Title: Global and regional estimates of health-system costs of unsafe abortion

Key words: unsafe abortion, cost

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Summary:
Objective: Each year, 19 million unsafe abortions occur worldwide, and an estimated 5.2 million of these women seek treatment at hospitals and clinics for the resulting serious medical complications. The aim of this paper is to estimate the global and regional economic impact of post-abortion care on the health system.
Methods: We used two methods to estimate the cost of post-abortion care. The first derived the average cost of care per post-abortion patient from 24 available studies. The second 'bottom-up' approach applied the WHO Mother-Baby Package, supplemented with empirical data on the cost of specific components of care. Average cost estimates from both methods were multiplied by estimates of the number of post-abortion care hospitalizations to derive a measure of global and regional economic impact.
Findings: The mean cost of post-abortion care from the literature was estimated to lie in the range $67-$129 (2006 US$) per patient. Globally, post-abortion care costs health systems $380 to $680 million each year in direct costs. Using the 'bottom-up' method resulted in a worldwide estimate of direct costs of $463 million (central estimate).
Conclusion: Post-abortion care constitutes a significant financial burden on public health systems in the developing world and is a significant cause of maternal mortality, morbidity and long-term disability. It diverts scarce health resources and is more costly than providing safe abortion and ensuring access to contraceptive services. We believe that these cost data strengthen existing arguments for the need for safe and legal abortion.

Introduction

Each year, an estimated 19.7 million unsafe abortions occur worldwide, and around 66,500 women die from abortion-related causes.[1] An estimated 5.2 million women are treated annually for complications from unsafe abortion.[2] The cost of treating unsafe abortion complications burdens health systems in developing countries, where almost all unsafe abortions occur. It diverts scarce health resources and, as we will demonstrate, costs much more than the alternative of contraceptive services. Quantifying the economic costs of unsafe abortion is therefore a matter of importance for public policy.

Economic Impact of Unsafe Abortion – Framework for Analysis

Unsafe abortion generates unnecessary costs to society at a variety of levels. A proportion of women who have an unsafe abortion will experience complications (Figure 1); some of these women will seek care within the formal health system, while many will seek care outside of the formal health system or not seek care at all. Even where abortions are legal, many women will still have recourse to unsafe procedures for a variety of reasons: the stigma that society still attaches to abortion, the desire of the woman to maintain a cloak of secrecy, or the inadequacy of the health system vis-à-vis abortion procedures. Where women seek care determines who bears the direct medical costs. In public facilities, the costs may be shared between households and government if fees are charged. The process of seeking care will also incur direct non-medical costs, such as transport costs, which can be significant.[3,4]

Women suffering from complications face three possible outcomes: survival with no long term sequelae; survival with long-term consequences; or death. Each outcome generates indirect costs in the form of lost productivity, which will be borne by the households affected and society more broadly. In economies with large pools of unemployed, these costs will be more easily offset at the societal level. Indeed, even at the household level, some proportion of short-term lost productivity would most likely be made up by the individuals themselves or friends and family. However, long-term productivity losses cannot be offset at an individual / household level in the same way they can at the societal level. Moreover, all coping strategies impose costs of one sort or another. Finally, children from households experiencing long term maternal disability or a maternal death may also suffer in terms of their future health and education potential,[5] with further economic implications for the household and society.

While recognizing the multi-dimensional nature and range of potential economic impacts, the focus of this paper is on estimating one component—the cost of unsafe abortion to health systems (see the highlighted cell in Figure 1). Household costs are excluded from the current study, not because they are unimportant, but due to the lack of empirical evidence. Productivity losses are also excluded because of the paucity of empirical studies as well as a lack of consensus among economists as to how to value such losses.[6]

The emphasis in this framework is on costs that can be measured in monetary terms, although how to value lost productivity, in the case of indirect costs, is a question that is still open to discussion. Social and psychological costs are difficult to monetize, but are nonetheless real. The stigmatization that women who are known to have had an abortion suffer is a very real cost in some societies. Other psychological traumas that post-abortion women may suffer also may impose great costs on the women, which also may be hard to quantify.

The evidence base on the cost of unsafe abortion is limited, and regional or global economic impacts are currently unknown. The paper responds to existing data constraints by using two different approaches: 1) using estimates of average cost per patient of post-abortion care (PAC) based on available literature; and 2) using results from a costing model. The first approach is "top down" since it uses empirically derived total treatment costs per case, while the second is "bottom up" since it relies on cost estimates of detailed inputs that make up PAC. When combined with estimates of the number of women hospitalized for serious medical complications of induced abortion, the two approaches provide a range of estimates of the direct cost of unsafe abortion to health systems, at the global and regional levels. To reiterate, these cost estimates do not include costs borne by households, whether direct medical costs such as the purchase of drugs, direct non-medical costs such as transport to facilities, or the productivity costs of lost production due to ill health.

Methodology and Data

The average cost per case of PAC calculated from available empirical studies was the basis for the *first costing approach*. A systematic literature review identified 72 facility-based samples in developing countries in which estimates of the cost per case of PAC were provided. Published costing studies were identified by searching databases (Medline, Embase, Econlit, and Popline) using validated search terms for economic evaluations,[42, 43] namely: "economics" or "cost"; and "abortion" or "post-abortion care." Results were limited to studies published between 1985-2007 describing data collected in low or middle-income countries. Websites of relevant organizations, including Population Council, Guttmacher Institute, UN, WHO, Pathfinder and IPAS, were searched for project reports. Staff was contacted at the organizations mentioned above, and a hand search was done of relevant journals' tables of contents. Finally, relevant conference proceedings were searched.

