHS, 2001 and 2006)*

The trend in abortion complications to date reveals a very slight decline in the ratio of high severity abortion complications across the study time period. Data collection is ongoing and, like South Africa, it may take 5 to 6 years post-legalization to demonstrate an effect of legalization on women's health.

Conclusions

Despite limitations, this examination of data on hospitalizations from abortion over a seven year period indicates a slight downward trend in severe complications. A number of factors contribute to the number of women experiencing pregnancy, seeking abortion, getting safe services, and presenting to a hospital with a complication. We developed a measure of severity suitable for the data source and useful for ongoing monitoring in Nepal, and perhaps in other settings. Further work is needed to determine the overall rate of complications from unsafe abortion in Kathmandu and to examine levels of knowledge regarding the availability of safe services. Anthropological work to investigate the abortion knowledge, attitudes, and experiences of low-literacy women who experience unwanted pregnancy would be beneficial. Studies of the introduction of medical abortion are needed. Finally, admirable work has been done to implement the abortion policy in Nepal and efforts to increase training opportunities and to expand the availability of safe abortion must continue.

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Table 1. Description of severity indices, n = 11,101 (2000-2007)

	n	% (valid n)	Test for Linear Time Trend IRR (p-value)
Combined Severity Index			
Low	9123	82.2	
Medium	1157	10.4	
High	821	7.4	0.9959 (<.001)
Symptom Severity Index[a]		(9,391)	
Low	8391	89.4	
Medium	364	3.9	
High	636	6.8	0.9978 (<.001)
n missing	*1,710*		
Body temperature[b]		(960)	
Normal (<99.1°F)	496		
Low fever (99.2-100.2°F)	160		
Fever (100.3 °F +)	304		
Qualitative			
Febrile (temperature not taken)	5		
Afebrile	8329		
Combined		(9,294)	
Normal	8825	95.0	
Low fever	165	1.8	
Fever	304	3.3	
n missing	*1807*		
Heart rate		(10,531)	
< 120 beats per minute	10208	96.9	
≥ 120 beats per minute	323	3.1	
n missing	*570*		
Signs of mild infection			
Cervicitis	3		
Offensive discharge	46		
Painful/cramping abdomen	5285		
Signs of serious infection			
Peritonitis[c]	25		1.0108 (<.001)
Sepsis/septicemia	282		0.9883 (<.001)
Septic shock	74		NS
Pelvic inflammatory disease	26		
Genital tract infection	8		
Organ failure			
Disseminated intravascular coagulation (DIC)	1		
Shock (hypovolemic or not specified)	36		
Renal failure	7		
Organ failure, not specified	7		
Other (DVT, unconscious)	33		1.0078 (<.001)
Signs of injury			
Cervical injury	3		
Vaginal injury	3		

Intestinal injury Perforated/ruptured uterus Perforated/ruptured intestine Reproductive tract injury	4 40 3 3		1.0287 (<.001)
Treatment Severity Index Low Medium High *n missing*	 4308 5249 1494 *50*	(11,101) 39.0 47.5 13.5	 0.9993 (<.001)
Conservative treatment	1181		
Manual vacuum aspiration/repeat MVA/referral to safe abortion provider on-site (post 2004)	5715		
D&C/D&E/Exploration/Repeat D&C or D&E	4156		
Intravenous fluids	5581		
Antibiotics (any)	4183		
Antibiotics (intravenous)	791		
Blood transfusion	778		
Surgical repair	86		
Intensive care unit	117		
Tetanus toxoid vaccination	315		

[a] Coded hierarchically (see Measures). Some of the cases with missing values for temperature were coded using information on the case in the diagnosis and symptom fields. Therefore, there is less missing data on the severity measure than on the temperature measures.

[b] Coded as peak temperature. If peak temperature missing, coded as admission temperature or fever recorded elsewhere in chart.

