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Original Article

The cost of post-abortion care in developing countries: a comparative analysis of four studies

Michael Vlassoff,* Susheela Singh and Tsuyoshi Onda

Guttmacher Institute, 125 Maiden Lane, 7th Floor, New York, NY 10038, USA

*Corresponding author. Guttmacher Institute, 125 Maiden Lane, 7th Floor, New York, NY 10038, USA.
E-mail: mvlassoff@guttmacher.org

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Abstract

Over the last five years, comprehensive national surveys of the cost of post-abortion care (PAC) to national health systems have been undertaken in Ethiopia, Uganda, Rwanda and Colombia using a specially developed costing methodology—the Post-abortion Care Costing Methodology (*PACCM*). The objective of this study is to expand the research findings of these four studies, making use of their extensive datasets. These studies offer the most complete and consistent estimates of the cost of PAC to date, and comparing their findings not only provides generalizable implications for health policies and programs, but also allows an assessment of the PACCM methodology. We find that the labor cost component varies widely: in Ethiopia and Colombia doctors spend about 30–60% more time with PAC patients than do nurses; in Uganda and Rwanda an opposite pattern is found. Labor costs range from I$42.80 in Uganda to I$301.30 in Colombia. The cost of drugs and supplies does not vary greatly, ranging from I$79 in Colombia to I$115 in Rwanda. Capital and overhead costs are substantial amounting to 52–68% of total PAC costs. Total costs per PAC case vary from I$334 in Rwanda to I$972 in Colombia. The financial burden of PAC is considerable: the expense of treating each PAC case is equivalent to around 35% of annual per capita income in Uganda, 29% in Rwanda and 11% in Colombia. Providing modern methods of contraception to women with an unmet need would cost just a fraction of the average expenditure on PAC: one year of modern contraceptive services and supplies cost only 3–12% of the average cost of treating a PAC patient.

Key words: Abortion, cost, developing countries, post-abortion care

Key messages

- Four recent costing studies, which provide the best estimates of the cost of post-abortion care (PAC) to national health systems, show that costs per case vary widely, from I$334 in Rwanda to I$972 in Colombia.
- The components of PAC costs—labor, drugs/supplies, overhead and capital—also differ substantially among the four countries, showing that resource-allocation decisions are important in determining the efficiency with which PAC is provided to clients.
- The financial burden of PAC is considerable: the expense of treating one PAC case is equivalent to around 33% of annual per capita income in Uganda, 25% in Rwanda and 10% in Colombia.
- Providing modern methods of contraception to women with an unmet need would cost just a fraction of the average cost of PAC.

Introduction

In 2008, around 21.2 million unsafe induced abortions[1] took place in the developing world (WHO 2011), and between 22 000 and 44 000 women died from abortion-related causes.[2] In 2012, an estimated seven million abortions were cared for in health facilities in developing countries for medical complications that required medical treatment (Singh and Maddow-Zimet 2015). Post-abortion care (PAC) encompasses the treatment of many types of medical complications, the most common one being incomplete abortion, ranging to less common but much more severe ones such as sepsis and uterine perforation.[3] Treating unsafe abortions, while essential for women's health and survival, diverts health resources from other uses and is a significant burden to the health care systems in developing countries where 98% of all unsafe abortions occur (WHO 2011). At the same, it is a preventable phenomenon depending on access to safe abortion care or effective contraception. Therefore, there is both an interest and a need to estimate the cost of PAC to inform public discussion of unsafe abortion and to help policy makers more efficiently allocate resources (Vlassoff *et al.* 2009b).

The report *Adding it up: the costs and benefits of investing in sexual and reproductive health* (Singh *et al.* 2014) estimates the total health-system cost of providing PAC services in the developing world at US $232 million in 2014. Because many women need PAC but cannot access it—and those who do get medical care may not receive comprehensive quality care—providing all women in need with the WHO recommended standard of care would cost substantially more, an estimated $562 million. Unsafe abortion is a burden not only for health systems but also for women themselves and their households. A study in Uganda, where abortion is common despite being legally restricted and highly stigmatized, found that women having unsafe abortions spent on average US $49 in out-of-pocket expenditures for the procedure as well treatment of complications (Sundaram *et al.* 2013). For many of these women, similar to much of the developing world where unsafe abortion is prevalent, such expenditures are onerous given the prevailing low levels of income.

Until recently, few studies on the cost of PAC were available and they generally lacked a standard methodology, making their findings difficult to generalize (Vlassoff *et al.* 2009b; Shearer *et al.* 2010). In response to this knowledge gap, a coherent methodology has been developed, pilot tested and further refined in four successive country studies. This methodology, the *Post-abortion Care Costing Methodology* (*PACCM*), will be described in more detail below. The findings of the studies using PACCM provide the start of a consistent evidence base, comparable across countries and regions. While calculating the cost of unsafe abortion varies according to the frame of reference chosen (Vlassoff *et al.* 2008), PACCM adopts the perspective of national health systems, focusing on the financial burden that the treatment of post-abortion complications imposes on health systems.

Over the last five years, comprehensive national surveys of the cost of PAC to national health systems have been undertaken in Ethiopia, Uganda, Rwanda and Colombia using the PACCM approach. (Vlassoff et al. 2012; Prada *et al.* 2013; Vlassoff *et al.* 2014a,b) This study extends the research findings of these four studies, making use of their extensive datasets to thoroughly exploit the possibilities for comparative analysis. Our objective is to compare empirical results of the health-system costs of treatment of complications resulting from unsafe induced abortion from these country applications of the PACCM methodology. These studies offer the most complete and consistent estimates of the cost of PAC to date, and comparison of their findings not only provides generalizable implications for health policies and programs, but also allows an assessment of the PACCM methodology.