One hundred seventy two articles were screened, resulting in 23 relevant papers representing 21 empirical studies. Studies were included if they presented original data, presented costs from the health systems perspective, and provided sufficient detail of methods used in order to assess the study quality. Within these 21 studies, 72 reported

unit costs were presented and analyzed.[7-29] Reported unit costs were converted to 2006 international dollars as well as 2006 United States dollars.[30] Study-year costs in USD were adjusted for inflation using US GDP deflators to arrive at the 2006 USD costs, which were then converted to 2006 local currency costs using official exchange rates and divided by the purchasing power parity (PPP) conversion factor to arrive at the 2006 international dollars cost. All historical economic data was taken from the World Bank World Development Indicator website.[31]

Several review parameters were chosen for evaluating the papers found through the literature search in order to critically assess the costing methods used by each study. Published critical reviews and economic evaluation textbooks guided the choice of parameters.[30,44,45] The review parameters are listed below.

Study background and context. Issues related to the study itself, such as whether economic analysis was among the study's primary aims, whether sensitivity analysis was performed, and the year and place of publication, indicate the quality and internal validity of the study. Characteristics of the study population, the legal status of induced abortion, geographical location, and a description of the level and type of care provided at study hospitals assisted in interpreting the results and assessing external validity.

Resource inputs. Differences in resource inputs can lead to large variations in cost outputs. Resource inputs include the type and nature of the intervention, as well as the resources that support the interventions and their cost profiles, such as personnel, drugs, supplies and overhead costs. Whether capital resources are included is noted. Additional factors that influence the cost of treatment include the severity of the patient being treated, as well as the average length of stay in health facilities.

Costing methods. The methods used to collect and analyze data ultimately influence the resulting unit cost estimations, as well as the internal validity of the study. Empirical collection of cost data requires a detailed assessment of individual inputs and their quantity, and is sometimes substituted by modeled estimates, which can be less accurate. Empirical costing can be done using a top-down or bottom-up approach, and these methodologies may influence study results, as can the study sample size. It is also important to discern whether a study considers only financial costs, or all economic costs, and whether incremental or full costs of an intervention are presented.

Health and economic outcomes. The cost of abortion care is often presented as a *per case* or *per treatment* outcome. While it is most correct to differentiate between the two (a treatment is a single event whereas a case may include follow-up treatments for the primary complaint), abortion cases often only consist of one treatment, and so the two outcomes are used interchangeably in much of the literature. This review is concerned

primarily with the cost to the health system, but costs to patients are also reported where possible.

Post-abortion complications encompass a very wide range of medical problems. The treatments and interventions mentioned in the empirical literature, however, are less extensive. The following is a summary of the medical procedures and treatments reported on in this literature:

Operative Procedures

- Colpopuncture
- Colpotomy (A)
- Dilation and curettage
- Hysterectomy
- Intestinal resection
- Laparotomy (B)
- Manual vacuum aspiration
- Resuscitation, intensive care unit
- Surgery (unspecified)

Other Procedures

- Blood transfusions
- General anesthesia
- Intravenous antibiotics
- Intravenous fluids
- Local anesthesia
- Sedation

Medicine Administered

- Abortifacients
- Analgesics
- Antibiotics
- Antimalarial drugs
- Flagyl
- Haematinics (C)
- Tetanus vaccination

This list is incomplete. For instance, treatment for poisoning, renal failure, psychosis, and infertility*, inter alia*, would require interventions not listed here.

(A) Colpotomy: an incision made into the wall of the vagina. This was formerly used to confirm the diagnosis of ectopic pregnancy.

(B) Laparotomy: a surgical incision into the abdominal cavity, for diagnosis or in preparation for major surgery.

(C) Haematinic: an agent that tends to stimulate blood cell formation or to increase the haemoglobin in the blood.

Results

Table 1 lists a number of cost-per-patient estimates based on the 21 empirical studies. The first row of the table shows simple averages over all 72 cost estimates. The average cost per patient is $86.04 (USD, 2006).

Of the 72 samples, 46 can be categorized as low-severity samples, meaning that the women sampled would be classified as having "low" severity complications using the Kay-Rees severity framework. [20, 32] Many of these studies, investigating operational aspects of the manual vacuum aspiration technique, typically excluded patients with severe post-abortion complications. The other 26 samples included women of all severity categories. As shown in rows 2-3, the average cost per patient for treating low-severity complications is $72.07, while the average cost for samples of women with all types of complication is $110.76.

A few studies contribute many samples to the total of 72, possibly biasing average costs. To investigate this possibility, averages were recalculated by first obtaining within-study averages. Then simple averages of these 21 averages were obtained (rows 4-6). In this way, each study contributes the same weight to the overall averages. The overall average increases slightly to $88.28, while the average for low-severity samples decreases a little to $67.72 and the all-severity average cost per patient declines to $108.84. Overall, it makes little difference which of the two calculation methods is used. Nevertheless, from this point onwards we use the within-study averages from the 21 articles.

Of the 21 studies, ten took place in Africa (nine in sub-Saharan Africa) and eleven in Latin America and Caribbean. No cost studies were found for Asia, a serious lacuna in the literature. Average costs per patient by region are shown in rows 7-10. In USD terms, there is little variation by region, from $82.63 in Africa to $93.92 in LAC.

A *second approach to costing* is to model all inputs for each treatment category of PAC. We used the WHO Mother-Baby Package (MBP) costing spreadsheets.[33, 34] In this model, each type of PAC treatment is broken down into quantities and unit costs of drugs, materials, equipment, personnel, overhead and infrastructure. The model has been applied in five country studies (Table 2). The purpose of the studies was to estimate costs for all Mother-Baby-Package interventions, except for the Nigerian study which focused solely on PAC costs. The studies covered only selected districts of the country, so none of them can claim to yield estimates that apply to the whole country. The approach used in Uganda, Bolivia and Ghana was to collect data on current practices, then to estimate "standard" practice, meaning compliance with WHO protocols for the MBP initiative.

