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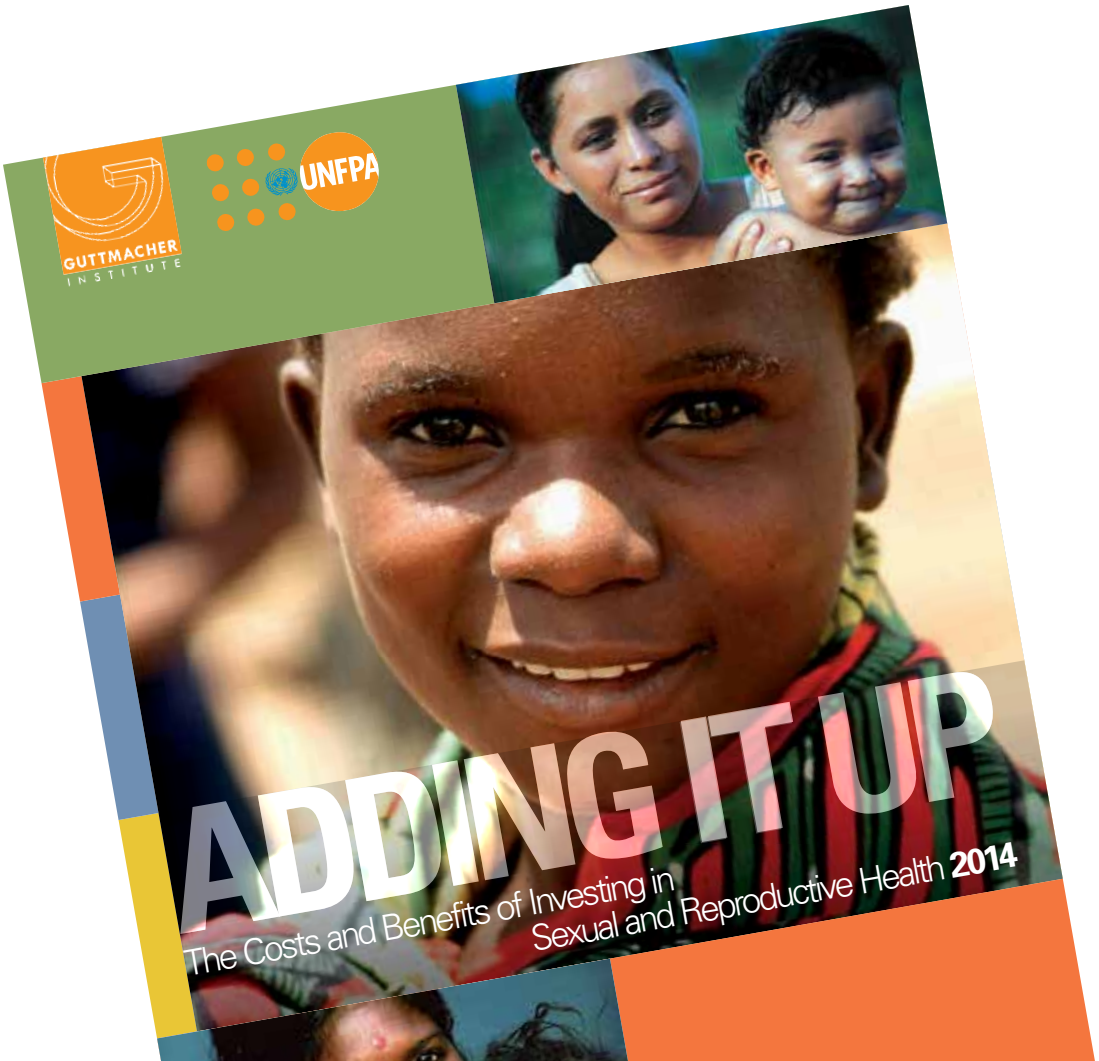
ADDING IT UP: The Costs and Benefits of Investing in Sexual and Reproductive Health 2014

Estimation Methodology

By Jacqueline E. Darroch, Susheela Singh and Eva Weissman



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SECTION 1: Introduction to Adding It Up 2014

This report provides methodological details on the estimates presented in *Adding It Up: The Costs and Benefits of Investing in Sexual and Reproductive Health 2014*[1] and related publications.[2–5] Adding It Up is an ongoing Guttmacher Institute project in which researchers estimate the need for and the use, costs and impacts of various sexual and reproductive health services for developing countries. The years for which estimates have thus far been produced are 2003, 2008, 2012 and 2014. While the basic approach remains unchanged, there have been changes in coverage and in some of the methodological approaches across these projects.

Adding It Up Reports

The first Adding It Up project (AIU-2003) estimated the costs of meeting all women's needs for modern contraceptives in developing countries in 2003 and resulting benefits of investing in contraceptive services in terms of the number of pregnancies, births, abortions, and maternal and infant deaths averted and disability-adjusted life years (DALYs) saved, as well as the reduction in the number of children losing their mother from maternal mortality.[6–8] Costing data in this project came from a small number of country-level studies then available in the literature.

The last full Adding It Up project expanded the scope to estimate the costs and impacts of increasing maternal and newborn health care in addition to family planning for 2008.[9,10] AIU-2008 covered the impacts and costs of meeting all need for modern contraception and all need for maternal and newborn health care, as well as a synergistic scenario in which both types of needs would be met. Cost estimates were based on a United Nation Population Fund (UNFPA) update of cost estimates for implementing the International Conference on Population and Development (ICPD) Programme of Action.[11–13]

Interim Adding It Up analyses for 2012 separately updated estimates for contraception[14] and for maternal and newborn health care,[15] but did not investigate the synergistic impacts of fully meeting both types of needs. The contraceptive estimates of need, use and impact helped inform the FP2020 baseline estimates and projections.[16,17] Cost estimates for AIU-2012 included updated direct costs for drugs, supplies and personnel, including information from a new database of contraceptive commodities provided by donors to developing countries.[18]

AIU-2014 further expands the scope of sexual and reproductive health needs and services addressed to include antiretroviral care for pregnant women living with HIV and their newborns, and treatment for four common STIs, in addition to modern contraceptive services and maternal and newborn health care.[1] Cost estimates include updated costs for drugs and supplies and 2014 estimates of personnel costs.

Trends Over Time

Estimation methods and many of the information sources on needs for and use of contraceptive and maternal and newborn health care have been similar across all Adding It Up analyses and allow for comparisons over time.[19,20] However, since costing data and methods have changed over time, they do not provide valid time trends of service costs.

Data Sources

All data used in this project came from publicly available sources and did not contain individuals' identifying information. Patient consent was therefore not required for these analyses.

Other Recent Estimates

Adding It Up is one of a number of recent efforts to estimate the resources required to meet the need for sexual and reproductive health services in developing countries. Several high-level global initiatives have published estimates in recent years, including the FP2020 initiative,[21,22] Global Strategy for Women's and Children's Health[23] and Countdown to 2015, which is coordinated by the Partnership for Maternal, Newborn and Child Health.[24,25] Also, UNFPA tracks resources committed annually for population and reproductive health activities.[26] The Adding It Up project has benefited from these efforts and from prior estimation work carried out by UNFPA,[11] the Joint United Nations Programme on HIV/AIDS (UNAIDS),[27] Women Deliver,[28] the High-Level Taskforce on Innovative International Financing for Health Systems[29] and Norway's Global Campaign for the Health MDGs,[30] as well as other cost and impact analyses.[31–33]

The global estimates published by these organizations and initiatives differ from each other because each includes a different subset of sexual, reproductive and child health services. Estimates may also differ in terms of geographic coverage—for example, focusing on countries with the lowest income or with the highest burden of disease. FP2020 focuses on 69 countries with 2010 per capita incomes of $2,500 or less, while estimates from the Countdown to 2015 collaboration focus on the 75 countries where 95% of maternal and child deaths occur; Adding It Up estimates include all 148 developing countries.

Other examples of differences among estimates include

- covering only direct service costs, or covering total costs, including indirect costs, such as infrastructure, management and training of health personnel;
- covering the total costs associated with services, or covering only the additional funds needed to expand services from their current level;
- using a one-year time frame, or showing cumulative costs over a number of years;
- using a methodology based on the average cost per case for each health intervention, or on the costs of different types of inputs across a group of interventions; and
- targeting the fulfillment of all need for services, or focusing on fulfilling just a certain proportion of need.

Adding It Up covers all developing regions, as defined by the United Nations Population Division.[34] It assesses the numbers of women needing and receiving each category of covered sexual and reproductive health services recommended by WHO, and it provides estimates of the total costs of current services and of services that would fully satisfy needs—both direct costs and the indirect program and systems costs that support service provision. Further, it estimates the health benefits of meeting these needs, allowing comparisons between the impact of current services and the impact that would be made by fully meeting service needs.

The estimates in this report are based on the assumption that the necessary investments and accompanying changes will occur in the short-term, and that all unmet needs will be fulfilled in the near future. If all needs are not met, the costs will be correspondingly lower, but so will the benefits of the investments. Similarly, if needs are met over a longer time horizon, cost increases and benefits will be spread out as well. In addition to population growth in most developing regions, the growing preference for smaller families will result in an increase in the number of women needing services (all other things being equal), and therefore additional resources will be required to maintain the gains in service provision that have been achieved.

Organization of this Report

In this report, we describe the analytic framework, sources and calculations behind the AIU-2014 estimates. Our objective is to enable users to better understand the results, and the limitations, of the estimates presented in Adding It Up publications.

The Adding It Up approach starts with estimating the need, current use or coverage, and the unmet need for care for components of sexual and reproductive health care: Need – Coverage = Unmet Need. Section 2 of this report describes the Adding It Up scenario-based approach to making estimates of sexual and reproductive health service needs, coverage, costs and impacts. The next section describes the methodology and data sources for the demographic measures used in the project, including numbers of women by marital status, pregnancies by intention status, and outcome and maternal and newborn mortality (deaths) and morbidity (disability-adjusted life years, or DALYs). Estimates of need and coverage for sexual and reproductive health care in this project were built from individual interventions (components of care). In subsequent sections, we describe each intervention and the bases for estimating need for and coverage of each intervention. Section 4 describes how we estimated contraceptive need and method use, and Section 5 provides similar information for maternal and newborn health care. Section 6 covers prevention of maternal-to-child-transmission of HIV, and treatment for four common curable STIs, broken down by type of intervention or service needed. Treatment requirements of commodities and supplies, personnel and hospitalization for each intervention are detailed in Appendix A.* In Section 7, we estimate impacts of sexual and reproductive health services, based on estimates for each component intervention. Impacts are presented for each of the estimation scenarios, including both independent and synergistic impacts on pregnancies, health status and costs. The broad benefits

to women and children, families, communities and society that are discussed in AIU-2014 were not estimated in this project but are based on the findings of other published and unpublished studies.[1] We discuss available information for estimating service costs in Section 8, along with the details of how we made costing estimates. Appendix B* describes the investigation and analysis of program and systems costs that were carried out in the project.

Data and estimates used in AIU-2014 are presented in tables.* Estimates of many measures were made in this project from a large number of different data sources, including census information, survey tabulations, modeled estimates and existing literature. Confidence intervals are therefore not available for estimates. Numbers presented in the tables are unrounded to facilitate their use in further calculations, but this does not indicate precision. Calculations of distributions, rates and numbers for AIU-2014 were made from unrounded data.

*The tables and the appendixes are published online at https://www.guttmacher.org/report/adding-it-costs-and-benefits-investing-sexual-and-reproductive-health-2014-methodology.

SECTION 2: AIU Approach

Adding It Up is a synthesis of information from a wide range of sources intended to present a coherent and comprehensive set of estimates covering all developing regions, identify synergies between sexual and reproductive health focus areas, illustrate the need for addressing sexual and reproductive health needs in unified ways and put disparate research findings into the fuller context of women's lives. To accomplish these goals, estimates must be set in common context. We adjusted all estimates to 2014 and 2014 U.S. dollars and used a common demographic framework across all service areas. Some data were available for countries and others were for various geographic groupings. We transformed data for geographic groups to country levels for doing calculations and made estimates for missing values; see the following sections for details relevant to each intervention.

Scenarios

In AIU-2014, we made estimates of impacts, costs and benefits for three basic scenarios, one representing current use of sexual and reproductive health care, one in which no women needing sexual and reproductive health care receive it, and one in which all women receive all the sexual and reproductive health services they need. Combinations of scenarios for different interventions were used to estimate the synergistic effects of meeting needs for more than one type of intervention, rather than looking at each intervention separately.

Current-use scenario

For each type of sexual and reproductive health care, we first estimated current levels of coverage or service use, impacts and costs in 2014. Section 3 provides information on the sources and assumptions used for establishing the demographic framework behind all the need and coverage measures, specifically population numbers and characteristics, numbers and outcomes of pregnancies and numbers and causes of deaths and DALYs.

No-needs-met scenario

To estimate the impacts of current coverage levels, we estimated comparison scenarios in which no women or newborns would use each intervention.

Family planning. We assumed that no women wanting to avoid pregnancy would use modern methods and that there would be no change in the proportions of women wanting to avoid pregnancy currently using traditional methods or no method, or in the level of unintended pregnancies among women in these groups. We assumed no change in factors that affect the proportions of women wanting to avoid a pregnancy, such as marital status, sexual activity, fecundity and childbearing intention, and that intended pregnancies would continue to occur at 2014 levels.

Maternal and newborn care. We assumed that pregnant women and newborns would receive no maternal or newborn health care, but that their needs for care would be unchanged.

HIV-related maternal and newborn care. We assumed that current levels of HIV infection and pregnancy levels and risk of mother-to-child HIV transmission among women living with HIV would be at 2014 levels, but that no pregnant women would receive antiretrovirals to prevent mother-to-child transmission of HIV.

STIs other than HIV. We assumed that STI incidence would be unchanged. The risks of developing pelvic inflammatory disease (PID) and subsequent infertility from untreated chlamydia and gonorrhea and the risks of mother-to-child transmission of syphilis among untreated women would also remain unchanged.

Full-needs-met scenario

Family planning. We assumed that women who currently want to avoid a pregnancy and are using traditional methods or no method would all become users of modern methods (and that those already using modern methods would continue to do so). We included women relying on traditional methods as needing modern contraceptives because the failure rates of traditional methods are typically much higher than those of modern methods.[35]

We assumed that the types of modern methods adopted by new users, and the percentage distribution of these methods, would reflect the method mix of current modern method users in their country with the same marital status (currently, formerly or never-married) and childbearing intentions (spacing vs. limiting future births). We assumed no change in the proportions of women wanting to avoid a pregnancy or in levels of intended pregnancy.