Data sources and methods

PACCM follows the 'ingredients approach' (Johns *et al.* 2003) and traces its origin to the WHO's *Mother-Baby Package* costing spreadsheet (Weissman *et al.* 1999). A prototype of the method was first used in an abortion-incidence study in Nigeria (Bankole *et al.* 2007) and subsequently the Guttmacher Institute developed PACCM, first testing it out in pilot studies in Mexico, Ethiopia and Pakistan in 2008. PACCM, using a health-system perspective, was designed as a low-cost method of estimating PAC costs that would be useful for policy analysis. Data on drugs, supplies and materials, labor inputs of medical personnel, hospitalization costs, overhead costs and capital costs are collected from key informants in a survey of health facilities. Direct-cost data are gathered on each of the five broad categories of abortion complications—incomplete abortion, sepsis, shock, cervical/vaginal laceration, and uterine laceration/perforation (WHO 1999).[4] A key feature of PACCM is its coverage of both direct and indirect costs—overhead and infrastructure costs that, while not direct inputs into the provision of specific treatments, are nevertheless necessary for the provision of care in general. Indirect costs, in particular, have rarely been estimated in earlier costing studies (Vlassoff *et al.* 2009b). However, PACCM studies show that indirect costs are an important component of total PAC costs. Other work, not related to PAC costs, has also highlighted the importance of indirect costs. For example, a United Nations report estimated that in 2009 indirect (also referred to as non-medical) costs made up two-thirds of total reproductive health costs in Sub-Saharan Africa (United Nations, Economic and Social Council 2009).

Each of the four studies surveyed a sample of health facilities that provide PAC, with a typical sample size of about 40 facilities, relatively small but considered adequate to represent variation, and having the advantage of keeping data-collection costs low. The design of the sample of health facilities takes into account the three dimensions of region, facility type and ownership. Within each region-type-ownership cell it is assumed that there will be little variation in the cost inputs such as drug dosages or salaries of personnel, making it reasonable to select just a few facilities per cell. Major regions of the country should be included in the design, to the extent that ethnic, cultural or socio-economic differences could conceivably affect the availability and quality of PAC. Usually three types of facility are sampled representing major levels of health care, keeping in mind that facilities with no capacity to provide PAC should not be included.

For each of the five post-abortion conditions, PACCM gathers detailed data on labor, drugs, materials and supplies, which together make up the direct cost of PAC. The labor component consists of the salary cost of the time spent treating the patient by all health workers involved in the patient's care (over the full course of a patient's stay). Labor from all medical personnel is accounted for in PACCM, from gynecologists and anesthesiologists, to various cadres of nurses, to lab technicians and pharmaceutical staff. Typically, specific data on ten or more categories of worker are collected. As medical staff's time is not entirely devoted to providing care, data are collected on the non-medical time spent by each category of worker, for example in activities such as meetings, training, idle time and paperwork. This information is used to adjust upward the contribution of labor to the total cost per PAC treatment.

The second major component of direct cost in the PACCM is the sum of all inputs of drugs, materials, supplies and lab tests given

over the course of a particular treatment. The number of inputs is quite large, typically in the range 100–150. For each input used in the treatment of a specific post-abortion complication and inpatient/outpatient status, we calculate an average cost by multiplying the percent of patients receiving the input by the number of units given over the course of treatment. Furthermore, these data are gathered separately for inpatients and outpatients, as the quantity of inputs given to patients may differ substantially by inpatient/outpatient status. The unit prices of these physical inputs are not collected in the PACCM survey itself. Prices of drugs and supplies are obtained both from a country's state medical procurement and distribution organization and from several international sources. Other factors influencing final cost, either positively or negatively, such as spoilage, stock-outs, transportation costs and bulk-order discounts are not measured. The prices of laboratory tests are obtained from a small survey of private laboratories. The cost of blood, particularly important for some complications such as shock, is also obtained through country-specific efforts.

In PACCM two kinds of indirect cost data are collected, covering capital costs and overhead costs. Capital cost include the cost of construction of facilities as well as the complete cost of equipping the facilities with furniture, vehicles, specialized machines and equipment such as X-ray machines and laboratory equipment. Key informants are also asked to estimate the useful lifetime of the facilities. These data, together with an assumed annual rate of inflation, allow the annual cost of capital per facility to be calculated.

The overhead costs in PACCM comprise all operational and other variable costs of health facilities that are not directly related to medical care. Detailed data are gathered on the labor cost of all non-medical staff, as well as annual expenditures for items such as outsourced services, administration, maintenance, utilities, insurance and other sundry costs. The number of data points in the PACCM questionnaires devoted to overhead items is typically in the order of 50–70 depending largely on the number of identifiable cadres in the country's health system.

Two questionnaires, one for collection of data on drugs, supplies and materials and one for all other inputs, gather information from key informants such as senior health care providers and facility administrators. Questionnaire A queries informants on labor costs, overhead costs and capital costs associated with the provision of PAC in their facilities. First, for each of the five abortion complications, the survey gathers data on the percent of cases, on average, that are attended by each type of health worker and the average number of minutes each worker spends treating or attending the patient.

Questionnaire A also collects information on the monthly salary for each cadre (including fringe benefits such as health insurance, pensions, travel allowances, etc.), and the time health personnel spend on non-treatment activities such as administrative duties and idle time. In order to collect information on the indirect costs, the respondents are also asked to provide estimates on the useful life of the infrastructure and equipment, the cost of constructing new facilities and a checklist of specific overhead expenses at their facilities. Questionnaire A is also administered to key informants at the central level (e.g. ministries of health or headquarters of faith-based organizations), as a means of cross-checking information gathered in facilities.

Questionnaire B collects detailed information about the kinds and quantities of drugs, supplies and materials used for each of the five types of abortion complication. Respondents are requested to estimate the percent of patients receiving each input used in treating each condition, as well as the quantity of the drug typically administered or the quantity of supplies/materials consumed. This questionnaire also gathers information on laboratory tests performed. Information about additional drugs or supplies not listed in the questionnaire but still used at the facility to treat complications is solicited as well.