Table 2 shows the cost-per-case results of the MBP studies. The overall costs per patient (in USD, 2006) display considerable variability, from about $10 to $112, under current practice, and from $31 to $212, under "standard" practice. Latin American costs are substantially higher than African costs, primarily reflecting higher Latin American salaries. Also, except for the Ghana study, "standard" costs are substantially higher than current costs. This may demonstrate that current treatment regimes do not utilize resources to the extent recommended by standard treatment protocols.

"Top down" Estimates

Row 10 of Table 1 contains average costs that will be used in the first of three methods for estimating regional and global total health-system expenditures using the "top down" approach. This method constitutes the lower boundary of estimates of total costs since it assumes that all women seeking PAC have only low-severity complications.

Row 11 shows the costs per patient for the second calculation method, where information about the incidence and cost of treatment by severity level is used. Two studies[20, 35] provide information on severity patterns in South Africa and Kenya. Combining the two studies, we assume that low-severity cases are 63.6 percent of the total of PAC cases, mid-severity cases 15.9 percent, and high-severity cases 20.5 percent. Using these weights together with the estimated costs by severity of the South African study, we arrive at an average cost across all levels of severity. This approach is, of course, a crude one, extrapolating the experiences of two SSA countries to the whole developing world. It is worth including, nonetheless, because it takes into account an important cost driver, namely the severity pattern of PAC.

Finally, rows 12-14 show average costs using the third calculation method. This method assumes that most existing studies have under-estimated the true cost of treatment by omitting certain, hard-to-measure cost components. In particular, overhead and capital costs are frequently omitted. Using information from the five studies which applied the MBP costing model (Table 2), estimates of the shares of overhead and capital costs in total treatment costs were made. Based on these five studies, direct costs were estimated to be 72 percent of total costs, overhead 16 percent and capital 12 percent. Observed costs were then inflated by a factor of 1.38 (1.00 / 0.72 = 1.38). The estimated costs using this method are higher than those from any of the other three methods and so form the upper boundary of the cost ranges.

Regional and global estimates of health-system costs for PAC are presented in Table 3 for the three calculation methods. The total cost to the health system ranges from $117 million to $198 million in Africa, with a central estimate of $171 million. Total costs in Latin America and the Caribbean range from $$70 to $135 million. Of the three methods,

Method 1 produces the least likely scenario and is included mainly to set lower bounds for the probable cost ranges. Methods 2 and 3 make use of additional data apart from the empirically derived costs per patient. In each case, however, the added information, though theoretically appealing, is scant and necessitates simplifying assumptions. For example, the pattern of severity of complications is maintained constant across all regions distorting regional prevalence estimates. Only 19 percent of all serious abortion complications occur in sub-Saharan Africa under our assumptions, even though around 43 percent of all maternal deaths due to unsafe abortion come from that region. Obviously, more research into both severity patterns and omitted cost components is needed in order to improve the precision of these estimates. Additionally, estimates for Asia and Pacific, and European developing countries are needed but data from those regions are lacking.

"Bottom up" Estimates

Only five empirical studies have used the MBP costing spreadsheet, including three countries in sub-Saharan Africa and two in Latin America and Caribbean. Rough estimates of the magnitude of PAC costs are thus possible for those two regions. We make the simplifying assumption that the per-case costs in the other developing regions are averages of these two regions and calculate first-approximation estimates for all developing regions (Table 4).

The "bottom up" approach yields an estimate of $227 million for current health-system expenditure on PAC for the two regions. If standard WHO-recommended protocols were being followed, however, an estimated $320 million would have been expended in these two regions. Note that these estimates do not include the millions of women who have serious complications but never reach a health facility.

To establish a range of estimates for total expenditures, we performed a simple sensitivity analysis (Table 4) using the lowest cost estimate (from Sub-Saharan Africa) to find the lower bound and the highest cost estimate (from Latin America) to calculate the upper bound. Actual practice estimates for Africa and Latin America combined ranged from $159 million to $302 million per year, while estimates of care to WHO standards ranged in cost from $179 million to $476 million.

Discussion

The total cost estimates from the MBP studies tend to be lower than the estimates derived from studies reporting overall costs per patient. Overall, the MBP-derived estimates are about 20 percent lower. Regionally, the SSA estimate from MBP data is more than 40 percent below the cost-per-patient estimate. However, the LAC central estimate (MBP

approach) is lower than the cost-per-patient central estimate. There was considerable variation in the methods used by the 21 studies and general lack of information provided to appraise completeness of the cost estimates. However, while the MBP figures may theoretically be more accurate estimates of the aggregate costs of PAC, they have weaknesses of their own. In particular, the MBP cost figures are derived from a model of typical practice which has been validated against the experience of only five countries.

It is interesting to compare regional costs in terms of international dollars (2006). Even though cost per patient is higher in LAC than in Africa in real terms, in terms of international dollars, the average cost in Africa is substantially higher ($213 vs. $161), showing that in relation to purchasing power, abortion complications are considerably more expensive to treat in Africa than in Latin America, despite the former being the poorer region.

While we attempted to apply the costs of PAC from Africa and LAC to the entire developing world, it remains that little or no empirical data exists for other regions. As such, the estimates for Europe and Asia should be treated carefully, considering that cost components vary widely between regions. In countries where abortion or menstrual regulation is legal and accessible, including Bangladesh and Vietnam as well as some European developing countries, abortion cost data is available in place of PAC data. However, more PAC costing research is needed in the remaining countries where access to safe abortion is restricted, particularly in Asia. In addition to the need for greater regional diversity, studies must also consider newer methods of uterine evacuation, including medical abortion.