Maternal and newborn health care. We assumed that all women and newborns would receive the maternal and newborn health care services covered in this project, including general care and, when needed, treatment for special conditions and complications.

HIV-related maternal and newborn care. For pregnant women living with HIV and their newborns, we assumed antiretroviral treatment would be provided for all pregnant women whose pregnancies end in live birth, stillbirth or spontaneous miscarriage, since in the full-needs-met scenario, these women are assumed to be obtaining antenatal and delivery care (for those giving birth) or antenatal and other needed care until miscarriage occurs. We did not include women obtaining induced abortions in the estimate of antiretroviral costs on the assumption that they would not be obtaining antenatal care. This is a conservative assumption, since some of these women would likely get some antenatal care prior to deciding to obtain an abortion (for instance, if they initially plan to carry their pregnancy to term but learn of or develop medical conditions during pregnancy that would cause them to have an abortion).

We estimated the impact of care on perinatal maternal-to-child transmission of HIV up to six weeks after live birth and the costs of antiretroviral treatment for six weeks after birth for all women with live births who were breast-feeding and all newborns. We did not estimate the levels of antiretroviral coverage, cost or impact on transmission during breast-feeding beyond the first six weeks after birth.

Synergistic scenarios

Because contraceptive use affects the numbers of pregnancies, births, miscarriages and abortions that occur through its impact on levels of unintended pregnancy, we estimated a number of combinations of scenarios in which the numbers of pregnancies and births differed according to contraceptive use scenarios. For example, we estimated the number of women and newborns who would need maternal and newborn health care and HIV-related care if women wanting to avoid pregnancy used no contraceptives versus if they all used modern contraceptives, along with differing scenarios of maternal and newborn health and HIV-related care coverage.

Time Period of Estimates

The estimates for the AIU-2014 analysis draw from the most recently available data, projected to 2014, and demonstrate the full gains from immediate attainment of fulfilling unmet needs. Cost figures are expressed in 2014 U.S. dollars, and all scenarios are calculated as of 2014. We recognize that the needed increases in coverage cannot be achieved immediately, especially because many of them depend on improvements in health service infrastructure. However, we use the same year for all scenarios to demonstrate the changes needed, compared with the current situation.

Another way to interpret the differences between the full-needs-met and current scenario estimates for 2014 is that they reflect effects of lack of progress in terms of unintended pregnancies maternal and newborn deaths and DALYs and costs of maternal, newborn, HIV-related care and STI care due to current unmet needs.

Geographic Coverage and Country Groupings

Countries included

The 2014 estimates include all countries classified as "developing" by the United Nations Statistics Division (Table 1).[34] Under this definition, developing countries include all countries in Africa, Asia (including Central Asia, but excluding Japan), Latin America and the Caribbean, and Oceania (except Australia and New Zealand).

Geographic groupings

In summary tabulations, countries are grouped by geographic region and subregion, also according to the United Nations Statistics Division classifications. In regional summaries presented in the tables, Oceania was included in Asia. The Arab countries grouping are based on the United Nations Development Programme Regional Aggregates.[36] Arab countries are identified in Table 1.

Country income groupings

World Bank 2013 country income classifications, based on gross national income (GNI) per capita in 2012, were used to group countries into three income categories.[37,38] Table 2 presents the distribution of women aged 15–49 in each income category across regions and other country groupings, as well as the distribution in each region and grouping who live in each of the three categories of countries.

Low-income countries are those with a 2012 GNI per capita of less than $1,035; lower-middle–income countries have a GNI per capita of $1,036–4,085; upper-middle– and higher-income countries have a GNI per capita of $4,086 or more. The upper-middle– and higher-income groups were combined because higher-income countries account for a small proportion of all women aged 15–49 in developing countries (3% in 2014).[39] This category of upper-middle– and higher-income countries includes some developing countries not covered by the World Bank classifications, namely Réunion and other small countries in Eastern Africa, Guadeloupe, Martinique, and French Guiana and other small countries in South America. These account for less than 1% of women 15–49 in developing countries.

Other country groupings

In many of the tables in this report, we present measures for country groupings that are the focus of various international efforts to improve health. These include the 75 Countdown to 2015 countries,[40] 28 DFID priority countries,[41] 69 FP2020 countries and 22 FP2020 focus countries,[20] 38 countries with generalized HIV epidemics,[42] 22 UNAIDS priority countries[43] and nine countries in the Ouagadougou Partnership.[44] The countries in each of these groupings are identified in Table 1.

SECTION 3: Demographic Estimates

All estimates in AIU-2014 draw from common estimates of key demographic measures of population size and composition, pregnancy levels and outcomes, and maternal and newborn mortality and morbidity. This section provides information on the data sources and assumptions for these measures.

Population Size and Composition

Total population and number of women aged 15–49

The total population and the number of women aged 15–49 for each country in 2014 used in the AIU-2014 estimates were obtained from UN *Population Prospects*, 2012 revision, medium variant.[39] These figures were used for all scenarios of the AIU-2014 estimates. In *Population Prospects*, some small countries are included in the regional totals but not in the detailed country listing. To avoid omitting these countries and so that country estimates could be summed to subregional totals, we included the combined populations of these small countries in the calculations. We estimated their combined populations to be the difference between the subregional totals and the populations of the countries for which population was reported; these combinations for small countries are identified in the notes to Table 1.

Numbers of women aged 15–49 in 2014 in developing regions are shown in Table 2 for selected country groupings. The UN projects the number of women aged 15–49 living in developing regions will grow by 5% between 2014 and 2020, as shown in the rightmost column of Table 2. This growth will add to the numbers in need.

Women aged 15–49, by marital status

Women who are legally married, cohabiting or in a consensual union are considered to be married. "Formerly married" refers to women who have previously been in a union and were not in union at the time of interview, and "never married" refers to women who have never been in union.

Currently married women. The 2014 proportion of 15–49-year-old women in each country who are currently married was taken from the UN Population Division 2013 revision of marital status estimates and projections.[45,46] To the extent allowed by the source data, this category includes women who are formally married, women living with a partner in a cohabiting or consensual union, and, in the Caribbean, women in visiting partnerships.[46] The proportions were applied to the number of women aged 15–49 in 2014 in each country to estimate the number of currently married women aged 15–49 in each country. As shown in Table 3, 67% of women aged 15–49 in developing countries are currently married, a proportion that ranged from 34% in Southern Africa to more than 70% in Eastern Asia and Southern Asia.

The UN Population Division estimates that the proportion of women aged 15–49 who are currently

married is declining slightly in Sub-Saharan Africa, from 64% in 2003 to 61% in 2014 and 59% in 2020. Levels are expected to remain fairly stable in other developing regions.

In prior AIU estimates, the proportions of women aged 15–49 who are currently married were based on surveys of women of reproductive age tabulated by Guttmacher Institute or on survey or census data compiled by the UN Population Division.[7,10,14] The percentage of women currently married from the most recent survey or census was applied to the number of women aged 15–49 in the relevant AIU estimation year.

Table 3 compares the percentages of women aged 15–49 who are currently married based on recent survey or census information with the estimates for the AIU project years from the recent UN Population Division estimates for the same years.[45] As expected given the UN estimates of decreasing proportions of women married in many countries, the recent UN year-specific estimates of the proportion of women aged 15–49 who are currently married are slightly lower than those based on surveys and censuses before the same year. For assessment of trends presented in AIU-2014, the previously published AIU estimates were adjusted to the recent UN Population Division estimates of the proportion of women currently married in 2003, 2008 or 2012, as relevant.

Formerly married and never-married women. Since the UN Population Division estimates and projections do not differentiate formerly married and never-married women, we followed the approach used in prior AIU projects to distribute unmarried women: We estimated the number of unmarried women in each country in 2014 as the difference between total women aged 15–49 and the estimated number who were currently married. The distribution of unmarried women according to whether they were formerly married or never married was estimated from available data. Specific sources used for each country are shown in Table 4.

For countries with a recent DHS or similar survey available or with recent census data compiled by the UN Population Division,[47] the percentage distribution of unmarried women aged 15–49 who were formerly vs. never married from the most recent data source was applied to the estimated number of unmarried women aged 15–49 in 2014 to estimate the numbers of formerly married and never-married women. The data compiled by the UN Population Division are for five-year age-groups; the percentages of all women aged 15–49 who were formerly married or never married were calculated by weighting the relevant age-specific percentages by the number of women in each age-group in 2014.[39]

For countries with no recent DHS or similar survey available, we used the subregional unweighted distributions of unmarried women aged 15–49, divided into formerly married and never-married categories, from countries with data or the distribution from a similar nearby country to estimate the proportions of unmarried women who were formerly and never married (see Table 4 for details). These proportions were then applied to the countries' estimated number of unmarried women aged 15–49 in 2014.

Pregnancies by Outcome and Intention Status

Current scenario numbers of pregnancies by outcome

Births. The total numbers of births in each country in 2014 were taken from the UN *Population Prospects* 2012 revision.[48] We took subregional proportions of births that were unplanned or planned from estimates for 2012.[49] We assumed that the subregional distribution of births by intention status applied to all countries in the subregion.

Induced abortions. Survey reports on induced abortion are generally inaccurate, and national abortion statistics are often unavailable or suffer from underreporting, especially in developing countries with restrictive abortion laws.[50] The number of induced abortions in each subregion in 2014 was calculated by applying the estimated 2012 ratio of abortions to unplanned births[49] to the 2014 number of unplanned births in each region. To estimate the number of induced abortions in country, we assumed that the ratio of induced abortions to unplanned births was constant across all countries in each subregion. This assumption omits consideration of country-specific differences in demand for or availability and accessibility of abortion services. Thus, the resulting estimates of pregnancies and abortions should not be taken to be country-specific estimates, but rather calculations that sum to available subregional estimates and that can be reorganized to approximate estimates for other country groupings.

We used subregional estimates of the proportions of induced abortions in each subregion in 2008 that occurred under safe vs. unsafe conditions.[51] We assumed the subregional proportions applied to all countries in each subregion and did not make any trend adjustment.

Miscarriages and stillbirths. Pregnancies ending in miscarriage—i.e., pregnancies that end in spontaneous abortion or stillbirth after lasting long enough to be noted by the woman (6–7 weeks after the last menstrual period)—were estimated to be equivalent in number to 20% of pregnancies ending in birth and 10% of those ending in induced abortion. These proportions are based on studies estimating that for every 100 pregnancies at six weeks since ovulation, roughly 8 will result in miscarriage by week 10, another 8 will end in miscarriage or stillbirth in the remaining weeks of pregnancy, and 84 will result in live births.[52] Thus the ratio of miscarriages to live births is 16%÷84%, or roughly 20%. Since induced abortions typically occur early in pregnancy, it is assumed that induced abortions occur less than 10 weeks after ovulation and that they include unintended pregnancies that would have ended as miscarriages during this time period. Miscarriage estimation relative to those pregnancies ending in induced abortions is based on the ratio of miscarriages to the pregnancies ending 10 weeks since ovulation is 8%÷92%, or roughly 10%.

Stillbirths are defined as the death of a fetus weighing at least 1,000g (2.2 lbs) or one that occurs at 28 weeks' gestation or later.[53] Cousens et al. have estimated country-level stillbirth rates (stillbirths per 1,000 total live births and stillbirths) in 2009.[54] From this, we calculated stillbirth ratios (stillbirths per 1,000 live births) and estimated the number of stillbirths in each country by applying

the adjusted ratio for each country to the total number of live births in 2014. For the few countries without available stillbirth rates in 2009, we used unweighted average subregional rates, with the following exceptions: We used the rate for Jordan for the State of Palestine, Morocco for Western Sahara, and China for Hong Kong and Macao. Lacking other information, we assumed that the ratios of stillbirths to live births were the same for births resulting from intended and unintended pregnancies.

We estimated the number of miscarriages at less than 28 weeks' gestation by subtracting the number of stillbirths from the number of total miscarriages. In AIU-2014, we use the general term, miscarriage, to refer to the miscarriages before 28 weeks' gestation.

Current scenario intention status of pregnancies

Intended pregnancies are estimated by adding all planned births, plus the miscarriages and stillbirths resulting from planned pregnancies. Unintended pregnancies are estimated by adding all unplanned births, all induced abortions, and the miscarriages and stillbirths resulting from unintended pregnancies. Some women with induced abortions likely had intended to become pregnant, but ended their pregnancies because of health complications for themselves or the fetus or because their personal situation changed in a way that made them feel they could not give birth.[55,56] However, there are no adequate data for estimating how many intended conceptions end in induced abortion. Therefore, we continue, as in prior AIU analyses, to assume that all induced abortions follow unintended conceptions.

Levels of estimation

Data for the AIU-2014 estimates were available for various geographic levels and groupings. When data were not available at the country level, country estimates were made from higher-level data to facilitate the calculations and so that findings could be regrouped into categories of interest. Since country-level estimates of pregnancies by intention status and outcome are available for very few developing countries, estimates involved assumptions from regional and global data.

As described above, the numbers of live births and estimates of numbers of stillbirths are country-level estimates. Subregional estimates were used for the proportion of births that were unintended, for the numbers of induced abortions and for the conditions under which abortions occurred. Global assumptions of ratios of all miscarriages (those before 28 weeks of pregnancy, as well as those ending as stillbirths) to births and abortions were used for all countries.

Thus we assumed that the proportions of unintended pregnancies that resulted in unplanned births, induced abortions and total miscarriages were the same for all countries within a subregion. This is a tenuous assumption, since, even within subregions, countries differ in access to abortion and other factors that may affect women's choice of outcome for unintended pregnancies. As a result, country-level estimates of unintended pregnancy and induced abortion, and unplanned births in some countries, are rough approximations. Therefore, although calculations behind AIU

estimates are made at the country level, estimates by pregnancy intention and abortion are not reliable for most countries and are presented only for groupings of countries.

Pregnancy estimates

Table 5 shows the estimated annual number of pregnancies, by outcome and intention status, according to region, subregion, economic group and other country groupings. Table 6 shows the proportions of all pregnancies and of all births resulting from unintended conceptions and the distribution of unintended pregnancies by outcome. It also shows the estimated proportions of induced abortions in each region or country grouping that occurred under safe and unsafe conditions.