Given the technical nature of the PACCM questionnaires, the field personnel selected for conducting interviews need to have a fairly high level of qualifications and/or experience. Recent graduates of master programs in public health or even physicians preparing for internships have been respondents for these four applications of PACCM. Approximately one facility can be covered per day because of the number of interviews and the amount of time needed to collect the full set of data for a facility. Interviews with several health workers and administrators are typically required to completely fill out the two questionnaires and interviews with respondents are often split into two or more sessions to avoid respondent fatigue and also because medical personnel need to respond to emergencies as they arise.

Although PACCM basically uses accounting type calculations, the number of dimensions in the data leads to somewhat complex formulae. Computing the cost of labor can be summarized by the following three equations.

$$L_{i,j,k} = S_k \times M_{i,j,k} \times P_{i,j,k} \times A_{i,k} \quad (1)$$

where $L_{i,j,k}$ is the unit cost of labor in facility type i, for treating one patient with complication j by cadre k, S_k is the salary per minute of cadre k, $M_{i,j,k}$ is the treatment minutes spent in facility type i, for complication j of cadre k, $P_{i,j,k}$ is the percent of cases of complication j which are attended to by cadre k in facility type i, $A_{i,k}$ is the adjustment factor (for non-treatment work time) in facility type i, for cadre k, i is the ith type of facility, $i = 1$ to I, j is the jth type of abortion complication, $j = 1$–5, k is the kth type of cadre (category of health worker), $k = 1$–K and $K$is the number of cadres.

$$A_{i,k} = 1.00 + \left(\frac{NT_{i,k}}{1.00 - NT_{i,k}}\right) \quad (2)$$

where $NT_{i,k}$ is the percent of non-treatment work time in facility type i, for cadre k.

$$LT = \sum_{i=1,\ I} X_i \times \left[\sum_{j=1,5} Y_j \times \left(\sum_{k=1,K} L_{i,j,k}\right)\right] \quad (3)$$

where LT is the total cost of labor, X_i is the number of facilities of type i and Y_j is the proportion of cases that are complications of type j.

Computing the cost of drugs, supplies and materials is given by the following two equations.

$$D_{i,j,k} = C_i \times B_{i,j,k} \times Q_{i,j,k} \quad (4)$$

where $D_{i,j,k}$ is the cost of input i, to treat complication j, under service k, C_i is the price per unit of input i, $B_{i,j,k}$ is the percent of patients with complication j who receive input i, under service k, $Q_{i,j,k}$ is the number of units of input i, for complication j, under service k, i is the ith input (drug, supply, material), $i = 1$–I, j is the jth type of abortion complication, $j = 1$–5, k is the kth type of service (inpatient, outpatient), $k = 1$–2, I is the number of inputs and K is the number of services (=2).

$$DT = \sum_{j=1,5} F_j \times \sum_{i=1,I} \left(\sum_{k=1,2} D_{i,j,k} \times E_k\right) \quad (5)$$

where DT is the total cost of drugs, supplies and materials, E_k is the proportion of patients using service k and F_j is the proportion of patients suffering from complication j.

The annual per-facility capital cost for PAC by type of facility is computed as follows:

$$K_i = A_i \times G_i \times \frac{1}{V_i} \quad (6)$$

where K_i is the annual capital cost needed to treat one PAC case in one facility of type i, A_i is the annual amortized cost of capital per year of useful life in one facility of type i, G_i is the proportion of the facility's cases that are PAC cases in one facility of type i, V_i is the number of PAC cases per year in one facility of type i and i is the ith type of facility.

For amortization, a constant rate of inflation of 3% per annum is assumed.

The total per-facility overhead cost for each facility type is calculated as:

$$TO_i = \sum_{j=1,J} U_{i,j} + \sum_{k=1,K} SO_k \times NO_{i,k} \quad (7)$$

where TO_i is the total overhead cost of one facility of type i, $U_{i,j}$ is the annual cost of overhead cost j in facility type i, SO_k is the annual salary of non-medical cadre k, $NO_{i,k}$ is the number of workers in cadre k in one facility of type i, J is the number of types of non-labor overhead expenditure, K is the number of non-medical cadres and i is the ith type of facility.

$$O_i = TO_i \div V_i \quad (8)$$

where O_i is the annual overhead cost needed to treat one PAC case in facility type i, V_i is the annual number of PAC cases attended to in one facility of type i and i is the ith type of facility.

Results

Comparison of four studies that applied the PACCM methodology

Although some details of the PACCM methodology changed from study to study, the broad similarity among the four studies allows us to compare their findings and to make wider generalizations. The studies covered Ethiopia (2008),[5] Uganda, (2010), Rwanda (2012) and Colombia (2012). Table 1 lists some key indicators of the four countries as well as characteristics of the four surveys carried out in these countries. The three African countries are similar in terms of income, their GDPs per capita falling within a narrow range (I$981–I$1167).[6] Colombia's income level is far higher (I$9121). Annual expenditure on health follows the same pattern: Colombians spend at least five times more than any of the three African countries. Also noteworthy is the fact that health spending per capita in Rwanda is three times greater than in Ethiopia. Furthermore, while Ethiopia spends around 5% of its income on health, Uganda and Rwanda spend around 10%.

In all four countries access to legal abortion is highly restricted. However, in 2005 Ethiopia broadened the grounds for legal

Table 1. Key characteristics of four studies of the cost of PAC in Ethiopia, Uganda, Rwanda and Colombia

	Ethiopia	Uganda	Rwanda	Colombia
Country economic and health indicators				
Number of women aged 15–44 (in 2010)	18 524 000	6 951 000	2 433 000	11 200 000
Number of induced abortions*	382 000	297 000	60 000	404 000
Number of PAC cases from induced abortion*	53 000	85 000	17 000	93 000
Induced abortion rate**	23	54	25	39
GDP per capita (I$2012)***	981	1165	1167	9121
Health expenditure per capita (I$2012)	64	122	188	927
Health expenditure as a percent of GDP (%)	5	9	11	6
*Distribution of post-abortion complications (%) *****				
Incomplete abortion	93.0	66.7	75.7	93.8
Sepsis	16.0	22.3	12.8	9.9
Shock	4.0	9.4	9.1	4.9
Lacerations	4.0	6.6	0.8	0.6
Perforations	1.0	3.2	1.5	0.4
All complications	118.0	108.2	99.8	109.5
Survey characteristics				
Year of data collection	2008	2010	2012	2012
Number of facilities in sample	14	39	39	30
Primary-care-level facilities	8	10	20	5
Secondary-care-level facilities	5	17	10	11
Tertiary-care-level facilities	1	12	3	14
Private facilities in sample	6	5	6	0
Coverage of survey	Sub-national	National	National	Urban based
Sample selection	Purposive	Purposive	Random	Random

*In year of study (see sources).