As is seen in Figure 1, estimating the health-system costs of treating serious abortion complications is only one component of the total economic impact on society of unsafe abortion. The costs of treating long-term health consequences such as chronic pelvic infections and infertility have hardly been studied. The indirect economic costs of unsafe abortion, borne by households, by sectors other than health, and by the economy more generally, are also essentially unmeasured so far. If we consider studies of maternal health we know that despite the difficulties in measuring the value of women's time in the informal sector, or the home, these costs can be significant. For instance, a study using the REDUCE model in four African countries estimated productivity losses from a maternal death at between $850 and $1,838 per case and losses related to maternal disability to range between $83-628 per case.[36] The REDUCE model estimates productivity losses of maternal mortality and morbidity by adjusting annual GDP per capita downwards to arrive at net annual productivity, and then taking into consideration proportions of productivity lost for each complication of maternal death or disability, and the duration of these.[36] Bloom *et al*. estimate that each extra surviving adult per 1000

increases per capita GDP by 0.119%, based on the finding that average wages rise by 0.179% for each additional person surviving from age 15 to 60 and that labour productivity and wages account for two-thirds of national income. [37] A study of malaria found that the condition accounts for a reduction of 0.25 to 1.3 percentage points of economic growth per person per year in malaria endemic countries, controlling for other demographic and economic factors.[38] Further research into the productivity effects of the ill health of women resulting from unsafe abortion in low-income settings is needed.

In many low income countries, households finance a large proportion of the costs of health care. For example, in sub-Saharan Africa, private expenditures on health represent 60% of total health expenditure.[31] Therefore, households are likely to bear a large proportion of the direct costs both of undertaking the abortion itself and of treating subsequent complications. Given the controversial nature of abortion as a medical procedure, and especially in settings where abortion is illegal, women may find it particularly difficult to access funds from usual social networks. Indeed, evidence suggests that women are more likely to seek abortion care alone.[39] For poor households, such expenditure may serve to exacerbate poverty.[40] Further research into the household costs of abortion care and coping strategies for paying for care is required.

A substantial proportion of women need hospital-based care for post-abortion complications but presently do not receive it (15-25 percent of all women who have unsafe abortions) [2]. No doubt this group includes the poorest women, but also, women who have poorest access to medical facilities (rural women) and groups that have greater social or cultural barriers to seeking care (young and unmarried women). If they were able to measure this needed care, the cost of unsafe abortion to health systems would possibly double. While large, this estimate is likely to be a minimum estimate of the marginal costs of addressing unmet need for PAC. In many contexts, there is not the spare capacity to treat these extra cases, implying additional capital costs for the construction of infrastructure as well as additional costs for training. More empirical research into the size and pattern of unmet need is a priority if the overall economic impact of unsafe abortion is to be better understood.

Unsafe abortions are direct consequences of unwanted pregnancies. The costs we have been able to document result from the failure to prevent these pregnancies or, where legal, to terminate them safely. One recent study in Nigeria[8] estimated that the cost of contraceptive services to prevent the unwanted pregnancies would have cost only one-fourth of what was expended in treating post-abortion complications. Results from a model[19] show that the hypothetical cost of obtaining a safe abortion in Uganda could range from $6 to $23 (although a full accounting would have to estimate the cost of prior policy research and advocacy that would be needed before abortion laws were modified

to allow safe and legal abortions), compared to the average regional cost of $89 of treating a post-abortion woman for complications, as determined by our study.

Conclusions and Implications

Empirical studies of the cost of abortion-related morbidity and mortality are scarce and existing data are flawed. This study presents worldwide and regional range estimates of the health-system costs of treating post-abortion complications using two approaches. Based on a synthesis of available cost studies, and using an existing costing framework, globally, these costs lie between $380 and $838 million.[D] Comparing these numbers to a recent analysis of national health accounts, between 0.6% and 1.2% of general government health expenditure is spent on treating unsafe abortions in the developing world.[41] Although the range of estimates is quite wide, the central estimates from the two methodological approaches used here largely coincide: $553 million (top-down approach) and $560 million (bottom-up approach, average of "current" and "standard" estimates).

There remain important data gaps in our evidence base. Specifically, we have identified five areas where additional research is required: 1) What are the size and characteristics of that large group of women who suffer serious complications but are never treated by the health system? 2) What are the economic consequences of morbidity resulting from unsafe abortion including associated productivity losses? 3) What are the costs in Asian and Pacific developing countries? 4) What are the household costs of post-abortion care and coping strategies for paying for required care? And 5) what is the impact of newer methods of abortion (particularly medication abortion) on the severity of unsafe abortion?

These results add a strong and new dimension to existing arguments about the need to eliminate unsafe abortion. Information on the direct health-system costs of unsafe abortion should be communicated to governments, and compared to much less costly alternatives for preventing unintended pregnancy and unsafe abortion. In addition, more resources should be directed towards studying the other costs of unsafe abortion which, in total, likely dwarf the health-system costs estimated here. In particular, data needs to be collected on the size and characteristics of that large group of women who suffer serious complications but are never treated by the health system. The economic consequence of morbidity resulting from unsafe abortion is another area where investigative work is urgently needed including studies of associated productivity losses.

[D] Global estimates are made by assuming that developing countries in Asia, the Pacific and Europe have average cost per cases equivalent to the averages from the two regions for which data exist (Africa and LAC).

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Annex: Exploring other costs of unsafe abortion

Untreated women. A major lacuna in abortion macro-analysis is the almost complete lack of information about the prevalence of women with serious complications who fail to receive medical attention from a regular health facility. Some informed estimates put this proportion at between one third and one half of those who experience complications in countries where access to abortion is highly restricted.[46,47] On the basis of very incomplete data, Benson and Crane estimate that 45 per cent of unsafe abortions—8.9 million—may result in complications annually. Using the estimate of Singh,[2] namely that around 15-25 per cent of women undergoing unsafe abortions suffer untreated complications, we estimate that between 3 and 5 million women have an unmet need for PAC, in addition to the 5.6 million hospitalizations that occur annually.(E)

Some of these women may be treated in non-formal or traditional medical systems and some may receive no treatment at all. Much of the abortion-related mortality takes place in this group of anonymous women. It is also likely that the inadequacies of formal health systems in low-income countries explain a large part of why a significant proportion of such women do not seek care or are unable to access it. Thus, the direct costs to the health system estimated in the previous section do not tell the whole story. If all the unmet demand for PAC were met by the health systems—in other words if the 3-5 million women who presently go untreated were to be treated, in accordance with the main goal of the ICPD—then the direct health-system costs would be much higher than the estimates given above.