Pregnancy intention and outcomes across other scenarios

AIU scenarios in which no women or all women wanting to avoid pregnancy were estimated to use modern contraceptive methods result in different numbers of unintended pregnancies from the current scenario. In all scenarios, unintended pregnancies in each country were distributed according to outcome (unplanned birth, induced abortion, miscarriage or stillbirth), based on the country's estimated 2014 distribution of unintended pregnancies (Table 6).

Pregnancy-Related Mortality and Morbidity

A benefit of increased attention in recent years to improvements that are needed and possible in health and lifespan, together with the development of new tools for data management and estimation, is that there are now multiple sources of mortality and morbidity estimates covering countries in all regions of the world. While general patterns in the levels and trends in mortality and morbidity are similar across international sources, differences between them require decisions about what sources to use.[57–59]

Maternal mortality

Selection of data sources. Estimates of the numbers and causes of maternal deaths have been made in recent years by WHO[60–63] and the Institute for Health Metrics and Evaluation (IHME),[64–66] in consultation with many experts. Results of the different estimation projects have differed, however, reflecting a variety of factors, including that country-level data sources are often incomplete or nonexistent, especially in developing countries; international coding of causes of deaths has changed over time and countries have adopted new versions at different times;[67] estimation methodologies have changed in recent years;[68] and there have been differences in definitions and assumptions across these efforts between and within organizations.[59,66]

The first step to estimating maternal mortality levels and causes in developing regions in AIU-2014 analyses was selecting the source estimates to use. The total numbers of maternal deaths estimated for 2013 by IHME and WHO researchers were very similar—292,982 and 289,000, respectively.[60,66] However, this similarity conceals differences in the estimation components: HIV-related indirect maternal deaths were estimated at 2,070 by IHME and 7,500 by WHO; and WHO defined maternal

death as, "the death of a woman while pregnant or within 42 days of termination of pregnancy…" and excluded deaths from direct or indirect obstetric causes after 42 days, when possible, but IHME included late maternal deaths (those occurring between 42 days and one year after delivery), when possible. Thus, IHME specifically included 43,507 late maternal deaths that are likely not included in the WHO estimates. The resulting number of maternal deaths in 2013 that appear to be comparable (total deaths minus HIV-related indirect maternal deaths and late maternal deaths) is 247,405 from IHME and 281,500 from WHO. The reason for this wide discrepancy is not evident.

We compared distributions by cause of maternal death from IHME and WHO sources. IHME graciously provided country-level tabulations of the number of maternal deaths by cause for 2010 from its website database,[65] and IHME researchers have published more recent estimates for 2013.[66] WHO researchers have published estimates of the causes of maternal deaths[62,63] and of the proportion of maternal deaths in developing countries due to unsafe abortion.[69,70]

As shown in Table 7, there is little consistency across these estimates. All sources agree in identifying hemorrhage, hypertension and sepsis as common causes of maternal mortality and some also estimate induced abortion and HIV-related causes as among the most common. However, the categories used in the different estimates vary; for instance, it is not always clear whether or not late maternal deaths are included. Ranges for estimates for some causes are quite wide: 5–18% for the proportion of deaths due to abortion, 15–32% for those due to hemorrhage and 1–18% for HIV-related maternal deaths.

We decided to use the most recent estimates from WHO researchers as the basis for the numbers and causes of maternal deaths and DALYs in AIU-2014.[60,63,71,72] These are roughly consistent with each other,[73] while the most recent IHME DALY estimates are for 2010[64] and appear to have been based on maternal mortality estimates that have since been superseded by more recent analyses. IHME DALY estimates for 2013 have not yet been released.[74]

In deciding to use WHO maternal mortality estimates, we adopted the WHO definition of maternal deaths: "the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes."[60]

Total number of maternal deaths. For each country, the ratio of maternal deaths per 100,000 live births was taken from WHO estimates for 2013.[60,75] For the few countries with no WHO estimate, we used the ratio from the unweighted average of countries with data in the subregion or for a similar country nearby (i.e., Morocco for Western Sahara and China for Hong Kong and Macao). The total number of maternal deaths in each country in 2014 was estimated as the product of the country's 2013 maternal mortality ratio and the total number of live births in 2014. No adjustments for trends over time were made to the maternal mortality ratios. The total number of maternal deaths estimated for 2014 in developing regions was 290,422 (Table 8).

Abortion-related mortality

There are three series of estimates of worldwide abortion-related mortality—two from WHO and one from IHME. Differences in the estimates from these sources are often confusing. The estimation methods and comparisons of results are summarized below.

Estimation of abortion-related mortality as one of all causes of maternal death. WHO has published two series of estimates based on analysis of data from sources reporting on the range of causes of death, one that estimated causes of maternal deaths for 1998–2002 and another that used more recent literature to make estimates for 2003–2009.

Khan et al. estimated causes of maternal death from a systematic review of "journal articles, registries and published or unpublished information from government or other agencies."[62] The review included data from 1990 on and estimated causes of maternal deaths in 1998–2002. They give no definition for "abortion," but include ectopic pregnancies in a separate category. They report separate estimates for the percentage of maternal deaths due to abortion in developed regions (8.2%), Africa (3.9%), Asia (5.7%) and Latin America and the Caribbean (12.0%). Weighting these estimates by the estimated number of deaths in 2000 from the most recent WHO maternal mortality estimates for 1990–2013[60] implies that worldwide and in developing regions as a whole, 6% and 5%, respectively, of maternal deaths circa 2000 were abortion-related. The corresponding numbers of abortion-related deaths in 2000 would be 22,800 worldwide and 22,500 in developing regions. Khan et al. include a separate category of "unclassified" causes of maternal deaths. The proportion of maternal deaths from "classified" causes that were abortion-related was 6%.

Say et al. estimated causes of death for maternal deaths in 2003–2009 using vital registration databases, published literature and governmental reports.[63] They call attention, however, to the fact that maternal deaths due to abortion, and more specifically unsafe abortion, may be underreported and misclassified under other causes of death. Say et al. excluded from analysis maternal deaths with unknown cause of death, and based the cause-of-death distributions they estimate on the reported classification of deaths, without adjustment for misclassification.

They estimated 8% of maternal deaths worldwide and in developing regions were from abortion, and they included in this category deaths from induced abortion, ectopic pregnancy and miscarriage. Using estimates from Kahn et al. of deaths from ectopic pregnancy and estimated mortality from miscarriages cited by Åhman and Shah[70] to separate deaths from these causes from those related to induced abortion, the percentage of maternal deaths due to induced abortion remained at 8%, indicating that differences in definition of abortion between Kahn et al. and Say et al. are small. The corresponding number of abortion-related deaths in 2013, based on the adjusted Say et al. proportions and the most recent WHO maternal mortality estimates,[60] would be almost the same as the earlier estimate from based on Kahn et al.—22,800 worldwide and 22,600 in developing regions.

The estimates from Kahn et al. and Say et al. imply an increase in the proportion of maternal deaths from abortion, from 5 to 6% in 1998–2002 to 8% in 2003–2009. However, because of estimated decreases in the total number of maternal deaths, the resulting estimates of the numbers of deaths from induced abortion are the same at around 23,000 per year. Almost all abortion-related mortality is from unsafe abortions. The mortality rates implied by the estimated levels of deaths from induced abortion in developing regions from the two sources are very similar: 114–122 per 100,000 induced abortions from Kahn et al. (22,500 deaths and an estimated 19,800,000 unsafe abortions in 2003[76] and 18,400,000 unsafe abortions in 2000[77]) and 107–113 per 100,000 from Say et al. (22,600 deaths and an estimated 21,200,000 unsafe abortions in developing regions in 2008[69] and 20,000,000 unsafe abortions in 2014; see Table 5). However, estimates based on the two sources are quite different at the regional levels, suggesting that similarity at overall levels overstates comparability between the sources.

IHME's estimates of causes of maternal deaths for 2008 and for 2013 are quite different from those estimated by WHO, and they differ from each other. Reasons for these differences in classification of causes of maternal death are not clear. For 2008, IHME estimated that 15% of maternal deaths were from abortion-related causes,[78] for a total of 37,000 deaths.[64] For 2013, IHME researchers estimated that 44,000 maternal deaths were from abortion-related causes.[66] Abortion-related deaths were estimated to account for 15% of all maternal deaths including late maternal deaths and for 18% of maternal deaths excluding late maternal deaths, which are not included in the WHO maternal mortality estimates.

Estimates of maternal deaths from unsafe abortions. Another WHO series separately estimates deaths from unsafe abortion. These derive from country-level estimates of the proportion of all maternal deaths that are related to unsafe abortion, but does not include analysis of other causes of death.[70] However, upward adjustments were made to estimates from national statistics that were judged to be 80% or less complete.[69]

Using this approach, the proportion of all maternal deaths due to unsafe abortion has been consistently estimated at 13% worldwide and for developing regions.[69,76,77] The number of deaths from this series reflects the estimate of the number of all maternal deaths, which has changed over time. Using WHO estimates of maternal deaths published in 2010,[60] Åhman and Shah revised prior reports to estimate that 69,000 women died in 1990 and 47,000 died in 2008 from unsafe abortion.[70] Using the most recent WHO estimates of maternal mortality[60] and assuming 13% were related to unsafe abortion, the number of deaths from unsafe abortion in 2013 would be 38,000. This decrease in the number of deaths would reflect the newer estimates of the maternal mortality overall and of continued decline in the number of maternal deaths worldwide.

Inconsistency in abortion mortality estimates. It is not surprising that there are such wide differences in estimates of abortion-related mortality. Valid information, indeed any information,

on the cause of death is lacking in many low-resource settings[59] as is reliable data on the numbers of women obtaining abortions.[51] Given the stigma that exists in many contexts around induced abortion, especially where legal restrictions force women to seek services in clandestine conditions, deaths from abortion complications may be reported according to the complications, such as hemorrhage or sepsis.

The WHO recommends use of abortion mortality estimates based on their most recent analysis published by Say et al.[63,79] until new information becomes available.

Source for AIU-2014 estimates of cause of maternal death

We based estimates of the causes of maternal deaths by Millennium Development Goal (MDG) regions on Say et al. (Table 7).[63] The choice to use these most recent WHO abortion mortality estimates means that the AIU-2014 estimates of abortion-related mortality are consistent with estimates for other causes of maternal death and are conservative estimates of abortion-related mortality.

Adjustment for HIV-related maternal deaths. Cause-of-death distributions from Say et al. are based on 23 studies published in 2003–2012 and are not specific to any particular year. They estimated 5.5% of maternal deaths were HIV-related maternal deaths, compared with 2.6% estimated for 2013 by WHO.[60] We applied country-level 2013 estimates of the proportion of maternal deaths related to HIV from WHO[80] to estimate maternal deaths in 2014 that were HIV-related, arriving at a total of 7,533 deaths in developing regions. We assumed that the cause of death distribution of maternal deaths from non–HIV-related causes reported by Say et al. applied to the estimated 282,889 non–HIV-related maternal deaths in 2014.

Country-level cause of death estimates. We applied the HIV-adjusted cause of death distributions by MDG region to the number of deaths in each country within the relevant region to estimate the numbers of deaths, by cause, for each country. These estimates are not actual country-level numbers of deaths, but lacking other information, we assumed that the distribution by cause of maternal death was the same for all countries in an MDG region.

Estimation of mortality from safe and from unsafe abortions. Based on Say et al.'s analysis, we estimated 24,703 maternal deaths in 2014 were related to induced abortions, spontaneous abortions (miscarriages) and ectopic pregnancies. We estimated the proportion of these deaths that were ectopic pregnancies from Kahn et al., assuming that their category of abortions included both induced and spontaneous abortions.[62] This resulted in an estimate of 2,164 maternal deaths from ectopic pregnancies in developing regions in 2014. Åhman and Shah cite a mortality rate of one per 100,000 spontaneous abortions.[70] Based on this estimate and the number of miscarriages at 14–27 weeks of pregnancy estimated for 2014, we estimated 43 maternal deaths in 2014 in developing regions were caused by miscarriages. We assumed the remaining 22,496 deaths were from induced abortion.

We assumed that the mortality rate was two deaths per 100,000 safe abortions. This is at least double the reported rates for women having safe abortions in developed countries[81] and draws on the assumption that differences in health status and health care access would contribute to higher mortality in developing countries. We assumed this rate for all safe abortions in developing regions other than Eastern Asia in 2014. Applying this mortality rate to the number of abortions estimated to have occurred in Eastern Asia in 2014 yielded more maternal deaths than we estimated to have occurred from abortion in the region, based on Say et al. and the above adjustments. We took the number of maternal deaths from safe abortion for Eastern Asia and the numbers estimated for other regions based on a mortality rate of two per 100,000 safe abortions. This resulted in an estimated 174 maternal deaths from complications of safe abortions in developing regions in 2014 and 22,323 deaths from unsafe abortions (Table 8).

Maternal DALYs

Disability-adjusted life years (DALYs) are a measure of the number of years of healthy life lost as a result of premature death and disability. One DALY equals one lost year of healthy life. The measure was developed to provide comparable estimates of the burdens of premature death and disability attributable to different causes around the world. Expressing diverse health outcomes in a common unit allows decision-makers to compare the impact of different health interventions.[82,83] In cost-effectiveness analyses, estimates are made of the number of years of disability-free life that would be gained from a particular health intervention, yielding a cost per DALY averted.

We took the total numbers of DALYs from maternal conditions in MDG regions from WHO estimates for 2012.[72] To estimate the numbers of DALYs for 2014, we multiplied the number of DALYs from maternal conditions in each MDG region in 2012 by the ratio of the number of maternal deaths in 2014 in that region (estimated from WHO country-level maternal mortality ratios[60]) to the regional number of maternal deaths in 2012 (as estimated in the WHO Global Health Estimates project[71]). This yielded an estimate of 19,655,837 DALYs from maternal conditions in developing regions in 2014.

DALYs and deaths from maternal conditions estimated in the Global Health Estimates series are not broken down further by cause of death. However, years of life lost from maternal deaths account for 91% of all maternal DALYs, as estimated for 2012 by WHO,[70] and 90% of maternal DALYs, as estimated for 2010 by IHME.[65] In the WHO estimates, the proportion of maternal DALYs accounted for by years of life lost was 83–95% in all MDG regions, except in Eastern Asia, where it was 57%.[72] Lacking information from WHO on the distribution of maternal DALYs by cause, we assumed the distributions of DALYs according to specific maternal conditions was the same as the distributions of causes of maternal deaths within each MDG region and for all countries within a region (Table 9).