**Number of induced abortions per 1000 women aged 15–44.

***Gross Domestic Product per capita on a purchasing power parity basis, international dollars.

****Percent of PAC cases presenting with a particular complication.

Sources: Prada et al. (2011) (Colombia).Singh et al. (2005) (Uganda, number of PAC cases). Vlassoff et al. (2014a) (Uganda, distribution of post-abortion complications). Singh et al. (2010b) (Ethiopia, number of PAC cases). Gebreselassie et al. (2010) (Ethiopia, distribution of post-abortion complications). Basinga et al. (2012) (Rwanda, number of PAC cases). Vlassoff et al. (2014b) (Rwanda, distribution of post-abortion complications). World Bank *World Dev Indicators* (financial data). United Nations Population Division *Population Prospects: the 2012 Revision* (demographic data).

abortion and in 2006 new procedural guidelines considerably increased access to abortion *de facto* (Singh *et al.* 2010). Colombia also widened access to abortion in 2006 as the result of a ruling by the Constitutional Court of Colombia (Prada *et al.* 2011). As seen in Table 1, Uganda has a very high abortion rate—one of the world's highest—while Ethiopia and Rwanda exhibit more moderate abortion rates. Colombia's abortion rate of 39 induced abortions per 1000 women in 2008 is higher than the Latin American regional average of 32 (Sedgh *et al.* 2012). Around 23–29% of women undergoing induced abortion were treated for post-abortion complications in Uganda, Rwanda and Colombia, but only 14% in Ethiopia. This proportion depends on two factors: the proportion of induced abortions that result in complications that need medical care in a facility (which in turn depends on the number of abortions carried out in unsafe conditions) and the proportion of women with such complications who are able to access facility-based care. One or both of these factors likely play a role in the low proportion observed in Ethiopia.

The reported distributions of types of post-abortion complications (Table 1) show some variation among the four countries. Incomplete abortion, the least severe of the five complications analyzed, makes up > 85% of all post-abortion complications in Colombia, but only a little over 60% of them in Uganda. Conversely, perforations of the uterus, the most serious complication, are almost absent in Colombia but comprise around 3% of all complications in Uganda. In general, the severity burden is highest in Uganda and lowest in Colombia. Ethiopia and Rwanda fall in between these two extremes.

The four studies are all based on survey data collected from PAC providers and administrators at health facilities. In Rwanda and Uganda the selection of facilities (39 facilities in each case) gave the data collected a national coverage. In Colombia, 30 facilities were selected from all five major regions of the country, but were limited to the largest urban centers in each region. In Ethiopia, due to budget restrictions, only 14 facilities were sampled, all of them either in the capital city, Addis Ababa, or in neighboring districts. As such, the findings of the Ethiopian study are not necessarily representative of the whole country. Despite these differences among the four studies, the commonality of the methodology allows us to explore variations in treatment inputs to gain a better understanding of PAC cost drivers.

Table 2. Comparison of labor inputs from four studies of the cost of PAC in Ethiopia, Uganda, Rwanda and Colombia

	Ethiopia	Uganda	Rwanda	Colombia	Average
Average number of minutes spent with a PAC patient					
Doctor	202	99	87	185	143
Nurse/midwife	152	220	245	114	183
Technical personnel	17	41	56	157	68
Counselor	48	30	9	39	31
Auxiliary nurse	63	65	NA	181	103
Total minutes spent	*482*	*455*	*397*	*677*	*528*
Percent of total time spent with a PAC patient (%)					
Doctor	42	22	22	27	27
Nurse/midwife	32	48	62	17	35
Technical personnel	4	9	14	23	13
Counselor	10	7	2	6	6
Auxiliary nurse	13	14	NA	27	20
Total minutes spent	100	100	100	100	100
Average monthly salary (I$2012)					
Doctor	3363	1293	3561	9293	4377
Nurse/midwife	972	657	1209	3315	1538
Technical personnel	655	798	1472	4039	1741
Counselor	1354	620	964	3605	1636
Auxiliary nurse	555	318	NA	1986	953
Percent of work year spent in non-treatment activities (%)					
Doctor	2	18	6	3	7
Nurse/midwife	12	15	9	15	13
Technical personnel	16	12	9	9	12
Counselor	10	12	11	6	10
Auxiliary nurse	5	7	NA	6	6
Average across cadres	9	13	9	8	10
Cost of labor per PAC case (I$2012)					
Doctor	30.2	19.6	22.2	159.2	57.8
Nurse/midwife	13.5	15.8	28.4	42.3	25.0
Technical personnel	0.9	3.4	6.7	52.5	15.9
Counselor	0.3	1.9	0.8	15.3	4.6
Auxiliary nurse	0.5	2.1	NA	31.9	11.5
Total labor cost per case	45.4	42.8	58.2	301.3	114.8

Note: Doctor, General Practitioner, Physician, Obstetrician/Gynecologist, Anestheticist, Psychiatrist, Internist Technical personnel, Lab technician, Pharmacist, Drug dispenser, Sonographer Counselor, Counselor, Psychologist, Social worker, Health officer.