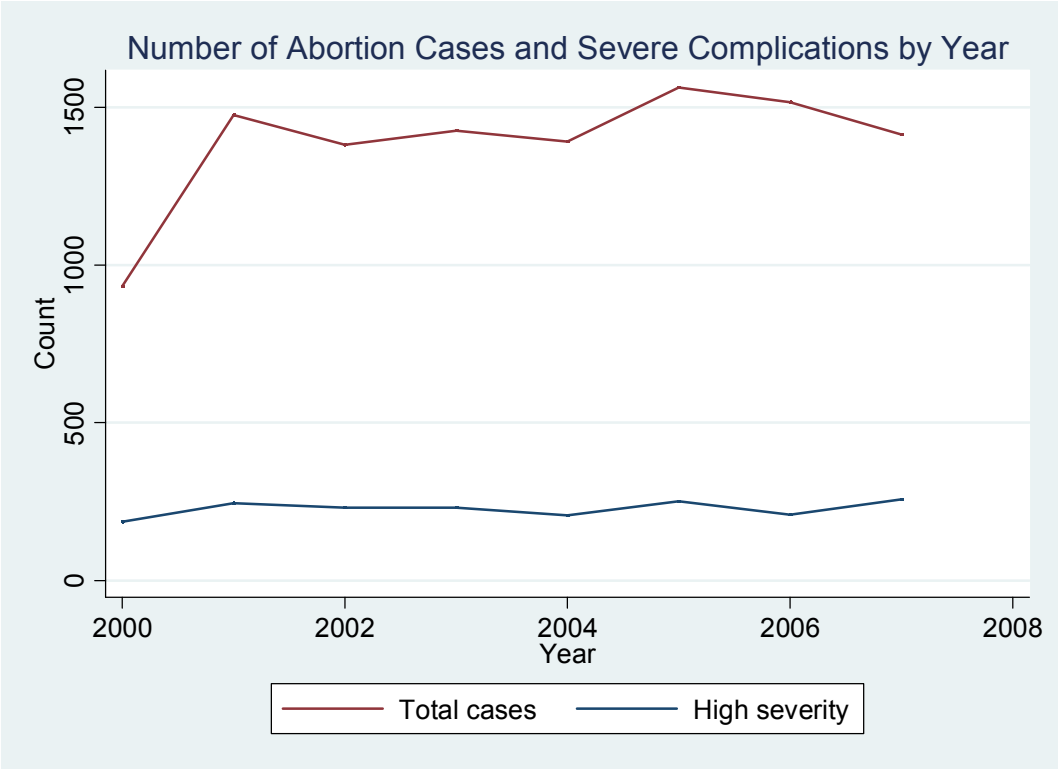
[c] Pelvic peritonitis and generalized peritonitis are included in this category. For many cases the clinical notes did not specify the type.

Table 2. Characteristics of women by Combined Severity Index, n = 11,101 (2000-2007)

	Total	Low	Medium	High	p-value
Induced abortion (%)	9.3	6.8	9.0	37.4	<.001
Mean age (SD) [median = 24, range (13-56)]	25.2 (6.1)	25.1 (6.0)	25.2 (6.2)	27.2 (6.9)	<.001[a]
Unmarried (%) (valid n = 10,959)	0.6	0.4	0.4	2.6	<.001[b]
Permanent residence (%):					<.001
Kathmandu Valley	38.4	39.7	35.4	27.9	
Outside Kathmandu Valley	59.4	58.0	62.5	70.8	
Outside Nepal	2.2	2.3	2.0	1.4	
(valid n = 11,367)					
Ever used contraception (%) (valid n = 5,824)	39.3	38.6	38.8	49.0	<.001
Parity (SD) [median = 1, range (0-13)]	1.27 (1.5)	1.19 (1.4)	1.31 (1.6)	2.0 (1.8)	<.001[a]
Parity (%):					<.001
0	37.7	39.3	37.3	21.3	
1-3	54.2	53.5	54.4	60.7	
4+	8.1	7.2	8.3	18.0	
Ward (%):					<.001
Private	11.8	11.9	12.2	9.7	
General	88.2	88.1	87.8	90.3	
Season of admission (%):					<.001
Spring	24.3	24.7	23.8	20.9	
Summer	30.8	30.5	33.0	31.4	
Fall	24.2	23.8	24.9	27.4	
Winter	20.6	20.9	18.3	20.3	