Neonatal (newborn) mortality

The neonatal mortality rate is defined as the number of babies who die within 28 days of birth per 1,000 live births.[84] We estimated the numbers of neonatal deaths in each country in 2014 by multiplying the median country-specific estimates from the Child Health Epidemiology Reference Group (CHERG) of neonatal mortality rates in 2012 by the number of live births in each country in 2014.[48] We estimated 2012 neonatal mortality rates for countries not included in the CHERG estimates from subregional averages or from nearby countries; these estimated neonatal deaths accounted for less than 0.2% of the total estimated number of neonatal deaths in developing countries in 2014 (Table 10).

We limited impact estimates in AIU-2014 to neonatal mortality because the maternal and newborn health interventions we were able to include primarily affect neonatal survival. As shown in Table 10, neonatal deaths account for 59% of infant deaths in developing regions. Neonatal mortality rates range from less than five per 1,000 live births in 10 developing countries to more than 40 per 1,000 in nine countries (data not shown). Country neonatal and postneonatal infant mortality rates are closely related (r=.91), as are neonatal mortality rates and maternal mortality ratios (r=.86).

Neonatal (newborn) DALYs

We took MDG regional estimates of neonatal DALYs for 2012 from WHO's Global Health Estimates.[72] There is an almost constant ratio of 92:1 between the numbers of neonatal DALYs and deaths in the Global Health Estimates across MDG regions and causes of deaths and DALYs. Therefore, we estimated the numbers of DALYs in each MDG region in 2014 by multiplying the 2012 number of DALYs by the ratio of the number of neonatal deaths estimated for 2014 to the Global Health Estimates number of neonatal deaths for 2012.

We calculated MDG regional ratios of neonatal DALYs per 1,000 live births and used these to estimate neonatal DALYs at the country level, assuming that all countries in an MDG region had the same ratio. Table 10 shows the resulting estimates, as well as estimated levels of postneonatal infant DALYs. Neonatal DALYs account for a much smaller proportion (41%) of infant DALYs in all developing regions, reflecting the greater contribution of years of life lost to disability in the postneonatal period. The relationship between neonatal and postneonatal infant DALYs is less strong than that between neonatal and postneonatal deaths (r=.84).

SECTION 4: Need for and Use of Contraception

We classified women aged 15–49 in each country and marital status subgroup according to their risk for unintended pregnancy and their contraceptive method use. Except where noted, Adding It Up classifications of risk status follow revised DHS definitions.[85,86]

Definitions

Pregnancy intentions

Wanting to avoid a pregnancy and in need of modern contraceptives. Women are classified as wanting to avoid a pregnancy and being in need of modern contraceptives if

- they or their partner are currently using a contraceptive method, either traditional or modern;
- they are currently married or are unmarried and sexually active, and they are able to become pregnant, but want to wait two or more years before having a child; or
- they identify their current pregnancy as unintended or are experiencing postpartum amenorrhea after an unintended pregnancy.

Women who identify their current pregnancy as unintended or are experiencing postpartum amenorrhea after an unintended pregnancy are included (per the DHS approach) because their current or recent experience with unintended pregnancy indicates that they wanted to avoid becoming pregnant at some point in the last year. They therefore help to complete the picture of the total number of women wanting to avoid pregnancy in any given year.

Not wanting to avoid a pregnancy. Other women are classified as not currently wanting to avoid a pregnancy and are therefore not considered to be in need of contraceptives. Following the DHS methodology, these include unmarried women who are not sexually active, women who are infecund, those who want to have a child in the next two years, and those who are currently experiencing a pregnancy they identify as having been intended or are experiencing postpartum amenorrhea from a pregnancy they identify as having been intended.

This measure somewhat underestimates the proportion of women who want to avoid pregnancy, since some women who are not using contraceptives and want to wait less than two years to have a child want to avoid a pregnancy at the current time.[87]

Sexually active status

All currently married women were assumed to be sexually active. Women who were not married were classified as sexually active if they reported having had intercourse in the three months prior to the survey. This is a longer time period than used in the revised DHS definition, which considers unmarried women who have had sex in the past month to be sexually active for calculation of unmet need estimates.[85]

Because of the stigma attached to nonmarital sex, the level of sexual activity—and therefore risk for unintended pregnancy—is likely to be underestimated among unmarried women, especially in Asian and Arab countries, where stigma is especially strong. Almost all surveys in Sub-Saharan Africa and Latin America include unmarried women, although their sexual activity is likely to be somewhat underreported. However, unmarried women are largely excluded from surveys in Asia and Northern Africa, and, where they are included, underreporting of their sexual activity is likely to be extensive. We made estimates for unmarried women in these based on data from national surveys and from subnational studies in order to present estimates for all women of reproductive age.

Infecundity

Sexually active women were classified as infecund if they declared when surveyed that they were infecund, had had a hysterectomy or were menopausal. Also considered infecund were women who were not using contraceptives and were neither pregnant nor experiencing postpartum amenorrhea but who had not had a menstrual period for six months or longer, and those who were married and had not used a contraceptive method during the past five years, but had not had a birth and were not currently pregnant.

Childbearing intentions

Women wanting to avoid pregnancy who wanted no (more) children in the future were classified as wanting to limit childbearing. Women wanting to avoid pregnancy who did want (more) children in the future, including women wanting to delay a first birth and women with children who wanted to wait two or more years before having another child, were classified as spacing births.

Modern contraceptive methods

In AIU-2014, we defined modern contraceptive methods to include the most effective methods (hormonal implants, IUDs, and female and male sterilization), hormonal pills, injectables, male condoms and "other modern methods" (female condoms, other supply methods, and modern fertility-awareness methods of periodic abstinence, i.e., the Standard Days Method and TwoDay Method).[88] Traditional methods include other periodic abstinence methods, the lactational amenorrhea method (which involves exclusive breast-feeding for up to six months postpartum), withdrawal and folk methods.

Unmet need for modern family planning

Women with unmet need for modern contraception are those who want to avoid a pregnancy but are currently not using a method or using a traditional method. Other studies may not define women using traditional methods as having unmet need, but the AIU focuses on the need for *modern* methods because women using traditional methods face higher risks of unintended pregnancy than those using modern methods.[89,90] In most tabulations of unmet need, we show

separate estimates for women not using a method and those using a traditional method so that readers can calculate unmet need for just those women using no method of contraception.

Data Sources

Nationally representative surveys are the principal source of data on women's need for and use of contraceptives (Table 11).

Full coverage

Tabulations for this project were made for all countries with available data sets. These include Demographic and Health Surveys (DHS), U.S. Centers for Disease Control and Prevention Reproductive Health Surveys (CDC-RHS), United Nations Children's Fund (UNICEF) Multiple Indicator Cluster Surveys (MICS) and other independent surveys. As shown in Table 12, data on the distribution of women aged 15–49 by contraceptive need (wanting or not wanting to avoid pregnancy) and use (of modern contraceptives, traditional methods or no method while wanting to avoid pregnancy) were available for 71% of all women aged 15–49 in developing regions in 2014, ranging from 25% of never-married women to 47% of formerly married and 92% of currently married women.

For most countries, data were also available on distributions of women by the reasons for wanting to avoid pregnancy and distributions among those wanting to avoid pregnancy by contraceptive method used and the desire to delay/space or limit childbearing. For some countries, these distributions were estimated from two available sources, usually using recent, but incomplete, data (e.g., from a preliminary report of national survey findings) to update information from a prior survey. Countries with two sources of information are shown in Table 11.

For countries for which the distribution of women not in need was unavailable, we assumed it was the same as the unweighted distribution of women not in need in other countries in the subregion with available data. For countries for which the distribution of contraceptive users by childbearing intention was unavailable, all women relying on sterilization were assumed to be limiting childbearing and women using each reversible method were assumed to be equally split between spacing and limiting. In countries with full data, 57% of women using reversible methods in countries reported wanting no more children (44% in Africa, 50% in Latin America and the Caribbean, and 60% in Asia). For the few countries without data on the distribution of nonusers wanting avoid pregnancy by childbearing intention, women were likewise assumed to be equally split between spacing and limiting. In countries with full data, 48% of women wanting to avoid pregnancy who were using no method wanted to limit childbearing (34% in Africa, 57% in Asia and 51% in Latin America and the Caribbean). See Table 11 for specific estimation information.

Partial coverage

When the national survey or published source did not include all the data items needed for estimating the distribution of women aged 15–49 by contraceptive need and use, we made

estimates based on a prior survey for the country, patterns in similar countries or the weighted average for the subregion. Partial data were available for 4% of all women aged 15–49 (0% of never-married women, 4% of formerly married women and 6% of currently married women).

Estimation

Other countries lacked recent national survey data and we found no other published data for use in this project, or the available data and reports did not cover never-married women or omitted all unmarried women. Estimates were therefore made for these countries and women, accounting for 25% of all women aged 15–49. While the distributions by contraceptive need and use and childbearing intention were estimated for only 2% of currently married women, estimation was required for 49% of formerly married and 75% of never-married women.

For most such countries, we assumed distributions of women by risk, future childbearing intention and/or contraceptive use were similar to those in other countries in the same subregion or region or to other countries that are demographically or socioeconomically similar. However, as noted above, for most countries in Asia and Northern Africa, we made estimates for unmarried women based on data from national surveys and from subnational studies. For never-married women in Eastern Asia, we assumed that 84% were not in need, 8% used modern contraceptives and 8% used traditional methods or no method, even though they want to avoid pregnancy; for those in Southeast Asia, we assumed 94% were not in need, 3% used modern contraceptives and 3% used traditional or no methods; and, for Western Asia, we assumed 98% were not in need, 1% used modern methods and 1% used traditional or no method. Within these categories, we distributed women not in need into subcategories and those assumed to be using modern methods or with unmet need for modern methods into subcategories of childbearing intention and method types based on the weighted distribution of never-married women in Asia from countries with available data (Mongolia, Kazakhstan, Vanuatu and Samoa).

Estimates of Contraceptive Need and Use

The methodology used to develop the 2014 estimates of use of and need for contraceptives among women aged 15–49 is the same as that used for the Adding It Up estimates for 2003, 2008 and 2012.[7,10] Estimates of contraceptive need and use were calculated separately for currently married, formerly married and never-married women and summed to obtain estimates for all women of reproductive age. Women in each marital status group were first classified into those wanting and not wanting to avoid pregnancy; those wanting to avoid pregnancy were further subdivided into those wanting to delay or space births and those wanting to have no more children; women within these two groups were then classified according to their contraceptive use status.

Tables 13 and 14 show for each country and for selected country groupings the resulting estimated distributions of all women aged 15–49 and of currently, formerly and never-married women aged 15–49 by need for and use of contraception, i.e., not at risk for unintended pregnancies (not wanting to avoid pregnancy), using modern or traditional contraceptives, or wanting to avoid pregnancy

but using no method. In addition, Table 14 shows the distribution of women in each marital status group who want to avoid pregnancy. The proportion of women wanting to avoid pregnancy using modern contraceptives represents the percentage of demand for family planning met with modern contraceptive methods.[91,92] Together, the proportions of women wanting to avoid pregnancy who use traditional methods or use no methods are considered to have unmet need for modern contraceptives.

Tables 15 and 16 present the marital status distribution of women in each of the main contraceptive need and use groups, showing that although most women wanting to avoid pregnancy are currently married, substantial proportions are unmarried.

More detailed distributions of women in each country by reasons for not wanting to avoid pregnancy and by specific contraceptive methods used are shown in Table 17 for currently married women aged 15–49 and in Table 18 for all women 15–49. Detailed contraceptive need and use information for all women and for those in each marital status group are shown by selected country groupings in Table 19 (percentage distribution) and Table 20 (numbers of women). Table 21 shows method use (in numbers and percentage distributions) among women wanting to avoid pregnancy who want to delay or space future births and who want no (more) children and are seeking to limit future childbearing.

Service Requirements

Standard WHO protocols and expert opinions were used to specify the type and amount of drugs, supplies and personnel time required for provision of each method. All requirements are shown, according to method, in the first seven tables of Appendix A.

For short-term methods (injectables, oral contraceptives and male condoms), requirements are for one year of use. For long-acting reversible contraceptive methods (IUDs and implants), requirements include initiation, follow-up and removal of the method. Supply requirements for sterilization were based on treatment guidelines from EngenderHealth.[93]

SECTION 5: Need for and Receipt of Maternal and Newborn Health Care

The proportions of women and newborns in need of health services include components in the basic package of care recommended by WHO.[94–97] We have estimated need for specific intervention components from published estimates of incidence or prevalence. Estimates of the proportions receiving needed health services ("met need") draw on survey information for the most recent birth in the time period covered in the data source, usually the past two years (MICS) or three years (DHS), published studies and literature reviews, including estimates developed for the Lives Saved Tool (LiST).[10,15,98,99] Otherwise, we based estimates of the receipt of care on the type of care needed, women's receipt of antenatal care and whether birth occurred in a health facility. Estimates of receipt of postabortion care are from the Guttmacher Institute.[100]

Antenatal Care

Ectopic pregnancy case management

An ectopic pregnancy is a complication of pregnancy in which the embryo implants outside the uterine cavity. With rare exceptions, ectopic pregnancies are not viable. Most ectopic pregnancies occur in the fallopian tube, but implantation can also occur in the cervix, ovaries and abdomen. In developing countries, ectopic pregnancies are usually only recognized when they have ruptured or are in danger of rupturing and require surgical intervention.

Need. We based the assumption that ectopic pregnancies equal 2% of live births plus induced abortions on an analysis of data from the early 1990s by researchers at the Centers for Disease Control.[101] Following assumptions used in the OneHealth model,[102] we assumed that half of all ectopic pregnancies, i.e., 1% of live births plus abortions, need surgical treatment. This OneHealth estimate is based on web citations stating that about half of ectopic pregnancies will resolve without treatment; we found no primary source for this information. Based on this estimate, we assumed that, in developing countries, all ectopic pregnancies that do not resolve on their own (about 1% of all live births plus abortions) will require a laparoscopy or laparotomy.

Coverage. We assumed current coverage for women with ectopic pregnancies needing care equaled the estimated coverage for emergency obstetric care, i.e., 50% of the country level of facility delivery (see Table 23). Treatment needed for women with ectopic pregnancies was based on WHO recommendations.[103] Drugs and supplies and personnel time for an average case are shown in Appendix A: ectopic pregnancy.