Labor inputs

The labor cost of health personnel who are directly involved in treating patients is a major component of PAC costs. The labor input is made up of several components: the composition of the health cadres, the composition of complications, the amount of time spent with patients, the salaries and benefits paid to health personnel and the proportions of their work time actually spent in treating patients. Table 2 shows some of these labor input components for five groupings of health workers. (Personnel not directly involved in medical treatment of patients are dealt with below as part of indirect costs.) In the first panel of the table, the average amount of time spent with patients during treatment at health facilities is compared across the four countries for the five health cadres. These estimates are weighted averages for the five types of complication. Two patterns are evident: in Ethiopia and Colombia doctors spend about 30–60% more time with PAC patients than do nurses; in Uganda and Rwanda however nurses spend 220–280% more time with patients than do doctors.[7] These latter countries seem to be more successful at task shifting, although a relative shortage of doctors may also play a part. Also noteworthy is the greater involvement of technical personnel, mainly lab technicians, in Colombia (157 min) compared to the three African countries (<40 min on average). As an economically more developed country, one may speculate that more diagnostic tests are routinely performed.

Salary structures (second panel of Table 2) show large differences among the four countries. For all cadres of health personnel, almost without exception, Ugandan salaries are the lowest and Colombian the highest, keeping in mind that they are shown here in international dollars, which equalizes purchasing power across the four countries. Compared to Uganda, Ethiopian health workers are about 1.8 times more expensive, Rwandan workers twice as expensive and Colombian workers almost six times more costly.

Another hard-to-measure component of labor cost is the adjustment that needs to be made for non-treatment time spent by health providers (third panel, Table 2). Overall, the four studies estimated that 10% of work time is spent in non-treatment activities such as paperwork, attending meetings and idle time. The proportion of non-treatment time is lowest among doctors (2–6% in three countries although much higher in Uganda at 18%), likely because of the

higher cost of their time and greater interest in using that time efficiently. Levels are also lower than average for the least qualified cadre of health workers (5–7% among auxiliary nurses)—possibly because this group has less involvement in meetings and lower responsibilities for paperwork. However, since non-treatment time is likely to be under-reported in studies without time-motion observation, this component of labor cost is almost certainly underestimated.

The fourth panel of Table 2 combines all the above cost components into estimates of labor costs per PAC case. These range from lower levels in the three sub-Saharan countries (I$42.80–I$58.20) to a much higher level in Colombia (I$301.30). Technical personnel and counselors in Colombia are relatively costly components of labor costs (being 3.3 times more than the four-country average), while nurses are relatively less expensive (1.7 times the average cost). Also noteworthy, doctors comprise 67% of the total labor cost in Ethiopia but only 38% of it in Rwanda. Conversely, nurses contribute 30% to direct labor costs in Ethiopia but 49% in Rwanda. The contribution of technical cadres (such as lab technician, sonographer, etc.) to labor costs is striking: in Ethiopia it amounts to only 2%, while in Colombia it accounts for 14% of labor costs.

Table 3. Comparison of inputs of drugs and supplies from four studies of the cost of PAC* in Ethiopia, Uganda, Rwanda and Colombia

	Ethiopia	Uganda	Rwanda	Colombia	Average
Cost of drugs/supplies per PAC case (I$2012)					
Incomplete abortion	100	83	116	41	85
Sepsis	59	70	87	149	92
Shock	62	77	159	645	236
Lacerations	23	97	36	70	56
Perforations	380	244	92	279	249
Average cost per case	93	85	115	79	93
Compared to four-country averages (%)					
Incomplete abortion	117	98	137	48	100
Sepsis	65	77	95	163	100
Shock	26	33	68	274	100
Lacerations	40	172	64	124	100
Perforations	153	98	37	112	100
Average cost per case	100	92	124	85	100

*'Drugs and supplies' also includes laboratory tests and procedures such as sonograms.

Drugs/supplies inputs

The second major component of direct costs is the set of physical inputs that are consumed in PAC treatments. These include drugs, medical supplies and materials as well as laboratory tests and procedures such as sonograms. Costs per PAC case for these inputs for the four countries, broken down by type of treatment, are shown in the upper panel of Table 3. The average cost of drugs and supplies is lowest in Colombia (I$79) and highest in Rwanda (I$115). In general, cost differentials between countries are not large, compared to differences in labor costs, and it is particularly notable that they are lowest in Colombia, on a purchasing power parity basis.

Purely in terms of costs, Colombia does well in treatment of cases of incomplete abortion, which comprise the large majority of PAC cases, spending only I$41 per patient on drugs, supplies and tests, compared to I$116 spent in Rwanda and I$100 in Ethiopia. On the other hand, treating patients with shock in Colombia is more than ten times more costly (I$645) compared to Ethiopia where only I$62 is spent on physical inputs. However, from these data it is not possible to tell how far these differences reflect efficiencies in treatment—they may also indicate scarcity in availability of drugs, supplies and lab tests in lower-income settings.[8] Overall, PAC in Colombia requires the least expensive bundle of physical inputs (I$79) compared to an average expenditure of I$93 across the four countries. Drilling down into the data on laboratory tests confirms this finding. For example, in Colombia patients being treated for incomplete abortion are given 0.3 hemoglobin tests and 0.3 white blood cell tests on average, whereas in Rwanda and Uganda such patients are given between 1.0 and 1.4 tests.

Indirect costs

The four studies also collected data on indirect costs to the health system of PAC. The data in Ethiopia, however, were later judged to be deficient and were not reported on. Table 4 summarizes the results for three components of indirect costs: capital costs (the amortized annual cost of infrastructure construction and capital equipment), non-medical labor costs (the cost of personnel not directly involved in medical treatment) and operational costs (the cost of maintenance, utilities, etc.). In Colombia it was not possible to separate the latter two overhead components, so the estimate of I$517 includes both combined. This estimate is several times greater than overhead costs in either Uganda (I$57) or Rwanda (I$97). On the other hand, the estimate of the annual amortized cost of capital is substantially higher in Uganda (I$213) than in Rwanda or Colombia. It constitutes 52% of the total cost per case in Uganda, compared to 16% in Rwanda and only 10% in Colombia.