[a] The assumption of equal variances was not met for the ANOVA test of mean differences. The significance of the nonparametric Kruskal-Wallis test is provided.
[b] Due to small cell counts, the Fisher Exact test for independence was used.

Figure 1. Count of cases by year, n = 11,101



Test for log-linear time trend for ratio of severe to all cases, IRR (p-value) = 0.990, p<.001

Figure 2. Graph of the ratio of high severity case by month, n= 11,101

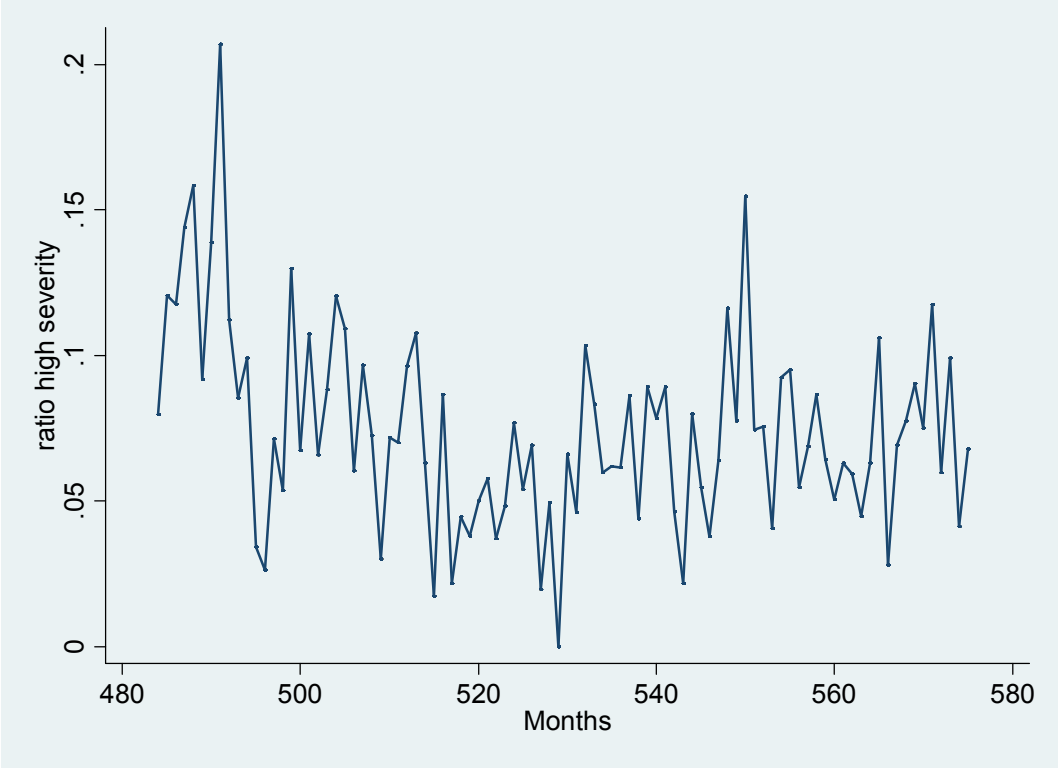
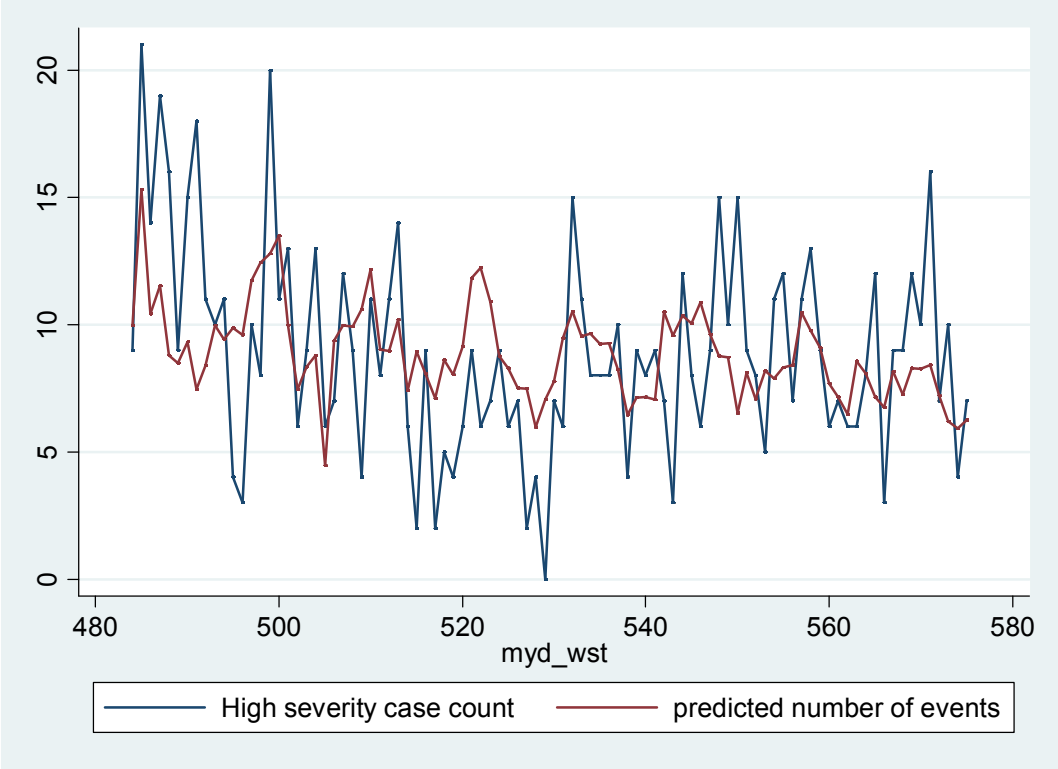