Basic antenatal care

WHO recommends that a pregnant woman make at least four antenatal visits.[94,104] In this category of basic antenatal care, we included a pregnancy test, physical exams, blood tests for glucose, blood

group and Rh factor and urine tests, along with 10 minutes of a nurse's time per visit. We treated other components as separate interventions. Table 22 provides estimates of the proportions of women with live births who made any professional antenatal care visits and who made four or more visits, by selected country groupings.

Need. We assumed all women whose pregnancies end in birth (live birth or stillbirth) need at least four antenatal care visits. For women with miscarriages before 27 weeks' gestation, we assumed their pregnancies would have lasted long enough to require an average of two visits.

Coverage. Estimates of receipt of needed health services ("met need") draw on a wide range of surveys of women who had live births in recent years, principally the DHS, supplemented by the MICS, the RHS, independent national surveys and other national sources of data on health services, as well as estimates from published studies and literature reviews. Where available, we took information reported for the most recent birth in the time period covered in the data source, usually the past two years (MICS) or three years (DHS). An exception was made in the case of India, where rapid change in the proportion delivering in health facilities, resulting from a large-scale intervention (Janani Suraksha Yojana), was better captured by using data for the last full year of data from the most recent national survey, the 2007–2009 District-Level Household Survey.[105]
Women in DHS, MICS and similar surveys are asked from what types of providers, if any, they received antenatal care. From surveys for which data files were available, we tabulated the numbers of visits to skilled professionals, recognizing that some of these visits may have been made to unskilled providers. We used country classifications of the types of providers who were deemed professional or skilled. Generally these included physicians, midwives and nurses.

For some countries, data on the number of antenatal care visits were available from a more recent data source or for countries without available data sets. These included preliminary reports and UNICEF's database.[106] For these countries, we assumed that the numbers of visits among those reporting antenatal care visits included at least one visit to a professional provider. In most of these cases, the only detail on the number of visits was the 4+category. We used prior survey tabulations for the country or subregional estimates from countries with full data to estimate the full range of numbers of visits.

Data on antenatal care is available from women who had live births. We assumed the same care was obtained by women with stillbirths. To estimate the number of women with miscarriages before 27 weeks who receive zero, one or two antenatal care visits, we used the proportions of women giving birth who made zero, one or two visits.

Components of basic antenatal care were based on WHO recommendations.[107] WHO recommends 20 minutes of provider time per visit, but since this includes interventions (such as tetanus toxoid injection or syphilis detection and treatment) that are treated separately from antenatal care in the Adding It Up model, we allocated only 10 minutes staff time per visit for basic antenatal care. See

Appendix A: basic antenatal care.

Tetanus toxoid injection

Tetanus is acquired when the spores of the bacterium Clostridium tetani infect a wound or the umbilical stump of a newborn baby. The disease is particularly common and serious in newborn babies. Neonatal tetanus can be prevented by immunizing women of childbearing age (pregnant or not) with tetanus toxoid. This protects the mother and, through a transfer of tetanus antibodies to the fetus, also her baby.[108]

Need. We assumed that all women giving birth (live births or stillbirths) and all with miscarriages before 27 weeks need two doses of tetanus immunization: "In countries where [maternal and neonatal tetanus] remains a public health problem, special attention should be given to immunizing women of childbearing age. As a minimum strategy, eligible pregnant women should be routinely immunized at their first contact with antenatal clinics or other health services offering vaccination. Pregnant women with an inadequate or unknown immunization history should always receive 2 doses of tetanus toxoid-containing vaccine: the first dose as early as possible during pregnancy and the second dose at least 4 weeks later. Efforts should be made to complete the recommended series of 5 immunizations, e.g. when the mother brings her baby for vaccinations and in connection with subsequent pregnancies, while respecting the minimum intervals between doses."[109(p.199)]

Coverage. We took the proportion of women with live births who had received at least two tetanus injections from tabulations of DHS, MICS and other national survey tabulations and reports, and from the UNICEF database. We estimated missing data from weighted subregional averages and assumed levels of immunization during pregnancy applied to women with both live births and stillbirths. Table 22 provides estimates of the proportions of women with live births who received at least two tetanus toxoid injections, by selected country groupings.

To estimate coverage among women with miscarriages, we looked to information on coverage levels according to the number of antenatal care visits women made. Tabulation of DHS data files available as of October 22, 2012 (excluding those for India) showed the following proportions of women received at least two tetanus shots during last pregnancy in the past three years, by their number of professional prenatal visits[110]:

0 visits: 19.4%
1 visit: 19.0%
0–1 visits: 19.2%
2 visits: 46.9%
3 visits: 55.3%
4+ visits: 57.8%
2+ visits: 56.2%
Total: 48.5%

For women with miscarriages before 27 weeks, we assumed those with fewer than two visits had at least two tetanus shots in a ratio of 19.2/48.5=0.39 of the country's level among women giving birth and that those with at least two visits had ratio of 46.9/48.5=0.97 of the country's level among women giving birth. For supplies and staff time we assumed to be needed to provide two tetanus toxoid injections during antenatal care, see Appendix A: tetanus toxoid injection.

Syphilis screening and treatment

WHO recommends that all pregnant women be screened for syphilis at their initial antenatal care visit and shortly before birth and that they be treated, if needed, for their own health and to prevent mother-to-child transmission of syphilis.[111]

Need. We assumed the proportion of women screened at first antenatal care visit who were positive for syphilis[112] represents the proportion of pregnant women who are positive for syphilis at first and at second screening. We estimated that 65% of pregnant women who test positive for syphilis need treatment for probable active syphilis.[113] Table 22 provides estimates of the proportions of women with live births who received a syphilis test at a first antenatal care visit, by selected country groupings.

Coverage. Following Newman et al.,[113] we used data from the WHO Global Health Observatory to estimate the proportion of women who received syphilis screening at their first antenatal care visit.[114] This proportion times the proportion of women with at least one antenatal care visit was used to represent the percentage of pregnant women with an initial syphilis test. This proportion, in turn, times the proportion of women with at least four antenatal care visits was used to estimate the proportion of women giving birth who received a second syphilis screening.

We assumed that 65% of women who were screened at their first antenatal care visit and found to be positive were treated, i.e., we assumed those who were not screened were not treated. Lacking information on the proportion of women screened for a second time during pregnancy who would be infected with syphilis, we did not estimate treatment for these women. Table 22 provides estimates of the proportions of women with live births who needed treatment because they had probable active syphilis infection, by selected country groupings. Treatment requirements are shown in Appendix A: syphilis treatment for seropositive women.

Hypertensive disease case management

Women with conditions associated with high blood pressure during pregnancy may progress from mild disease to a more serious condition over the course of their pregnancy. These hypertensive disorders of pregnancy are hypertension without proteinuria (covered in this intervention), mild preeclampsia, severe preeclampsia and eclampsia (covered as separate interventions, below).

Need. We assumed all women who give birth need screening for hypertensive disease as part of

antenatal care and that women who had miscarriages were not screened (because very few women had miscarriages at weeks 20–27, the time period when they would have obtained screening). We estimated that 3.73% of women develop hypertensive disorders of pregnancy resulting in hypertension without proteinuria and that 3.4% develop preeclampsia, including 1.33% with mild preeclampsia at less than 37 weeks' gestation, 1.33% with mild preeclampsia at 37 weeks or later, and 0.75% with severe preeclampsia.

From Dolea and AbouZahr, we assumed the average incidence of preeclampsia in developing countries was 3.4% of births.[115]

In an analysis of 38,923,280 deliveries after 20 weeks in the United States in 1988–1997, Zhang et al. found that 5.9% of women had hypertensive disorders of pregnancy, including 3.01% with hypertension without proteinuria, 2.73% with preeclampsia and 0.11% with eclampsia (distributing the 1.8 per 1,000 deliveries with preeclampsia/eclampsia superimposed on chronic hypertension across categories of mild preeclampsia, severe preeclampsia and eclampsia).[116]

Of the women in Zhang et al.'s study with preeclampsia, 78% had mild preeclampsia and 22% had severe preeclampsia. Applying these percentages to the 3.4% average developing-country incidence of preeclampsia (from Dolea and Abouzahr), we estimated that 2.65% of women giving birth have mild preeclampsia and 0.75% have severe preeclampsia. Lacking data, we assumed that half of women with mild preeclampsia develop it before 37 weeks' gestation and half at 37 weeks or later.

In Zhang et al.'s analysis, the number of women with eclampsia was 3.9% of the total with mild or severe preeclampsia. While this is higher than the 2.3% level estimated by Dolea and AbouZahr, we used the figure from Zhang et al. to estimate that 0.13% of women giving birth develop eclampsia. (Using the percentage from Dolea and AbouZahr would have resulted in 0.08% with eclampsia.)

In the Zhang et al. study, women with preeclampsia and eclampsia made up 48.6% of all those with hypertensive disorders of pregnancy. Based on this, we assumed that the total estimated levels of 3.53% with preeclampsia and eclampsia was 48.6% of a total 7.26% with hypertensive disorders and that the difference, 3.73% were women with hypertension without proteinuria.

Coverage. We assumed that women who had any professional antenatal care visits and had a urine test during professional antenatal care were screened for hypertensive disease and that women who had miscarriages were not screened (because very few women had miscarriages at weeks 20–27, the time period in which they would have obtained screening). We assumed the percentage of women with any antenatal care visits who had a urine test applies to those with any professional visit. Table 22 provides estimates of the percentage of women with live births who had a urine test during professional antenatal care, by selected country groupings.

We assumed that all pregnant women who have at least four antenatal care visits and a urine test and are found to have hypertensive disorder without proteinuria obtain weekly monitoring for high blood pressure.

For those with mild preeclampsia before 37 weeks' gestation, we assumed those identified (percentage with at least four antenatal care visits times percentage of those with antenatal care who have a urine test) receive needed care (monitoring blood pressure and protein in urine twice weekly).

For those with mild preeclampsia at or after 37 weeks' gestation or severe preeclampsia, we assumed the proportion of those identified (percentage with at least four antenatal care visits times percentage of those with antenatal care who have a urine test) who receive treatment was equal to the estimated proportion of births that occur in in facilities with emergency obstetrical care coverage.

Treatment requirements. We based estimates of treatment requirements for women with hypertensive disorders of pregnancy on WHO sources.[103,117]

We assumed that hypertensive women without proteinuria need weekly monitoring for blood pressure and proteinuria and that hypertensive disorders of pregnancy are usually discovered around week 35, with the average woman with hypertension without proteinuria needing five monitoring visits through the end of pregnancy.[118] For treatment requirements, see Appendix A: hypertensive disease case management for hypertensive women without proteinuria.

For those with mild preeclampsia before 37 weeks, treatment requirements include outpatient follow-up twice a week and weekly monitoring of blood pressure, urine (for proteinuria) and fetal condition. Anticonvulsants, antihypertensives and sedatives are not to be given. If urinary protein levels increase, it should be managed as severe preeclampsia (see below). Treatment requirements are shown in Appendix A: preeclampsia case management—mild cases <37 weeks.

For women with mild preeclampsia at 37 weeks or later, treatment recommendations are to expedite delivery if there are signs of fetal compromise. We assumed 50% of women can be monitored and 50% need immediate delivery and that treatment would be to rupture membranes and induce labor using oxytocin, if the cervix is favorable, or, if unfavorable, to ripen cervix using prostaglandins or deliver by cesarean section. Treatment requirements are shown in Appendix A: preeclampsia case management—mild cases ≧37 weeks.

Severe cases of preeclampsia require active in-hospital management with delivery, including antihypertensive drugs and, if needed, anticonvulsive drugs. See Appendix A: preeclampsia case management—severe cases.

Hookworm treatment

Infection with hookworm parasites causes intestinal bleeding that can lead to anemia and protein malnutrition that can in turn lead to poor pregnancy outcomes and maternal mortality.[119,120]

Need. WHO recommends that, "For soil-transmitted helminthiasis, this manual recommends that albendazole or mebendazole be offered to pregnant women in the 2nd and 3rd trimesters of pregnancy and to lactating women in preventive chemotherapy interventions targeting areas where the prevalence of any soil-transmitted helminth infection (ascariasis, trichuriasis and hookworm infection) exceeds 20%."[121] We assumed that pregnant women who have miscarriages or induced abortions do not need this preventive care related to their pregnancies.

We were unable to find any source of data classifying regions or countries with hookworm prevalence reaching 20%. Therefore, we estimated the proportions of pregnant women needing medication for soil-transmitted helminthiasis from the WHO estimates of the proportions of children (aged 1–4) needing such medication.[122] We estimated proportions for countries with missing data from Hotez et al.[119] Estimates by selected country groupings are shown in Table 22.

Coverage. We used survey proportions of women with any professional antenatal care visit who took medication for intestinal parasites during pregnancy when available. For countries with endemic hookworm for which there were no data, we used the regional proportion of pregnant women with antenatal care who took medication. For Sudan, we used proportions from Nigeria; for Papua New Guinea, we used Solomon Islands; for China and Mongolia, and for countries without survey data in the Caribbean and South America, we assumed women with at least four antenatal care visits received hookworm medication. (No estimates are available for Eastern Asia; estimates for the Caribbean are from data for Honduras; the only South American country with data are Guyana.) Resulting estimates are presented in Table 22. Treatment guidelines were taken from WHO.[103] See Appendix A: hookworm treatment.

Malaria prevention—insecticide-treated bed nets

Pregnant women are especially susceptible to malaria infection, which can lead to malarial anemia and severe disease with a high risk of maternal mortality, pregnancy loss and poor infant outcomes.[123] Use of insecticide-treated bed nets is the primary strategy recommended for protecting pregnant women from infective mosquito bites.[124]

Need. We assumed that pregnant women living in endemic (stable and unstable) areas need long-lasting insecticide treated bed nets. We assumed that a country's percentage of pregnant women living in endemic areas for Plasmodium falciparum is equal to the percentage of population aged 15 and older in areas with unstable or stable transmission and that the percentage in endemic areas for Plasmodium vivax equals the percentage of the total population in areas with unstable or stable transmission. We assumed the total percentage of pregnant women living in malaria endemic areas was the greater of the proportion in P. falciparum or P. vivax.[125,126] See Table 22 for estimates of the

proportions of women in selected country groupings needing to use long-lasting insecticide-treated bed nets.