Total cost per PAC case

Table 4 summarizes the six cost components identified in these studies and presents their estimates of the total cost per PAC case in international dollar terms. At I$972, the cost of treating unsafe abortion in the Colombian health system is by far the costliest. Keep in mind, however, that indirect costs were not calculated in the Ethiopian study. If indirect costs were taken to be the average percentage of total costs across the other three studies (61%), the total cost per case in Ethiopia would amount to I$345, in between the Uganda and Rwanda estimates. Using this estimate for Ethiopia, the average cost per case across the three Sub-Saharan African countries is I$362. Labor and overhead are the major cost drivers in Colombia (together they constitute 81% of the total cost), but less important in Uganda and Rwanda (22% and 46% respectively). The costs of drugs/supplies and the cost of capital, on the other hand, seem to be more important drivers of PAC costs in African settings.

PAC is costly on a per capita basis as seen in the last panel of Table 4. Treating a single PAC patient costs the equivalent of 11% of the annual GDP per capita in Colombia and an astounding 35% in Ethiopia and Uganda. Regardless of who pays and what subsidies exist, fully one third of the average annual productive output on one individual goes to offset the cost of to treating one PAC patient in Ethiopia and Uganda. When we compare cost per PAC case to the average annual expenditure in health, the financial burden of unsafe abortion is put into even starker relief. Treatment for one episode of post-abortion morbidity consumes more than three times the annual per capita expenditure on health in Uganda and more than five times in Ethiopia. Even in Colombia, expenditure on one PAC case is $>100\%$ the average annual per capita spending on health.

Table 4. Comparison of major cost components from four PACCM studies (I$2012) of the cost of PAC in Ethiopia, Uganda, Rwanda and Colombia

	Ethiopia	Uganda	Rwanda	Colombia	Average
Direct costs per PAC case (I$2012)					
Labor cost	39	34	57	276	101
Cost of drugs and supplies	93	85	115	79	93
Other direct costs	4	18	11	0	8
Total direct costs	136	137	184	355	203
Indirect costs per PAC Case (I$2012)					
Amortized cost of capital	NA	$213	$54	100	122
Cost of non-medical labor	NA	$25	$38	{517**	193
Cost of operations	NA	$32	$59		45
Total indirect costs	$209*	$270	$150	618	316
Total cost per PAC case (I$2012)	345*	407	334	972	518
	Percentage distribution				
Direct costs per PAC case (%)					
Labor cost	29	8	17	28	18
Cost of drugs and supplies	68	21	35	8	17
Other direct costs	3	4	3	0	1
Total direct costs	100	34	55	36	36
Indirect costs per PAC case (%)					
Amortized cost of capital	NA	52	16	10	22
Cost of non-medical labor	NA	6	11	53	34
Cost of operations	NA	8	18	NA**	8
Total indirect costs	NA	66	45	64	64
Total cost per PAC case	100	100	100	100	100
Cost of family planning (I$2012)***	29.00	28.70	26.40	29.10	28.30
As a percentage of:					
GDP per capita (%)	35	35	29	11	15
Health expenditure per capita (%)	541	334	178	105	158

*Indirect costs were not available in the Ethiopia study. Using the average indirect costs from the other three studies, the total cost per case in Ethiopia (direct and indirect costs) was estimated to be I$345.

**In Colombia it was not possible to separate non-medical labor costs and operational costs, so the estimate of I$517 includes both combined.

***Annual cost of contraceptive services for woman/couple. Source: Singh et al. (2014).

Cost of PAC vs. competing costs

In general, PAC costs are substantially higher than the cost of safe abortion procedures. In countries where abortion is legal or administratively permitted such as Colombia or Ethiopia, the differences in costs are worth noting: the average PAC cost per client in Colombia is I$972 versus an average cost of a safe abortion[9] of I$313 (Prada *et al.* 2013); and in Ethiopia I$345 (PAC) versus I$190 (abortion procedure).[10] A global study of all developing countries estimated that the average cost per PAC case was more than twice the average cost of safe abortion procedures . (Singh *et al.* 2014)

In many developing countries such a comparison cannot be made because abortion is illegal for the most part. Pregnancies may be terminated by induced abortion, but most unintended pregnancies can be prevented from occurring by using an effective method of family planning. In Table 4 (lower panel) we present estimated total one-year costs of contraception for the four PACCM countries, using data from the latest edition of the *Adding It Up* study. (Singh *et al.* 2014) When these costs, which range from I$26 to I$29, are compared to the PAC costs in Table 4, one sees a great advantage to preventing unwanted pregnancies through family planning over treating post-abortion complications, which costs health systems from I$334 to I$972 in these four countries.

Finally, it is worth comparing the cost of PAC to the cost of maternal and newborn health (MNH) in general, since PAC is one component of MNH. The national cost of MNH in Uganda (without PAC costs included) was estimated in 2008 at US$345 million (Vlassoff *et al.* 2009a), which, when extrapolated to 2012, becomes around I$990 million. The annual national cost of PAC in Uganda was found to be around I$42 million in 2012, a little over 4% of the MNH total (Vlassoff *et al.* 2014a). On a per case basis, however, an average MNH intervention in Uganda cost I$123 in 2012, while an average PAC case cost I$394 to treat. A similar comparison can be made for Ethiopia using estimates from Sundaram *et al.* (2010) and Vlassoff *et al.* (2012). National PAC costs in Ethiopia in 2012 are somewhat >3% of national MNH costs (annually I$54 million and I$1.6 billion, respectively). On the other hand, per case costs were estimated to be I$238 (PAC) compared to I$433 (MNH) in 2012.

Discussion

In the developing world abortion is still largely prohibited, except for narrow legal indications and is still heavily stigmatized. Research in this subject area is thus fraught with difficulties in gathering reliable and complete data. Data on the cost of medical care to treat abortions complications are likewise scarce. However, more studies of the cost of PAC have recently become available, four of which apply a standardized methodology and well-specified descriptions of the cost components analyzed—two important factors that will allow us to use these four studies to begin building a body of comparable costing estimates.