Using this rough estimate of untreated women, an idea of the magnitude of the increase in costs can be made. If the cost-per-case method of estimation is used, another $293-$488 million would need to be spent by national health systems. If we use the MBP "bottom up" approach, an additional $277-$432 million would be needed to meet the unmet demand. Whatever the true size of the expenditure, a critical shortcoming in the current delivery of health services in the developing world is apparent.

Morbidity from infertility. One of the most important long-term disabilities associated with unsafe abortion is secondary infertility resulting from serious complications of unsafe abortion such as acute infections or uterine perforations. The incidence of post-abortion secondary infertility is not well documented, but recent work at WHO has estimated the proportion of women suffering from infertility as a result of unsafe abortion

(E) Benson and Crane[47] estimate that only around 75 per cent of women needing hospital care after unsafe abortions actually present themselves at hospitals. Kay *et al*. (p. 446),[20] however, quoting an older study from Chile, report that perhaps only "10-50 % of women who have had unsafe abortions actually receive medical attention." In this study, the 15-25 per cent range reported by Singh[2] has been used.

in the range of 3 to 12 per cent depending on region.[48] From these data, it is possible to obtain rough estimates of the numbers of women suffering from post-abortion infertility.

We can safely assume that very few women in developing countries, except those coming from the highest income strata, are able to seek infertility treatment, given the high cost of techniques such as in vitro fertilization, which, in developed countries, can easily cost several thousands of dollars. Also, in developing countries, infertility treatment within public health systems is virtually unknown. We can conclude with certainty that almost all women who suffer from infertility as a consequence of unsafe abortions belong to the group of women with an unmet need for infertility treatment. However, it has been suggested that in some societies and in certain circumstances—e.g., in cases of powerlessness to use contraception—some women may resort to unsafe abortion as a form of contraception, calculating that the procedure may lead to infertility, an outcome that these women desire.[49] Thus, even if we know how many women suffer infertility as a long-term sequelae of unsafe abortion, we do not necessarily know the proportion of these women who desire to be treated if such treatment were available to them. Obviously, this is an important question that will need empirical research before it can be answered.

From the estimate of infertility morbidity given by Ahman *et al*.,[48] there may be 1.5 million women annually who become infertile after unsafe abortions. If treatment costs around $4,000 for each of these women,[50] then the potential cost of the global unmet need for infertility treatment could amount to $6 billion each year.(F) This estimate would decrease if we could factor in the proportion of infertile women who would not want to be treated, but at the same time it would increase if could estimate the average number of IVF treatments needed before a successful pregnancy occurs.

Even though infertility treatment has almost never been part of the reproductive health services of public health services in the developing world—meaning that only the wealthiest strata can afford treatment—it is nevertheless important to highlight the magnitude of the cost that would be incurred if every case of post-abortion infertility were to receive adequate treatment. Although lack of data prevents precise estimation of this cost, there is no doubt that it is a very substantial amount indeed.

(F) The estimated 1.5 million women who suffer secondary infertility in a given year will not all seek infertility treatment (if it were available) in the same year. Some would never seek it at all and the treatments of those who do would be spread out over a number of subsequent years. However, if we can assume that this pattern remains roughly constant over several years, we can validly make the simplifying assumption that all 1.5 million cases sought treatment in the same year. Nonetheless, the problem of not knowing how many women would never seek treatment, even if it were available, remains, as does the problem of multiple treatments before successful pregnancies.

Out-of-pocket expenses. In the calculations of health-system costs presented above no attempt was made to separate costs borne by the public health system from those borne by the patient or the household to which she belongs. Regarding treatment costs, in some cases health systems have a well-defined schedule of co-payments which patients must pay as part of the service. In other, less well-organized systems, many of the costs that are formally contributed by the public system are in fact often borne by the patients themselves. For example, supplies and medicines may be habitually out-of-stock in public hospitals, so individuals must purchase these items on their own prior to receiving treatment. Thus, some double-counting may occur if patients' out-of-pocket expenses are added to estimated total treatment costs. It is interesting, nonetheless, to examine out-of-pocket expenses on their own since they may be an onerous cost from the woman's viewpoint, particularly if her household income is low to begin with.

The out-of-pocket expenses of women seeking PAC are not confined to incidental (or not so incidental) expenses associated with the treatment itself. They also include such expenses as transportation costs to and from the health facility, food and lodging while awaiting treatment, income foregone while seeking treatment, during treatment and after treatment during the recuperation period, as well as any income foregone by other household members while caring for women with post-abortion complications. To date, very little data have been collected on such costs. The studies that do provide some partial data on out-of-pocket costs are shown in Table 5. As can be seen in the table, the ten such studies primarily provide data on out-of-pocket expenses associated with the PAC treatment itself. The same is true of productive days lost: almost all studies have reported time lost in terms of average length of stay, usually in hospitals, while the treatment was administered. Only the 1980 study in Thailand reported on days lost before, during and after treatment. The Cambodia study reported on all three time periods but provided only aggregate results.

The data presented in Table 5 are obviously limited in geographical coverage. Eight of the studies took place in sub-Saharan Africa, the other two in Asia. None have been carried out in Latin America and Caribbean, northern Africa or Europe. The quality of the data is also suspect. For example, the Nigerian and Cambodian studies both measured out-of-pocket treatment costs, but in Nigeria these costs amounted to $104 whereas in Cambodia the cost was only about $7. The two sets of studies in Senegal, too, show quite different out-of-pocket cost ranges (e.g., from $16 to $75 for women seeking PAC during the pre-test phase of the studies) even though they employed similar methodologies. Average-length-of-stay data, on the other hand, show much less variation, with an average of 1.6 days. However, a better estimate of average length of stay (ALOS) may be obtained from a wider set of studies that report ALOS even though they do not report on out-of-pocket expenses. Vlassoff *et al*. compiles ALOS from 38 studies (some of which

contained more than one sample), including the ones listed in Table 5.[51] The average length of stay over all these studies—which include some studies sampling women with severe complications necessitating longer hospital stays—is 3.3 days.