Coverage. We took the proportion of pregnant women aged 15–49 sleeping under an insecticide-treated net the night prior to the survey from the ChildInfo Database[127] and StatCompiler.[128] For most countries without data, we used regional proportions of women in endemic areas with using insecticide-treated bed nets or weighted proportions for all developing countries with available data . We used the Nigeria proportion of women in endemic areas using nets for Sudan. For regions with no countries with data (Eastern, Central and Western Asia), we used the weighted proportion from all countries with data. Coverage estimates for selected country groupings are shown in Table 22. We assumed that an insecticide-treated net lasts three years, i.e., one year of use equals, on average, one-third of a net. See Appendix A: malaria prevention—insecticide-treated bed nets.

Malaria prevention—intermittent presumptive treatment in pregnancy

WHO recommends that "All possible efforts should be made to increase access to IPTp [intermittent presumptive treatment in pregnancy] with SP [sulfadoxine-pyrimethamine] in all areas with moderate-to-high transmission in Africa, as part of antenatal care services...at each scheduled antenatal care visit...as early as possible during the second trimester of gestation; each SP dose should be given at least 1 month apart; the last dose of IPTp with SP can be administered up to the time of delivery...In some countries where IPTp with SP is currently being implemented, transmission of malaria has been reduced substantially. In the absence of information on the level of malaria transmission below which IPTp-SP is no longer cost-effective, such countries should not stop IPTp. There is currently insufficient evidence to support a general recommendation for the use of IPTp-SP outside Africa."[129]

Need. We assumed that pregnant women living in endemic areas of Africa need IPTp, and that the percentage of pregnant women living in endemic areas is equal to percentage of total population aged 15 and older in their country who live in endemic areas.[125,126] See Table 22 for estimates of the proportions of women in selected country groupings needing intermittent preventive therapy.

Coverage. We took the proportion of last births where the mother received intermittent preventive treatment (at least two doses of SP/Fansidar) through antenatal care visits during pregnancy, from most recent source from ChildInfo Database[127] and StatCompiler.[128] We used the subregional proportion of women in endemic areas or proportion for all developing countries with data where information was not available. See Table 22 for estimates for selected country groupings and Appendix A: malaria prevention— intermittent presumptive treatment in pregnancy.

Malaria diagnosis and treatment

Pregnant women with malaria need treatment with artesunate-based combination therapy ACTs and those with severe malaria require hospital care.[130]

Need. We assumed estimated annual incidence of malaria per person applied to pregnant women.[131] Estimates for selected country groupings are shown in Table 22.

Coverage. We assumed the proportion of women with malaria who obtained needed care was the same as the proportion of women who gave birth who had four or more antenatal care visits (see Table 22 for estimated proportions of women receiving needed care) and the proportion of women with miscarriages other than stillbirths who had at least two antenatal care visits.

We estimated treatment needs from WHO treatment guidelines.[103,130] We assumed use of rapid diagnostic tests although microscopy may be used in some settings. We assumed that 25% more women are tested than end up being diagnosed with malaria, that 75% of infected women are nonsevere cases and 25% are severe cases. Treatment requirements are shown in Appendix A: malaria diagnosis and treatment for pregnant women.

Anemia screening

Screening identifies pregnant women with moderate anemia (hemoglobin level of 7–11g/dl) and severe anemia (<7g/dl).

Need. All pregnant women need screening with a blood sample.

Coverage. We assumed the proportion of women giving birth who had a professional antenatal care visit and had a blood sample taken during pregnancy equals the proportion of women giving birth screened for anemia. Estimated proportions of women with live births who were screened for anemia through an antenatal care blood test are shown in Table 22.

Across all DHS tabulations (except India), the proportion of women giving birth who had only one antenatal care visit who had a blood sample taken was 53% of the proportion of all women with any professional antenatal care visit with a blood sample.[110] We assumed that women with miscarriages before 27 weeks who were screened had the same likelihood of having been screened as women with only one antenatal care visit.

We estimated supplies and staff time for measuring hemoglobin through a blood test. WHO recommends checking for anemia at subsequent visits, looking for conjunctival or palmar pallor.[107] Treatment requirements are shown in Appendix A: anemia screening and treatment.

Iron and folic acid supplementation—nonanemic pregnant women

Pregnant women who are not anemic need iron and folic acid supplementation. The international recommendation for weekly supplementation for nonpregnant women of reproductive age is that supplements should contain 120 mg of iron in the form of ferrous sulfate and 2800 mcg of folic acid.[132]

Need. We took the proportion of pregnant women who were nonanemic (hemoglobin of at least 11g/dL) from available DHS tabulations[133] or from de Benoist et al.[134]

Coverage. We took the proportion of pregnant women who took iron supplements during pregnancy from DHS tabulations, using regional estimates from countries with data or global developing country estimate from countries with data for countries and regions with no information (Table 22). We assumed the proportion taking iron applied to women who gave birth and that those with miscarriages before 27 weeks were half as likely to take supplements. We assumed nonanemic pregnant women taking iron did so for an average of four months. See Appendix A: anemia screening and treatment.

Iron and folic acid supplementation—anemic pregnant women

Daily iron and folic acid supplementation is recommended for pregnant women with anemia.[135]

Need. We took the proportion of pregnant women who were anemic (hemoglobin less than 11g/dL) from available DHS tabulations[133] or from de Benoist et al.[134] Estimated proportions for selected country groupings are shown in Table 22.

Coverage. We found no data on the proportion of anemic pregnant women who take iron. We took the proportion of all pregnant women who took iron supplements during pregnancy from DHS tabulations, using regional estimates from countries with data or global developing country estimates from countries with data for countries and regions with no information, as shown in Table 22. We assumed that the proportion taking iron applied to women who gave birth and that women with miscarriages before 27 weeks were half as likely to be taking supplements. We assumed anemic pregnant women, including women with miscarriages, taking iron did so for an average of four months. Treatment is based on WHO guidelines; see Appendix A: anemia screening and treatment.[135]

Urinary tract infection

Urinary tract infection is a common infection that usually occurs when bacteria enter the opening of the urethra and multiply in the urinary tract. The urinary tract includes the kidneys, the tubes that carry urine from the kidneys to the bladder (ureters), the bladder and the tube that carries urine from the bladder (urethra).

Need. We estimated that 25% of women globally experience a urinary tract episode in any year.[102]

Coverage. We assumed that women needing urinary tract infection treatment who gave birth received care if they had at least four antenatal care visits and those who had miscarriages before 27 weeks who had two or more antenatal care visits received care. Treatment requirements are shown in Appendix A: urinary tract infection.

Labor, Delivery and Postpartum Care

Antenatal corticosteroids for preterm labor

Administration of steroids and inpatient care is recommended for women with suspected preterm labor.[136] The most effective intervention to improve newborn outcomes for women in preterm labor is the administration of corticosteroids. A significant reduction in respiratory distress syndrome is obtained if delivery can be postponed for 48 hours. Pharmacological treatment of preterm labor should aim at preventing preterm delivery for at least 48 hours.

Need. We assumed that the proportion of women giving birth who need this treatment equals the proportion of births that are preterm.[137] Table 23 shows the estimated proportions of births that are preterm for selected country groupings.

Coverage. We took the following coverage assumptions from the Lives Saved Tool (LiST): that 95% of women with births in facilities with emergency obstetric care and 20% of those delivering at other facilities have access to antenatal corticosteroids.[98] Care requirements for providing antenatal corticosteroids for women with preterm labor are taken from the literature.[138–140] See Appendix A: antenatal corticosteroids.

Antibiotics for premature rupture of membranes

Prelabor rupture of membranes is the rupture of the membranes before labor has begun. It can occur either when the fetus is immature (preterm or before 37 weeks) or when it is mature (at term). Administration of oral antibiotics to women with preterm premature rupture of membranes is recommended to prevent infection and its consequences.[141]

Need. We assumed one-third of women with low-birth-weight deliveries need treatment for prelabor rupture of membranes, based on the OneHealth model.[102] We took estimated country-level proportions of births with low birth weight from UNICEF database,[142] using subregional estimates for countries with no data. See Table 23 for estimated proportions of births that are low birth weight, by selected country groupings.

Coverage. We took the following coverage assumptions from LiST: that 95% of women with births in facilities with emergency obstetric care and 20% of women delivering at other facilities have access to care for prelabor rupture of membranes.[98] Treatment components were based on a published literature review.[141] Delivery-related hospitalization was not included in this intervention. See Appendix A: antibiotics for premature rupture of membranes.

Induction of labor (beyond 41 weeks)

Maternal complications of pregnancy can increase after 40 weeks' gestation in low-risk women.[143] We included induction of labor to prevent births occurring at or beyond 41 completed weeks. This intervention only includes the induction of labor with misoprostol; the actual delivery is included under essential delivery care below.

Need. We used the OneHealth assumption that 5% of pregnancies ending in birth go beyond 41 weeks.[102]

Coverage. Following LiST, we assumed 20% of births in facilities with emergency obstetric care have access to induction of labor.[102] Treatment was based on WHO recommendations for use of oral misoprostol (25mcg, twice hourly if necessary) for induction of labor.[144] Apart from easier administration, oral misoprostol has the advantage of an exact dose preparation. The 25mcg vaginal dose is usually prepared by cutting the 100mcg tablet into four sections. It is also possible to dissolve 200mcg misoprostol in 200ml tap water and give 25ml twice hourly. See treatment requirements in Appendix A: induction of labor.

Labor and delivery management—essential facility-based care for all women

In this intervention and treatment, we included care for women with routine vaginal deliveries.

Need. We assumed all women giving birth need facility delivery. We estimated the proportion needing routine vaginal delivery by subtracting the proportions in each country estimated to need assisted vaginal delivery or cesarean sections.

Coverage. We tabulated the percentage of recent births that occurred in a facility from DHS, MICS and other national surveys, and used regional or all-developing-country estimates for countries with no data. We estimated the proportion of births occurring in facilities with routine vaginal delivery by subtracting the proportions of births needing assisted vaginal delivery or cesarean sections. Proportions of births in health facilities and of births that occurred in health facilities via routine vaginal delivery are shown in Table 23.

We assumed 50% of women require an episiotomy. Active management of the third stage of labor is detailed as a separate intervention, below. See Appendix A: essential labor and delivery care for all women.

Active management of the third stage of labor

Active management of the third stage of labor (AMTSL) is an evidence-based, low-cost intervention used to prevent postpartum hemorrhage. Components include administration of a uterotonic agent (oxytocin is the drug of choice) within one minute after birth of the baby and after ruling out the presence of another baby, controlled cord traction with counter-traction to support the uterus and uterine massage after delivery of the placenta.[145,146]

Need. All women giving birth vaginally need AMTSL.

Coverage. We took the following coverage assumptions from LiST: that 95% of women with routine vaginal births in facilities with emergency obstetric care and 20% of women with routine vaginal deliveries in other facilities have access to AMTSL.[102] Treatment requirements were based on WHO

recommendations.[103,147] See Appendix A: active management of the third stage of labor.

Prereferral management of labor complications

Some women have major complications during pregnancy, delivery or the immediate postpartum period. For example, complications of preeclampsia (3.4% of births in developing regions), antepartum hemorrhage (4%), obstructed labor (6%), eclampsia (0.13%), maternal sepsis (3.8%) and postpartum hemorrhage (6.9%) occur in 24.3% of births. Some women have complications that cannot be managed at lower-level health facilities and require referral to a higher-level facility.

Need. There is little information available on how many women who have complications seek care at a lower-level health facility and are subsequently referred to a facility that can provide them with the care they need. Further, women who do not deliver in a facility may well need referral to a higher-level facility, but are not in a position to obtain the medical components of prereferral management.

We assumed that 20% of women with complications need referral for care. This is the assumption used in the RHCT,[13] based on the assumption that 20% of women who deliver in health facilities first seek care in a facility that cannot handle their care and need referral to another health facility for care.

Coverage. We assumed the proportion of women needing prereferral management who receive it equals the proportion of births in facilities without emergency obstetrical care. Of those with care, we assumed that 10% were transported to the referral facility accompanied by a nurse/midwife. We assumed that none of the women delivering outside a facility would be able to obtain prereferral management of complications.

We based treatment requirements on WHO recommendations. We assumed that all women being referred to a higher-level provider for care of complications need intravenous fluids, that 30% require management of antepartum or postpartum hemorrhage, 10% require treatment for eclampsia or preeclampsia, and 30% need treatment for fever/infection. Further, we assumed that all women need on average one hour for stabilization and that 10% of women in addition will require ambulance transportation along with 10 hours of a nurse's/midwife's time to accompany the women to the referral facility. Treatment requirements are shown in Appendix A: prereferral management of labor complications.

Antepartum hemorrhage

Vaginal bleeding from 20 weeks' gestation until delivery requires diagnosis and care.[148] Antepartum hemorrhage accounts for an estimated 7% of maternal deaths in developing regions (Table 9).

Need. We estimated that 4% of pregnant women need care for antepartum hemorrhage, based on

findings that the prevalence of antepartum bleeding of unknown origin in the second and third trimesters of pregnancy is 2%[149] and that in half of antepartum hemorrhage cases the causes is unidentified.[150,151]

Coverage. Coverage of women needing care is assumed to be equal to the proportion of births in facilities with emergency obstetrical care. We assumed that women with antepartum hemorrhage need treatment for shock and restoration of blood volume with intravenous fluids (blood transfusion in 25% of cases) and iron supplementation for 6–9 months; in most cases, expedited delivery (vaginal delivery or cesarean section, in another intervention below) is needed after bleeding is controlled.[103] Treatment requirements are shown in Appendix A: antepartum hemorrhage.

Prolonged labor

Prolonged labor is most often defined as regular, painful contractions accompanied by cervical dilation lasting longer than 24 hours without resulting in delivery. Women with slow progress to labor require clinical assessment and, in some cases, intervention to augment labor or intervene to deliver the baby.[152]

Need. We assumed that 10% of women giving birth experience prolonged labor.[153] We assumed that40% of cases of prolonged labor will end in normal delivery, 50% in assisted vaginal delivery and 10% in caesarean sections[103] (included in separate interventions, below).

Coverage. We assumed the proportion of women needing care who receive it equals the proportion of births in facilities with emergency obstetrical care. We assumed women with prolonged labor need augmentation of labor with oxytocin. Treatment requirements are shown in Appendix A: prolonged labor.

Obstructed labor

Obstructed labor occurs when, in spite of strong contractions of the uterus, the fetus cannot descend through the pelvis because there is an insurmountable barrier preventing its descent.[154] Reasons for obstructed labor include disproportion between the size, shape or position of the birth canal or fetus. Women with obstructed labor need assistance to deliver the baby, either vaginally or through cesarean section.