While research into the cost of PAC is beginning to attract more attention, important gaps still remain. The most thorough studies available, national-level studies from Ethiopia, Uganda, Rwanda and Colombia, estimated average costs per PAC case of I$345, I$407, I$334 and I$972, respectively. A review of literature in 2007 estimated an overall average of I$414 per PAC case (Shearer *et al.* 2010). Our review of more recent literature from 2008 to 2013 (Table 5) found that the average cost per PAC case was I$347 for seven studies that included both direct and indirect costs. Thus, a body of consistent cost estimates is emerging. As for regional differences in PAC costs, a comparison of the four PACCM studies shows the cost of PAC to be substantially higher in Colombia than in the three African countries, but this may not be generally true of the Latin American region since earlier regional estimates showed little difference between African and Latin American average costs per case: I$392 and I$430, respectively (Shearer *et al.* 2010). These various estimates suggest that spending on PAC is an important financial burden. In the four PACCM countries, the cost of treating one post-abortion patient is considerable: around 35% of annual per capita income in Uganda, 29% in Rwanda and 11% in Colombia. This burden is particularly acute in Uganda where facility-based treatment for one PAC patient costs the equivalent of four month's income for an average person.

Table 5. Cost of PAC procedures after induced abortions in selected countries*

Country	Study	Year of study	Type of data	Legal status of abortion	PAC procedure	Cost per patient (I$2012)	Cost components included
Abortion legal or partially legal							
Bangladesh (1)	Johnston et al. (2012)	2008	Original	Illegal except to save a woman's life, but permits menstrual regulation (MR) as part of government family planning services	VA (moderate complications, tertiary facilities)	66.81	Direct medical costs
Bangladesh (2)					VA (moderate complications, primary facilities)	37.92	
Bangladesh (3)					D&C (moderate complications, tertiary facilities)	79.06	
Bangladesh (4)					D&C (moderate complications, primary facilities)	75.70	
Bangladesh (5)					D&C (severe complications, tertiary facilities)	250.60	
Bangladesh (6)					D&C (severe complications, secondary facilities)	237.51	
Ghana (1)	Hu et al. (2010)	2007	Modeled	Permitted in cases of rape, incest or the 'defilement of a female idiot;' if the life or health of the woman is in danger; or if there is risk of fetal abnormality	D&C	26.02	Direct medical costs
Ghana (2)					MVA	18.79	
Ghana (3)					Medication	5.79	
Pakistan (1)	Tasnim et al. (2011)	2007-08	Original	Permitted to save woman's life	MVA	53.38	Direct cost (hospital cost)
Pakistan (2)					EVA	121.12	
Pakistan	Naghma-e-Rehan (2011)	2008	Original	Permitted to save woman's life	Not specified	216.57	Travel/boarding, hospitalization, medicines
Abortion illegal or highly restricted							
El Salvador (1)**	Foster-Rosales et al. (2003)	1999	Original	Illegal	Sharp curettage	183.21	Direct and indirect costs
El Salvador (2)**					MVA	164.08	
Malawi	IPAS (2013)	2009	Original	Permitted only to save the life of a woman	Not specified	32.65	Direct medical costs
Nigeria (1)	Hu et al. (2010)	2007	Modeled	Illegal except to save a woman's life	D&C	57.42	Direct medical costs
Nigeria (2)					MVA	44.94	
Nigeria (3)					Medication	31.72	
Nigeria	Benson *et al.* (2012)	2010	Original	Illegal except to save a woman's life	MVA/EVA, MPAC, D&C, D&E, Expectant management	135.71	Direct medical costs
Uganda	Babigumira et al. (2011)	2010	Modeled	Prohibited expect to save a woman's life	Not specified	185.04	Societal costs (direct medical costs, direct non-medical costs, indirect costs)

*The four studies described in Results section of the article are not included in Table 4.4 to avoid repetition. They are, however, included in any averages derived from this table.

**This study was inadvertently omitted from the earlier review of literature (Vlassoff et al. 2009b; Shearer et al. 2010) as it appeared to be the same study as the one reported in Koontz et al. (2003).

The increasing use of medication (typically misoprostol) in treating incomplete abortion, the least severe and most common type of complication, will probably lead to lower PAC costs in the future. Studies citing costs of specific post-abortion treatments indicate that using medication for treating incomplete abortion may be only one-sixth as expensive as MVA (Foster-Rosales *et al.* 2003; Hu *et al.* 2010). A model-based study of abortion costs in Uganda found that task shifting could also reduce PAC costs. For instance, the study calculated that by instituting a suite of cost-saving measures, including task shifting and use of lower-level facilities when appropriate for the treatment of particular types of post-abortion complications, costs would be reduced by around 45% (Johnston *et al.* 2007).

The wide variation in labor costs (both medical and non-medical personnel) seen in the four PACCM studies also point to operational efficiencies which could be made in PAC delivery by sharing experiences across countries. This is particularly the case for Colombia, where doctor salaries are as much as seven times the salaries of their African counterparts, even after adjusting for purchasing power. Task-shifting should be considered in Colombia as well as measures to reduce the total amount of time that medical personnel spend on the various treatments. On the other hand, the study showed little variation in overall expenditure on physical inputs and hence offers no lessons to be learned for this cost component. We found that overhead costs in Colombia were far above those of the three African countries. While it is beyond the scope of this study to speculate on the causes of this large disparity, there does seem to be scope for cost-cutting measures in the case of non-treatment expenditures in Colombia.