Figure 3. Predicted counts of severe abortion complications from log-linear Poisson model, n =11,101



Test for log-linear time trend, IRR (p-value) = 0.9959 (<.001)

Figure 4. Hospital admissions, 2000-2007

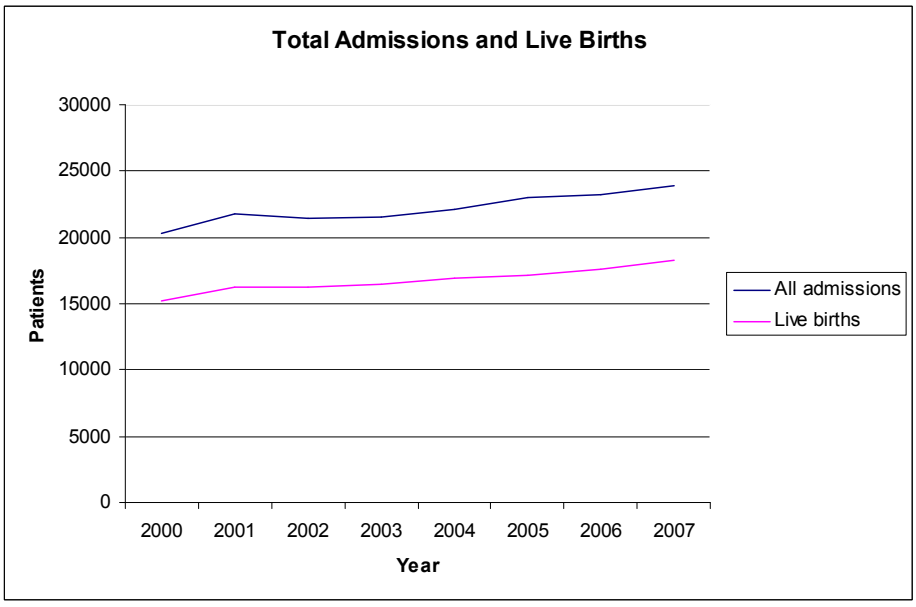


Figure 5. Number of abortions provided by government certified sites and clinicians in the Central Development Region

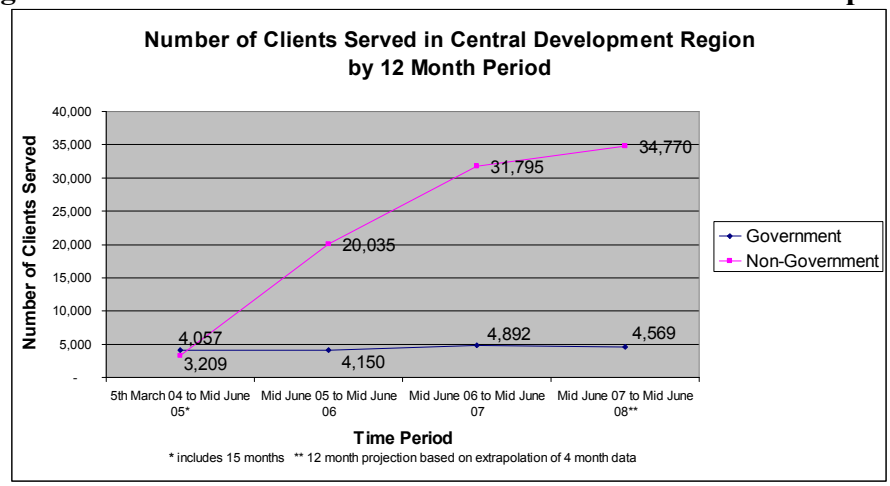
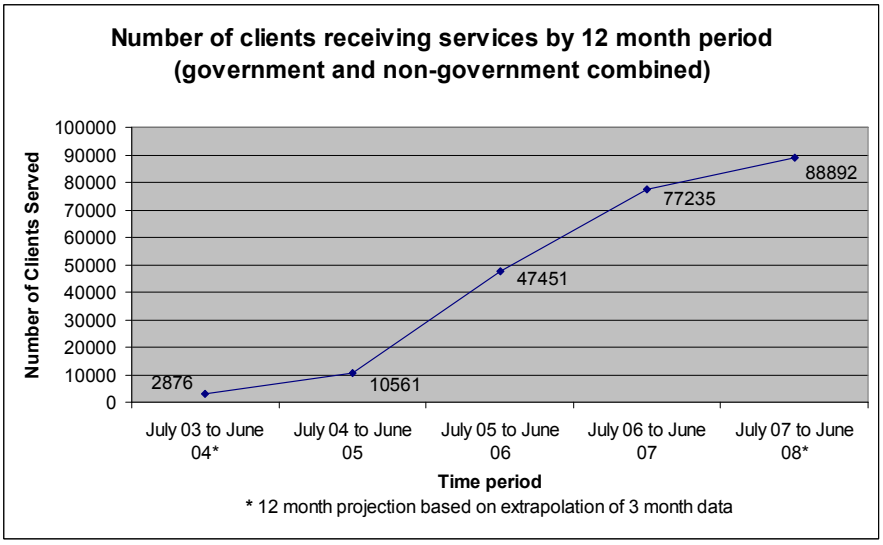


Figure 6. Total number of abortions provided by government certified sites and clinicians in Nepal



Appendix
Chart Eligibility Determination Flowchart (Expanded)