African data suggests that in Sub-Saharan Africa total out-of-pocket expenses for PAC treatment may amount to just under $200 million. Except for the dated Thai study, however, we have no information on productive days lost before treatment, transportation, food and lodging costs, or on productive days lost by the woman and other household members during the convalescence period. The Thailand data suggest that the before and after periods may account for the majority of lost income from post-abortion complications compared to the time lost during the treatment itself.[51] Extrapolating the Thai data to all developing countries, foregone income before, during and after treatment may total more than $400 million.(G) With so many missing pieces of information, nevertheless, estimating global or regional out-of-pocket costs is little more than guesswork.

Other direct costs. Certain other costs are borne by the affected women themselves or by the household in which they live. One such indirect cost of abortion-related mortality is the *cost of orphanhood*. Several studies of orphanhood costs after AIDS-related deaths of parents are available, which could serve as models for costing this aspect of unsafe abortion. Another indirect cost is the negative effect on *children's future prospects*, mainly through losing out on educational opportunities, but also via the negative effects of chronic poor health and nutrition. In all these cases, the causal chain would run from either crippling household costs from treatment, or from the death of the mother or from her long-term disability, to reduced expenditure on education, health or food. Finally, there are *psychological costs* as well. Secondary infertility in many settings is extremely damaging psychologically and stigmatizing to the woman. Chronic PID, teratogenicity(H) and dyspareunia(I) can also cause marital stress and lead to psychological trauma.

Loss of income. Death and disability affect a country's economy chiefly by lowering labor productivity and by lessening savings and investment.

(G) This estimate is based on 5.6 million women seeking PAC, the averages of lost productive time given in Table 5 and the global average for per capita income.

(H) Teratogenicity: the presence of an agent or factor that causes malformation of an embryo.

(I) Dyspareunia: difficult or painful sexual intercourse.

(a) Mortality. We first look at the impact that abortion-related mortality has on the economy or, conversely, the added economic benefits that would accrue in the absence of abortion-related deaths. Around 66,000 such deaths occur each year in the developing world. We follow the approach of Bloom, Canning and Wilson in valuating the gains to the economy through the mechanisms just described.[37] Building on prior work by Weil (Weil 2005),[52] Bloom *et al*. calculated the gains accruing to better survival through better health: "… each extra surviving adult in a group of 1,000 boosts income per capita by 0.119 per cent" (p. 35).

In order to make use Bloom's estimate of gain in per capita income from a reduction in mortality, we first estimate the number of additional women surviving to age 60 if all abortion-related deaths were eliminated.[J] With small incremental numbers, per capita income increases by an insignificant amount—only one US cent or less—depending on the region. For all developing regions combined the estimated cost of premature death due to unsafe abortion, in terms of lost productivity, is about $9.3 million.

(b) Morbidity. The long-term health consequences of abortion complications have not been well studied. Among those noted in the literature are: secondary infertility, hysterectomy, severe anemia, and pelvic inflammatory disease (PID). Empirical data on the incidence of these long-term morbidities, however, are almost non-existent. The only source of quantitative information on post-abortion morbidities comes from the World Health Organization. A WHO report[48] gives global estimates for both secondary infertility (see above) and PID.(K) According to this report, between 15 and 30 per cent of women having unsafe abortions develop reproductive tract infections (RTI) which can lead to secondary infertility as well as PID. The study estimates the incidence of infertility at 3-12 per cent of these women. Furthermore, from the WHO/World Bank Global Burden of Disease project, disability weights for infertility and chronic RTI are available.(L)

[J] We make the simplifying assumption that in each region, all abortion-related deaths occur at the observed average age of unsafe abortion using WHO data on age patterns.[53] We also assume that the age pattern of abortion-related deaths mirrors the age pattern of unsafe abortion. Using survival rates for the various sub-regions we then calculate how many of those women, *if they had not died from abortion complications*, would survive to age 60, using WHO life tables (pp. 96-124).[54] Since mortality patterns vary significantly within sub-regions, we have calculated survivors based on sub-regional survival rates, rather than using the large regional aggregates. In this analysis GDP is used as a proxy for income.

(K) Ahman *et al*. estimated that 16.5 per cent of women with unsafe abortions develop chronic PID.[48]

(L) The GBD disability weight for infertility is 0.180, meaning that on average a women suffering from infertility is physically disabled for 18 per cent of her life *post facto*. The disability weight for chronic RTI is 0.067.[55]

Using these sparse empirical estimates as a starting point, it is possible to approximate the effect that unsafe abortions have in lowering the productivity of women who subsequently suffer long-term morbidities (at least the two that are identified in the Global Burden of Disease work). To estimate the indirect cost of decreased functioning, we assume that the disability weights given by the GBD are reasonable proxies of the reduced productivity of women suffering from those disabilities. For example, a woman suffering infertility sequelae has a GBD disability weight of 0.18.[55] In a setting where the woman's average income is, say, $1,000 per annum, the value of lost income due to her disability would be estimated at $180 per year.

Out of 19.8 million women experiencing unsafe abortions annually, around 4.6 million are estimated to suffer from long-term PID and a further 1.6 million from secondary infertility (central estimates). For infertility morbidity, we estimate that the range that likely includes the true incidence figure goes from 1.2 million to 1.8 million women. For RTI/PID incidence, the range is from 3 million to 5 million women. This wide range seems appropriate given the weakness of the incidence rate estimates.