Need. We assumed that 6% of women giving birth would experience obstructed labor[155] and that 10% of these women would require assisted vaginal delivery and 90% would require cesarean section.[153]

Coverage. We assumed the proportion in need obtaining care equals the proportion of women who deliver in facilities with emergency obstetrical care coverage. Requirements for assisted vaginal delivery and cesarean sections are included in separate interventions below.

Assisted vaginal delivery

Assisted vaginal delivery entails the use of either forceps or vacuum extraction.

Need. We estimated half of women with prolonged labor and 10% of those with obstructed labor need assisted vaginal delivery.

Coverage. We assumed the proportion in need obtaining care equals the proportion of women who deliver in facilities with emergency obstetrical care coverage. Treatment needs were based on WHO recommendations.[103] See Appendix A: assisted vaginal delivery.

Cesarean section delivery

Cesarean section delivery is a surgical procedure used to deliver a baby through incisions in the mother's abdomen and uterus.

Need. Women assumed to need cesarean deliveries include 90% of women with obstructed labor, among others, up to a total level of 10% of all births. According to WHO, 10–15% of births require cesarean deliveries.[156] We assumed that at least 10% of a country's births need cesarean sections.

Coverage. For women in need of cesarean delivery because of obstructed labor, we assume the proportion receiving appropriate care equals the proportion of birth in facilities with emergency obstetric care coverage, unless the result was higher than the current level of a country's cesarean deliveries, in which case we used the current country level.

For other women giving birth, we assumed need for and coverage of cesarean deliveries for other reasons was equal to the current country level minus those needed because of obstructed labor. Proportions of births delivered through cesarean section, for obstructed labor and for other reasons, are shown in Table 23 for selected country groupings. Treatment requirements for supplies, personnel and hospitalization were based on WHO recommendations; see Appendix A: cesarean sections.[103]

Management of eclampsia

Eclampsia is a life-threatening condition associated with high blood pressure and proteinuria from hypertensive disorders of pregnancy that results in convulsions or coma.

Need. We assumed that 0.13% of women giving birth develop eclampsia (see "Hypertensive disease case management" above).[116]

Coverage. We took the following coverage assumptions from LiST: that 95% of women giving birth in facilities with emergency obstetric care and that 20% of women delivering in other facilities receive care for eclampsia.[102] Treatment needs were based on WHO recommendations.[103,117,157] See

Appendix A: management of eclampsia.

Maternal sepsis management

Maternal sepsis is infection of the genital tract occurring at any time between the rupture of membranes or labor and the 42nd day postpartum in which one or more of the following are present: pelvic pain, fever (oral temperature of 38.5°C or higher on any occasion), abnormal vaginal discharge (presence of pus, abnormal foul odor of discharge) or delay in the rate of reduction of the size of the uterus (<2cm/day during the first eight days).[158]

Need. Based on the assumptions behind Dolea and Stein's estimates of the likelihood of maternal sepsis according to women's care at delivery, we estimated the incidence of maternal sepsis as 2.5% of vaginal facility deliveries, 5.3% of cesarean sections and 5% deliveries of deliveries outside of facilities.[158] Table 23 presents the estimated proportions of women with maternal sepsis by selected country groupings.

Coverage. We assumed the proportion of women needing care who received it was equivalent to the proportion delivering in health facilities with emergency obstetric care coverage. Treatment needs were based on WHO recommendations.[103] See Appendix A: maternal sepsis case management.

Postpartum hemorrhage

Postpartum hemorrhage is defined as the loss of 500ml or more of blood from the genital tract within the first 24 hours after delivery of the baby, or in more than 24 hours but less than six weeks from delivery.[159]

Need. We estimated the proportion of births with postpartum hemorrhage based on Dolea, AbouZahr and Stein's estimates of the likelihood by type and place of delivery care and their assumption that severe hemorrhage makes up 90% of all postpartum hemorrhage.[160] We took estimates of the proportion of deliveries likely to involve severe postpartum hemorrhage from Dolea et al. and used our estimates of where deliveries in 2014 occurred to estimate incidence of severe hemorrhage among births in 2014: 5.7% of births with skilled attendance outside of facilities with emergency obstetric care coverage, 2.0% of births in facilities with emergency obstetric care coverage and 11.4% of births without skilled attendance. The proportion of births with postpartum hemorrhage was estimated as the overall proportion with severe hemorrhage divided by 0.90 for an overall estimate that 7% of women giving birth in all developing countries develop postpartum hemorrhage. The estimated proportions of women with live births experiencing postpartum hemorrhage are shown in Table 23 by selected country groupings.

A more recent systemic review by Carroli et al.[161] estimated that severe postpartum hemorrhage accounts for only 31% of postpartum hemorrhage, less than the earlier estimate by Dolea et al.[160] However, our estimate that 7% for women in all developing regions develop postpartum

hemorrhage is similar to the 6% estimated by applying proportions of women with postpartum hemorrhage estimated by Carroli et al.[161] in Africa, Asia, and Latin America and the Caribbean by the number of births in 2014 in those regions.

Coverage. We assumed the proportion of women needing care who received it was equivalent to the proportion delivering in health facilities with emergency obstetric care coverage. Treatment needs were based on WHO recommendations.[103,147] See Appendix A: postpartum hemorrhage.

Postnatal preventive care

Assessment and preventive care for maternal well-being includes prevention and detection of complications (e.g., infections, bleeding, anemia); anemia prevention and control (iron and folic acid supplementation); information and counseling on nutrition, safe sex, family planning and postnatal care planning; advice on danger signs and emergency preparedness; and provision of contraceptive methods, if desired. (Contraceptive service provision is included under the contraceptive interventions above.)

Need. All women are assumed to need this intervention after delivery (either at home or in a facility).

Coverage. In the absence of data, we assumed half of women delivering with a skilled attendant received postnatal preventive care. Table 23 shows the proportion of women with a skilled attendant at delivery, by selected country groupings. Treatment needs were based on WHO recommendations; see Appendix A: postnatal preventive care.[162]

Mastitis care

Mastitis is an inflammatory condition of the breast, which may or may not be accompanied by infection. It is usually associated with lactation, so it is also called lactational mastitis or puerperal mastitis. It can occasionally be fatal if inadequately treated. Mastitis is most common in the second and third week postpartum, and most reports indicate that 74–95% of cases occur in the first 12 weeks.

Need. We assumed 15% of women giving birth need management of mastitis.[13]

Coverage. We assumed half of women delivering with a skilled attendant receive postnatal preventive care and thus proper treatment for mastitis. The main principles of treatment of mastitis are supportive counseling, effective milk removal, antibiotic therapy and symptomatic treatment.[163] See Appendix A: mastitis care.

Obstetric fistula

A fistula is a maternal disability arising from obstructed labor. An obstetric fistula is a hole which forms in the vaginal wall communicating into the bladder (vesico-vaginal fistula) or the rectum

(recto-vaginal fistula) or both (recto-vesico-vaginal fistula), as a result of prolonged and obstructed labor. The immediate consequences of such damage are urinary incontinence, fecal incontinence if the rectum is affected, and excoriation of the vulva from the constantly leaking urine and feces. Secondary amenorrhea is a frequently associated problem.

Reconstructive surgery can mend the injury, and success rates are as high as 90% for uncomplicated cases. For complicated cases, the success rate is closer to 60%. Two weeks or more of postoperative care is needed to ensure a successful outcome. Counseling and support are also important to address emotional damage and facilitate social reintegration.

Need. Following Dolea and AbouZahr, we assumed that 2.15% of women with untreated obstructed labor developed obstetric fistula.[155]

Coverage. In the absence of data, we assumed the proportion of women receiving care for obstetric fistula equals the proportion who deliver in a health facility with emergency obstetric care coverage. Treatment needs were based on WHO recommendations; see Appendix A: obstetric fistula.[164]

Breast-feeding counseling and support

According to WHO recommendations, women should be counseled to exclusively breast-feed for six months after delivery, followed by appropriate complementary feeding and continued breast-feeding for two years or beyond. They should receive at least six counseling sessions: two during antenatal care, one immediately after birth, one within the first week after birth, one at 6 weeks, and one at 5–6 months. As the time period considered by our estimates generally does not go beyond six weeks after delivery, only four sessions were included in the costing.

Need. All women giving birth were assumed to need two antenatal sessions and those with live births were assumed to need two sessions within the first week after birth.

Coverage. We assumed that half of women with at least four antenatal care visits received two breast-feeding counseling sessions before birth. We assumed that the proportion of women receiving postnatal breast-feeding counseling and support equals half the proportion delivering in a facility who had live births. See Appendix A: counseling and support for appropriate breast-feeding.

Abortion and Postabortion Care

Abortion service provision

Induced abortions occur under a variety of conditions. Unsafe abortion is defined by WHO as any procedure to terminate a pregnancy done either by people lacking the necessary skills or in an environment that does not conform to minimum medical standards, or both.[165] Other abortions are classified as "safe" abortions.[50,51]

For women undergoing an abortion, WHO recommends the least invasive abortion procedures depending on gestation (the number of weeks since the woman's last menstrual period).[166] Procedures include manual or electric vacuum aspiration, dilation and evacuation (D&E) or medication abortion (using the drugs mifepristone and misoprostol or misoprostol alone where mifepristone is not available).

Need. All women seeking to terminate pregnancies need to obtain abortions in safe conditions.[166]

Coverage. Tables 5 and 6 show the numbers and percentages of induced abortions in 2014 that occurred under safe and unsafe conditions. We estimated treatment requirements for four methods of abortion provision—manual or electric vacuum aspiration (the recommended method for abortion up to 12–14 weeks' gestation), dilatation and evacuation (D&E, recommended for abortions of pregnancies over 12–14 weeks), and medical abortion with mifepristone and misoprostol (or with misoprostol only where mifepristone is unavailable), based on WHO technical guidance.[166,167]

There is very little information on the distribution of women having legal/safe abortions by procedure used. We made rough estimates based on broad patterns emerging from existing studies[168]:
Africa: 45% vacuum aspiration, 35% D&E and 20% medical abortion
Asia and Latin America: 35% vacuum aspiration, 25% D&E and 40% medical abortion

We used these estimates for costing treatment requirements, but did not estimate need and coverage for specific types of abortion procedures. Treatment requirements are shown in Appendix A: abortion provision.

Postabortion care

Some women who have induced abortions, as well as those with later-gestation spontaneous abortions (miscarriages), have complications requiring medical care. WHO provides standards of care for addressing postabortion complications, such as hemorrhage or infection, which are most likely to occur where abortions are illegal and unsafe. In addition to medical treatments for specific complications, WHO standards call for vacuum aspiration or treatment with misoprostol, rather than more invasive surgical methods, to be used for incomplete first-trimester abortions and also recommend contraceptive counseling and services for all abortion patients. We included need and use for contraceptive counseling and services for all women wanting to avoid pregnancy under the contraceptive interventions and did not include them as part of the postabortion care intervention.

Need. We followed prior estimates that 1% of women having induced abortions under safe conditions and 42% of women having induced abortions under unsafe conditions have complications requiring medical treatment.[10] We assumed that 20% of miscarriages that occur at

less than 28 weeks' gestation end in weeks 14–27.[52,169] We assumed that all women with miscarriages at weeks 14–27 need care, with vacuum aspiration, the preferred method (costed based on costs for safe abortions at the equivalent gestations).[170]

Coverage. Following prior estimates, we assumed that 100% of women having induced abortions under safe conditions who have complications requiring medical treatment receive that medical care.[10] We assumed that 62% (26/42) of women needing medical treatment for complications of unsafe abortion receive care and that 38% (16/42) do not receive needed care.[100] Based on information from country studies conducted between 2008 and 2012 in Colombia, Ethiopia, Rwanda and Uganda, we estimated that 82.3% of women requiring care for complications of induced abortion have incomplete abortion, 6.8% of patients require treatment for shock, 4.5% require care for uterine perforation and/or cervical lacerations and 15.2% have sepsis.[171–174] The percentages sum to more than 100% because some women need care for more than one of these complications.

We assumed the proportion of women with miscarriages at 14–27 weeks' gestation who received care was equivalent to half the proportion of births occurring in facilities (i.e., equivalent to level of emergency obstetric care).

Treatment requirements for each type of complication and care were based on WHO recommendations and country cost studies.[166,173–175] See Appendix A: postabortion care.

Newborn Health Care

We included basic newborn interventions that are low-cost and simple to perform and should be integrated with maternal health care. We did not include more complex, long-term care that is not generally available in developing countries, such as neonatal intensive care and surgery for congenital abnormalities.

Immediate care for newborns

After delivery, newborns require immediate drying and skin-to-skin contact as well as initiation of breast-feeding.

Need. We assumed all newborns need immediate care, and that it is most likely to be provided in health facilities.

Coverage. Based on LiST, we assumed that 60% of births in health facilities without emergency obstetric care and 95% of in facilities with emergency care are delivered with clean birth practices and other needed immediate care. We tabulated the percentage of recent births that occurred in a facility from DHS, MICS and other national surveys; used regional or all developing country estimates for countries with no data. Treatment requirements are shown in Appendix A: immediate essential care for newborns.

Newborn resuscitation (institutional deliveries)
Newborns with breathing problems can need resuscitation.

Need. We used the RHCT estimate that 3% of newborns experience asphyxia or other breathing difficulties.[13] The RHCT sources this estimate to WHO. See also Haider and Bhutta, citing WHO estimates of 4–9 million cases a year worldwide out of 130 million newborns a year, resulting in an incidence of 3–7%.[176]

Coverage. Following LiST, we assumed that 70% of births in facilities providing emergency obstetric care have access to neonatal resuscitation.[102] The average cost of equipment was estimated as the total cost divided by average caseload of a midwife (200 births per year).[177] See Appendix A: newborn resuscitation (institutional deliveries).

Newborn local infections
Newborn infections include conjunctivitis, infection of the umbilical stump and other local infections.

Need. We assumed that 10% of newborns will develop some type of local infection at current care levels; this is reduced to 5% under conditions of full maternal and newborn health care.[13]

Coverage. We assumed half of newborns delivered by a skilled attendant would receive care for local infections. We took treatment needs from WHO.[178] See Appendix A: newborn local infections.

Neonatal syphilis treatment
Newborns whose mothers are syphilis-positive require care for congenital syphilis.

Need. We assumed that babies would need treatment if they were born to women who were positive for syphilis (based on screening at first antenatal care visit or before birth) but who had not received needed treatment.