One important policy response to high levels of unsafe abortion is to attack its root cause, unintended pregnancy, by promoting family planning. Around 40% of all pregnancies in developing countries are unintended and almost half of all these unintended pregnancies are terminated by abortion (Sedgh *et al.* 2014). At the same time, substantial rates of unmet need for contraception are reported in virtually all developing countries (Sedgh and Hussain 2014). In the three African PACCM countries, Ethiopia, Rwanda and Uganda, the latest findings on unmet need are 26, 34 and 21% of all women of reproductive ages (ICF International 2012). In Colombia, by contrast, where fertility decline has reached replacement level, unmet need stands at 8%. Providing modern methods of contraception to women with an unmet need for contraception would greatly reduce unintended pregnancies (except for a small number of pregnancies that would occur due to contraceptive method failure). The cost of doing so is just a fraction of the cost of PAC: in Ethiopia one year of modern contraceptive services and supplies is equal to 12% of the average cost of treating a PAC patient, in Rwanda 9%, in Uganda 7% and in Colombia 3%.[11] Preventing unintended pregnancies would not only reduce health systems cost of PAC and the cost of abortion procurement to women and households, but would also bring great health benefits in the form of lower maternal morbidity and mortality, better infant health and broader intergenerational improvement. In the four countries with PACCM studies, providing contraceptive services for one year to a woman or couple cost only about one tenth as much as the cost of treating one PAC patient. It is our hope that the cost estimates provided in this article will stimulate policy discussion around these health issues.

In its latest report on unsafe abortion the World Health Organization estimates that 13% of maternal deaths are caused by unsafe abortion (WHO 2011). Policies that reduce unsafe abortion therefore are also important in efforts to lower maternal mortality and morbidity. One line of attack is to advocate for more liberal abortion laws. Even with a more liberal legal framework in place however, persistent value systems and the continued stigmatization of induced abortion may result in large proportions of abortions taking place clandestinely and under unsafe conditions. In Bangladesh, for example, even after more than three decades of national coverage by the government-supported menstrual regulation[12] program, about half of all pregnancy terminations are still via the procurement of (illegal) induced abortion rather than through legal menstrual regulation (Singh *et al.* 2012).

While the PACCM methodology is able to generate reasonably precise costing estimates with an inexpensive data-collection budget, the approach has some limitations. One drawback has already been alluded to: The PACCM method itself has evolved from the pioneering Ethiopian study through to the most recent Colombian one, with new refinements being added to each of its applications. For example, the indirect costs module proved to be inadequately specified in Ethiopia, so the estimates of indirect costs were ultimately discarded from the Ethiopian study. The evolution of the method has meant that the ability to compare results across studies is somewhat restricted. Another limitation of PACCM is that for the most part the data are based on expert opinion. Hence, results are less precise than if an intensive (but costly) case-based approach were used. A third limitation concerns the inherent difficulty in gathering data on abortion. In each of the four countries, we were able to rely on the results of existing studies of the incidence of induced abortion. Even so, some uncertainty exists around questions such as the percentage distribution of post-abortion complications, the proportion of women with post-abortion complications that do not or cannot access the health system and the split between induced and spontaneous abortions.

The PACCM methodology has provided health policy analysts with the first national-level comprehensive estimates of the cost of PAC to health systems. It has been applied in a variety of contexts and is a comparatively inexpensive tool for obtaining policy-relevant information on the cost of PAC. Incremental improvements to the methodology will continue to be made in future work, for instance by addressing the problem of interviewer fatigue in filling out long, tedious questionnaires. Replacing hard-copy questionnaires with interactive input software using laptop computers would be a useful improvement in this area. The consistency of results using PACCM gives confidence that further applications of the methodology would lead to an even more solid measurement and understanding of PAC costs in developing countries.

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Notes

1. We use the WHO definition of unsafe abortion: 'a procedure for terminating an unintended pregnancy performed by persons lacking the necessary skills, in an environment that does not conform to minimal medical standards, or both.' (WHO 2011) It follows from this definition that most post-abortion complications are the result of unsafe abortions.
2. See Say *et al.* (2014) and Kassenbaum (2013). Given the difficulty in obtaining abortion-related data and the tendency to under-report abortion-related deaths, the upper estimate is probably the more accurate one.

3. According to WHO recommendations, PAC should also include counseling and provision of family-planning and reproductive health services.
4. 'Uterine perforation' includes other complications such as abdominal perforations and conditions leading to hysterectomies.
5. Years in which the data were collected.
6. An international dollar (I$) in a given country buys a comparable amount of goods and services that a U.S. dollar buys in the United States. Using I$achieves 'purchasing power parity' when comparing costs between countries. The ratios of I$to US$in the four countries at the time of the study were: 2.15 (Colombia), 3.84 (Ethiopia), 3.00 (Rwanda) and 2.87 (Uganda).
7. In the Rwandan health system there are no personnel designated as 'auxiliary/assistant nurses'. There are, however, four categories of nurses. The functions of the lower grades may approximate those of auxiliary nurses in other countries.
8. Some other direct costs were measured in the three African studies but not in the Colombian one. These include the lodging and meals aspect of hospitalization and fees charged for specific services. These costs amounted to 3–5% of per case PAC costs in the three African countries (Table 4).
9. In Colombia, almost all of the small number of safe abortions recorded in official statistics use the D&C procedure.
10. As part of the PACCM study in Ethiopia in 2008 (Vlassoff *et al.* 2012), data were collected on the cost of one abortion procedure, manual vacuum aspiration, the procedure that was generally used at that time for safe abortions. Although the sample of facilities was not selected randomly, nor was it nationally representative, detailed information on the costs of inputs were collected from 14 health facilities in both in-patient and out-patient settings. For 2008, the direct cost of abortion procedures (MVAs) was estimated at USD 26.50. In terms of international dollars in 2012, the average cost of an abortion procedure was I$109. The total cost per procedure (direct and indirect costs) was estimated to be I$190.
11. For example, the total family planning bill to satisfy unmet need for contraception in Rwanda would be around I$21.6 million, while the total PAC bill would amount to I$7.5 million. Another I$2.9 million would be saved by averting abortion procedures. This, of course, is a very incomplete cost comparison since so many other benefits, in terms of health and finance, would accrue to lowering the level of unmet need for contraception—for instance, all the mother and newborn care costs saved by averting unintended childbirth. Data on cost of contraception are taken from Singh *et al.* (2014).
12. Menstrual regulation (MR) has been part of Bangladesh's national family planning program since 1979. MR is a procedure that uses manual vacuum aspiration to safely establish non-pregnancy after a missed period.

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