We estimate that infertility morbidity costs between $340 and $495 million in lower productivity over a one-year period, the central estimate being $419 million.[M] For RTI long-term morbidity, the estimated range is $380-$760 million and the central estimate is $503 million. Combining the two long-term morbidities, disability caused by unsafe abortions may cost from $720 million to $1.2 billion in lost income and production measured over one year. However, since we have no data on the extent to which these two disabilities might overlap, adding together the estimated costs of the two quite likely over-estimates the total cost. For example, if 50 per cent of all women suffering from post-abortion infertility also suffered from long-term PID, then the combined range of cost estimates would be lower: $550 million to $1 billion.

In this estimation of costs, we account for only one annual cohort of women undergoing unsafe abortions and evaluate the economic cost over a period of only one year. But each year about 19 million women suffer the same fate. To the extent that long-term disabilities persist for longer than one year—which is very likely—there would be a multiplier effect of women from previous years whose productivity was still adversely

[M] We assume that the value of a woman's work is equivalent to the national per capita income of the country she lives in. We calculate central estimates of the numbers of women suffering long-term disability effects using WHO's suggested rates, as well as lower-bound and upper-bound estimates to form ranges within which we can be more confident that the true incidence numbers lie. In the case of secondary infertility, WHO assigns incidence rates of 3-12 per cent of unsafe abortion cases depending on region. There is even less certainty in the case of the WHO estimates of RTI incidence among women having unsafe abortions, which WHO gives as between 15 and 30 per cent.[48]

affected by lingering disability. Without better data on how these disabilities persist over time, however, it is not possible at present to include a multiplier in these cost estimates.

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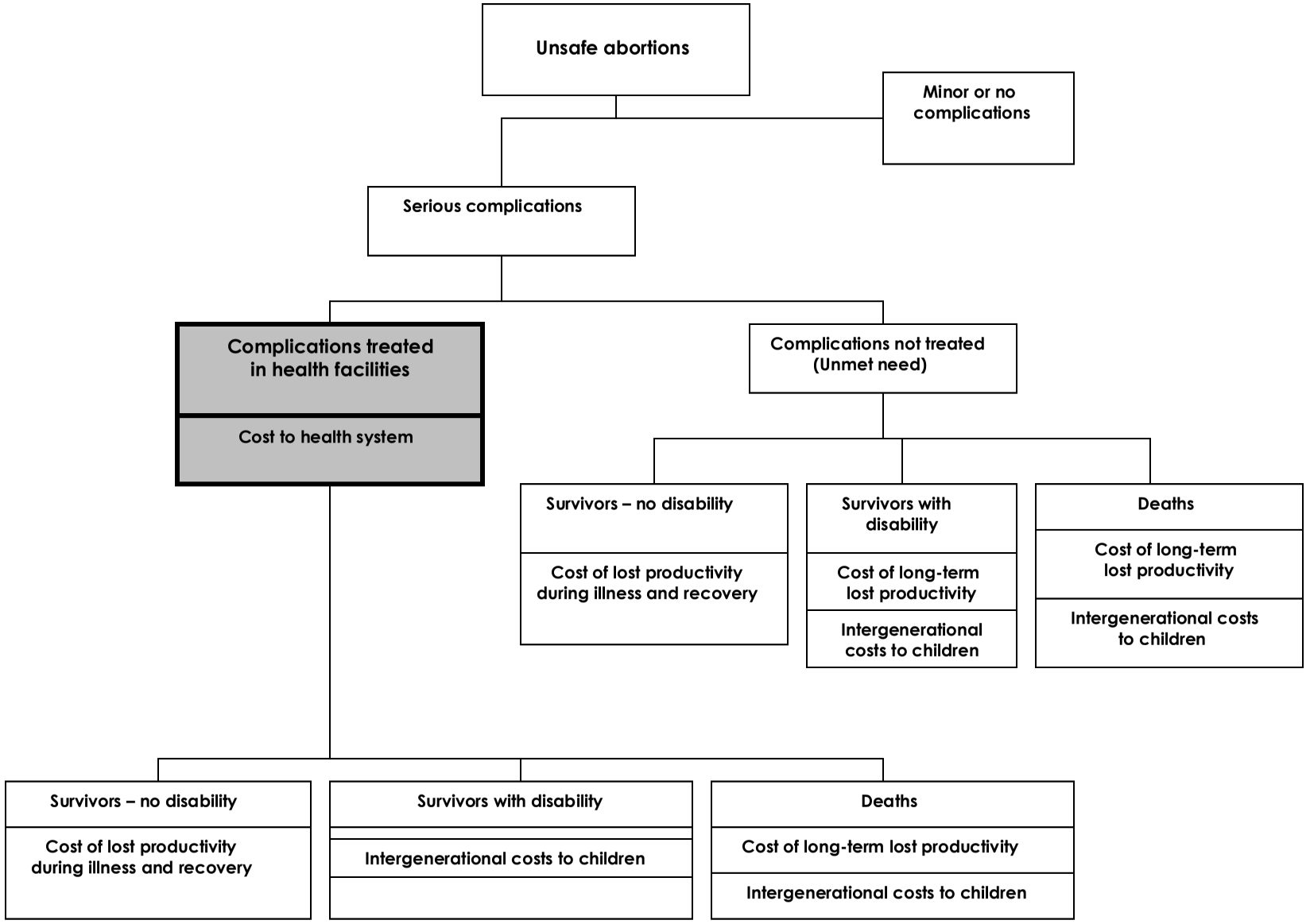

Figure 1: Framework for estimating the economic costs of unsafe abortion

Table 1. Average Costs per Patient from 20 Empirical Investigations

	Number of studies or samples	Cost per patient		
		Study year, US$	US$ (2006)	International dollars (2006)
Simple averages from all samples included in the 20 articles	72	$70.56	$86.04	$176.02
Simple averages of low-severity samples	46	$57.43	$72.07	$132.82
Simple averages of all-severity samples	26	$93.78	$110.76	$252.45
Simple averages from the 20 articles (after taking averages within each study)	20	$71.09	$88.28	$187.16
Simple averages of low-severity samples	10	$54.91	$67.72	$126.88
Simple averages of all-severity samples	10	$87.26	$108.84	$247.45
Africa	10	$62.93	$82.63	$212.87
Sub-Saharan Africa	*9*	*$67.56*	*$88.82*	*$227.92*
Latin America and Caribbean	11	$79.24	$93.92	$161.45
Cost Estimation Method 1: Lower Bound	20	$54.91	$67.72	$126.88
Cost Estimation Method 2: Severity Patterns	20	$93.21	$114.96	$215.38
Cost Estimation Method 3: Adding Overhead, Capital Costs				
Africa	10	$87.02	$114.26	$294.35
Sub-Saharan Africa	*9*	*$93.42*	*$122.82*	*$315.16*
Latin America and Caribbean	11	$109.57	$129.87	$223.25

Table 2. Applications of the MBP Costing Spreadsheet: Cost per Case of PAC (US$)

Study Area	Year of study	Cost of PAC - Health Centers (cost per case, current US$)		Cost of PAC - Hospitals (cost per case, current US$)		Cost of PAC - Overall (cost per case, current US$)		Cost of PAC - Overall (cost per case, 2006 US$)	
		Current	Standard	Current	Standard	Current	Standard	Current	Standard
Uganda[31]	1996	$1.71	$9.78	$12.16	$34.51	$8.24	$25.24	$10.16	$31.24
Bolivia[15]	1997	--	--	--	--	$69.00	$109.00	$83.67	$132.17
Mexico[14]	2001	--	$94.07	--	$198.36	--	$187.42	--	$211.72
Ghana[9]	2003	$36.90	$36.09	$54.85	$56.40	$45.88	$46.25	$49.92	$50.33
Nigeria[10]	2005	$74.00	--	$132.00	--	$103.00	--	$112.08	--
SSA								**$57.39** (1)	**$64.55** (3)
LAC								**$108.85** (2)	**$171.95** (4)

(1) Average of Uganda, Ghana, Nigeria

(2) Average of Bolivia and Mexico, assuming Mexico Current has same Current-to-Standard ratio as Bolivia

(3) Average of Uganda, Ghana, Nigeria, assuming Nigeria Standard is the same as Nigeria Current

(4) Average of Bolivia and Mexico

Notes:

Bolivia: Costs given in per capita terms. South American population and number of hospitalized PAC cases used to convert costs to per-case basis.

Ghana: Study does not give shares of cases treated in health centers and in hospitals. 50% : 50% shares assumed.

Two right-most columns show costs converted to US 2006 dollars. All other costs refer to year of study.

Table 3. Regional Estimates of Health-System Costs of PAC (2006 US$) Using Cost per Patient Averages

Developing Regions	Number of PAC Cases Treated	Method 1: Determining Lower Boundaries	Method 2: Using Severity Complication Patterns	Method 3: Adding Overhead and Capital Costs	Central Estimates
Africa	1,730,000	$117,000,000	$199,000,000	$198,000,000	$171,000,000
Sub-Saharan Africa	*1,180,000*	*$80,000,000*	*$136,000,000*	*$145,000,000*	*$120,000,000*
Latin America and Caribbean	1,040,000	$70,000,000	$120,000,000	$135,000,000	$108,000,000
Total	2,770,000	$187,000,000	$319,000,000	$333,000,000	$280,000,000

Table 4. Applications of the MBP Costing Spreadsheet:

Global and Regional Estimates of Cost of PAC (2006 US$)

Developing Regions	**Number of PAC Cases Treated** (in 000s)	**Cost of PAC** (in millions)		**Sensitivity Analysis: Minimum Estimated Cost of PAC** (in millions)		**Sensitivity Analysis: Maximum Estimated Cost of PAC** (in millions)	
		Current	**Standard**	**Current**	**Standard**	**Current**	**Standard**
Africa	1,730	$114	$141	$99	$112	$188	$298
Sub-Saharan Africa	*1,180*	*$68*	*$76*	*$68*	*$76*	*$128*	*$203*
Latin America and Caribbean	1,040	$113	$179	$60	$67	$113	$179
Total	2,770	$227	$320	$159	$179	$302	$476

Table 5. Summary of Studies of Out-of-Pocket Expenses of Women with Post-Abortion Complications

Country	Date of Survey	Productive Days Lost Before Treatment	Losses During Treatment		Productive Days Lost After Treatment	Losses (Time Period Not Given)		
			Expenses (Self)	Productive Days		Expenses (Self)	Income (Others)	Productive Days
Burkina Faso[56]	1996-1998	--	$41.54	1.5	--	--	--	--
Burkina Faso[56]	1996-1998	--	$18.33	0.8	--	--	--	--
Cambodia[57]	Nov-Dec 2005	--	--	--	--	$4.82	$2.26	3.0
Kenya[58]	1996	--	$9.94	1.7	--	--	--	--
Nigeria[8]	2002-2003	--	$104.07	2.9	--	--	--	--
Senegal[59]	1997	--	$74.52	2.3	--	--	--	--
Senegal[59]	1997	--	$56.20	1.9	--	--	--	--
Senegal[60]	2001	--	$15.58	1.3	--	--	--	--
Senegal[60]	2001	--	$12.78	0.4	--	--	--	--
Thailand[51]	1980	6.9	--	2.0	2.6	--	--	--
	Simple Averages:	**6.9**	**$41.62**	**1.6**	**2.6**	**$4.82**	**$2.26**	**3.0**

Notes: (1) All costs given in US dollars (2006).

(2) In some cases, expenses or productive days lost were reported as distributions. In such cases, weighted averages were calculated from the distributions.