Coverage. We assumed all babies needing care who were delivered in a health facility received treatment. Treatment requirements for newborns of syphilis-positive mothers are shown in Appendix A: management of neonatal syphilis.[179,180]

Postnatal preventive care for newborns
Routine postnatal care for all babies includes promotion and support of breast-feeding, cord care, thermal care, detection of illness and extra care for low-birth-weight infants. Infants delivered at home may be seen by a community level health worker (four visits). Those delivered in a facility often receive their first check-up at facility level, followed by continued facility care or by three home visits at community level.

Need. All newborns are assumed to need this intervention after delivery (either at home or in a facility).

Coverage. We assumed half of infants born to women delivering with a skilled attendant received postnatal preventive care and that this was included as part of the postnatal preventive care covered on page 41. Other interventions provided to the newborn during postpartum care are covered elsewhere. See Appendix A: postnatal preventive care.

Kangaroo mother care

Kangaroo mother care, defined as skin-to-skin contact between a mother and her newborn, frequent and exclusive or nearly exclusive breast-feeding, and early discharge from hospital, has been proposed as an alternative to conventional neonatal care for low-birth-weight infants.

Need. We assumed two-thirds of low-birth-weight infants need kangaroo mother care and that one-third need supportive care (intravenous glucose). Lacking other information, this proportion was informed by Blanc and Wardlaw's unweighted summary of DHS respondents' reports that 30% of births that were below average in size were very small.[181,182]

Coverage. We assumed half of the newborns needing kangaroo mother care who were delivered in a facility received it.[183,184] WHO has described kangaroo mother care requirements.[185] See Appendix A: kangaroo mother care.

Treatment of low birth weight

Birth weight of less than 2,500 g (5.5 pounds) is considered low birth weight.[186]

Need. We estimated the proportion of newborns who were low birth weight from estimates compiled by UNICEF.[181] We chose to use this measure rather than preterm births (before 37 weeks)[137] since there is uncertainty around both estimates and preterm births in need of care are likely also low-birth-weight babies.

We assumed two-thirds of low-birth-weight infants need kangaroo mother care and that one-third needed supportive care (intravenous glucose). Lacking other information, this proportion was informed by Blanc and Wardlaw's unweighted summary of DHS respondents' reports that 30% of births that were below average in size were very small.[181,182]

Coverage. From LiST, we assumed that in countries where fewer than 30% of deliveries occur in health facilities, 10% of low-birth-weight infants in those facilities receive care, compared with 20% in countries where 30–49% of deliveries occur in health facilities, half in countries where 40–94% of deliveries occur in health facilities and 80% in countries where at least 95% of deliveries occur in health facilities.[102] Note: Treatment included in these estimates only includes very basic care[187]

and does not include management of complications such as breathing difficulties, jaundice, intraventricular bleeding, etc. Treatment requirements included in these estimates are shown in Appendix A: treatment of low birth weight.

Neonatal sepsis management

This intervention includes management with injectable antibiotics for neonatal sepsis, meningitis, or pneumonia (90% of newborn sepsis cases) and full supportive care (10% of newborn sepsis cases).

Need. We assumed 10% of newborns develop sepsis. This estimate is based on a review of studies reporting rates of infection among infants up to 60 days of life in which the incidence of clinically diagnosed neonatal sepsis ranged from 49 per 1,000 live births in babies older than 24 hours in rural Guatemala to as high as 170 per 1,000 live births as detected by village health workers in rural India.[188] We estimated 90% of newborns with sepsis can be treated with injectable antibiotics, and 10% will require full supportive care.[189]

Coverage. We estimated the proportion of newborns with sepsis who can be treated with injectable antibiotics who would receive needed care was equivalent to half the proportion delivered by a skilled attendant. From LiST, we assumed that in countries where fewer than 30% of deliveries occur in health facilities, 10% of infants born in those facilities and requiring full supportive care receive it, compared with 20% in countries where 30–49% of deliveries occur in health facilities, half in countries where 40–94% of deliveries occur in health facilities and 80% in countries where at least 95% of all deliveries occur in health facilities.[102] Inputs for management with injectable antibiotics and for full support were based on OneHealth, drawing from input by the Child Health Epidemiological Reference Group (CHERG) and child health expert, Joy Lawn. For treatment requirements, see Appendix A: management of severe infection for neonates.

Newborn vaccination

We included three vaccines recommended for all newborns at or soon after birth: BCG vaccine for prevention of tuberculosis; hepatitis B vaccine, which is usually given as a course of two to three vaccine injections (one at birth, one a month later and one six months after the first); and polio vaccine, which WHO recommends at birth and at weeks 6, 10 and 14 in endemic countries (in nonendemic areas, the regimen can begin at 6 weeks).

Need. All newborns.

Coverage. We assumed all infants born in a health facility would receive one dose of each of the three vaccines. See Appendix A: newborn vaccines.

SECTION 6: HIV Care and Prevention and Treatment of Other STIs

HIV Care and Prevention

An estimated 35 million people were living with HIV worldwide as of 2012.[190] Globally, women make up 55% of adults living with HIV, mainly because of higher infection levels among women than among men in Sub-Saharan Africa and the Caribbean. Some 80% of women aged 15 and older who are living with HIV live in Sub-Saharan Africa, where the primary route of infection is heterosexual transmission.[191]

WHO's strategy of eliminating new HIV infections among children and keeping their mothers alive rests on four prongs[43]:

- Prong 1— preventing new HIV infections among women of reproductive age
- Prong 2—preventing unintended pregnancies among women living with HIV
- Prong 3—preventing new HIV infections among infants through prevention of mother-to-child transmission (PMTCT) by giving pregnant women living with HIV access to antiretroviral medicines to prevent transmission during pregnancy, delivery and breast-feeding
- Prong 4—providing HIV care, treatment and support for women and children living with HIV and their families

General population of women of reproductive age

Estimates of HIV infection among women aged 15–49, along with their need for and use of antiretroviral medicines was based on data from the Spectrum AIDS Impact Model (AIM) for 2012, the most recent year of reported data for almost all countries (data for India covered 2011).[192]

Need. We calculated country-level proportions of women aged 15–24, 25–49 and 15–49 who were living with HIV from the AIM population and HIV prevalence numbers. We applied these proportions to the numbers of women in each age-group in each country in 2014 to estimate the numbers of women living with HIV in 2014; we used regional averages for countries with no data (Table 24). In accordance with WHO guidelines,[193] we consider women living with HIV with CD4 counts of 500 cells/mm^3 or less and all pregnant women living with HIV to be in need of antiretroviral medicine.

Coverage. Following the AIM model, we made separate estimates for antiretroviral need and use among women aged 15–49 and among pregnant women having births. Numbers and proportions of women aged 15–49 living with HIV according to their need for and receipt of antiretroviral medicines are shown in Table 25. We did not include analysis of specific treatment and care needs for women in the general population living with HIV.

Pregnant women

Women living with HIV who become pregnant not only need care, support and treatment for their own health and well-being, they also need it to reduce the risk of transmitting the virus to their infant.

Information on HIV infection and antiretroviral use is available primarily for women who obtain antenatal care and women giving birth. We calculated country-level proportions of women giving birth who were living with HIV from the AIM births and HIV prevalence numbers. We applied these proportions to the numbers of total births and those to women aged 15–24 and 25–49 in each country in 2014 to estimate the numbers of women pregnant women giving birth who were living with HIV in 2014; we used regional averages for countries with no data (Table 26).

HIV screening

WHO recommends that all pregnant women be tested for HIV at their first antenatal care visit and that women living in countries with generalized HIV epidemics be tested again before birth.[193]

Need. We estimated the proportion of women who would have known they were living with HIV before entering antenatal care and assumed that this proportion applied also to women with antenatal care who had stillbirths or miscarriages. From DHS surveys, we tabulated the country-level proportion of women aged 15–49 who had ever been tested for HIV, using regional averages for countries without data. We assumed that 89% of the women who had been tested had received results and knew whether they were positive for HIV; this was the median proportion of female respondents to DHS surveys in 10 Sub-Saharan African countries who reported they had been tested for HIV and had received the test results (country-level proportions ranged from 81% to 91%).[194] We assumed the proportion of women knowing their HIV status because they had been tested and had received the results applied to women entering antenatal care who were living with HIV (Table 27). We assumed that all other women need HIV testing at their first antenatal care visit and that women still not identified as HIV positive after that first visit need a second test shortly before giving birth if they live in a country with a generalized HIV epidemic.

We estimated the proportions of pregnant women who are HIV positive at a first or second test as the total number of women in a country who are HIV positive at birth minus the number already known to be living with HIV before entering antenatal care or who are found to be HIV positive through antenatal testing, divided by the number of women tested for the first or second time during pregnancy.

Coverage. We estimated the proportion of pregnant women who were tested for HIV and received the results from UNAIDS, where available;[195] otherwise, we used DHS or MICS tabulations of the proportion of women giving birth in the past two years who were tested for HIV during antenatal care and received the results, or we used regional averages from countries with data. UNAIDS estimates were often higher than those from DHS and MICS surveys, but we used them where

available because they are from a unified source and are often more recent than the survey estimates.

Treatment requirement include supplies and personnel for HIV testing and pretest counseling, posttest counseling for women regardless of their HIV status, and confirmatory testing and posttest counseling of women initially testing positive. See Appendix A: voluntary counseling and testing for HIV.

Antiretroviral medicines for pregnant women living with HIV

Until fairly recently, efforts to prevent mother-to-child transmission of HIV focused on providing antiretroviral medicines (ART) to women with HIV during pregnancy, labor and breast-feeding. Under this approach (called Option B), women discontinue ART when there is no longer any risk of transmitting infection to their infants, unless they have need for medication because of their own CD4 count or clinical disease.[196] However, recent WHO treatment guidelines recommend Option B+, which aims to simplify access to services by recommending that all pregnant women living with HIV receive ART during pregnancy and continue with lifelong therapy after birth, regardless of their CD4 count or clinical stage.[193]

Need. Estimates based on data from the AIM model were used to estimate the numbers and proportions of pregnant women aged 15–49 living with HIV in 2014 according to their need for and receipt of antiretroviral medicines, i.e., Option B or Option B+ (Table 27).

For purposes of this project, we assumed that women whose pregnancy results in a live birth or stillbirth who are diagnosed with HIV before pregnancy need to use ART throughout pregnancy and that women with live births who breast-feed need ART for six weeks postpartum. We assumed that women found to be HIV positive through antenatal testing start ART at median timing matching the beginning of antenatal care (20.4 weeks in Sub-Saharan Africa and 14.5 weeks in other regions).[197] Although Option B recommendations were for women to use ART throughout breast-feeding and the newer Option B+ are for women to continue antiretroviral treatment lifelong, we only included need or coverage after birth for women had live births and breast-fed, and we limited their coverage in our estimates to the first six weeks after birth.

Coverage. We took the proportion of pregnant women living with HIV receiving ART from the AIM model and used regional averages for countries with no data.[192] Estimation of the proportions who began ART before or during antenatal care were estimated as described above (Table 28) for the current-care scenario. In the full-needs-met scenario, we assumed all pregnant women would use Option B+ and that 80% of pregnant women would be continuing use begun before their current pregnancy while 20% would begin Option B+ during the current pregnancy. Weekly drug, supply and personnel requirements for providing ART were taken from the WHO Global Price Reporting Mechanism[198] and Menzies et al.[199] Given our assumptions regarding onset and length of ART, we did not need to distinguish requirements for Option B from Option B+. See treatment

requirements in Appendix A: antiretroviral therapy for women.

Early detection of HIV for newborns

WHO recommends that infants born to mothers known to be living with HIV be tested within 4–6 weeks after birth to assess their HIV status and that those born to women whose HIV status is unknown should be screened to determine HIV exposure and, if exposed, tested to assess their infection status.[193]

Need. We assumed that all newborns need testing within the first six weeks after birth, with the specific tests for HIV depending on mothers' known HIV status and results of newborn testing.

Coverage. We took the proportion of infants born to mothers living with HIV tested for HIV from the most recent UNAIDS report.[195,200] If these were unavailable, we used subregional estimates from countries with data, weighted by the country-level numbers of infants born to HIV-positive mothers. Lacking other information, we assumed the same proportions of infants born to women not known to be HIV positive would be tested. Specific testing requirements were taken from WHO.[201] See Appendix A: HIV testing in newborns.

Antiretroviral medicines for newborns

Antiretroviral medicine is recommended for 4–6 weeks for all newborns born to HIV-positive mothers, to prevent infection and to treat those already infected. Since testing and knowledge of the newborn's own infection status often comes after the six-week time period we focused on, in the current-care scenario we included six weeks of antiretroviral medication for infants born to women receiving ART.

Need. We assumed all infants born to mothers living with HIV need antiretroviral medication.

Coverage. In the current-care scenario, we assumed that infants born to women receiving antiretroviral medicines would also receive antiretroviral care. Recommendations for specific antiretroviral medications for newborns differ by whether they are breast-feeding.[202] We assumed that the proportion receiving ART was the same for breast-feeding and non-breast-feeding newborns. Treatment requirements are shown in Appendix A: antiretroviral therapy for newborns.

STIs Other than HIV

Risk for acquiring an STI

Women's risk for acquiring an STI, including HIV, through heterosexual intercourse was estimated by marital status from DHS survey data and applied to the numbers of women aged 15–49 in each marital status group to estimate the numbers of women by risk status. We based estimates of risk on women's and men's reports of exposure to multiple sexual partners in the past year, realizing that the results are likely underestimates of exposure because survey respondents may be reluctant to report having sex outside of marriage or with multiple partners. Further, data are available for

women from only 53 of the 148 countries in developing regions, covering 33% of women aged 15–49, so results for some country groupings required extensive estimation; in some cases survey information covered only married women. Table 29 shows the proportion of women in each grouping covered with survey data. Estimates of sexual behavior and risk are not shown for groupings with less than 10% coverage, but results from all regions with poor coverage should be interpreted with caution.

We assumed that women who reported they were not sexually active in the past 12 months were not at risk for STIs, regardless of their marital status. Women who had had sex in the past 12 months were considered to be at high risk for STIs if they had two or more partners, regardless of their partners' sexual behavior.

Women who reported having had only one sexual partner in the past year were assumed to be at low to moderate direct risk through their own sexual behavior. To assess what proportion of these women might be at indirect risk for STIs because their male partner had one or more other partners (unless they were all within a polygamous union), we analyzed DHS survey reports from men aged 15–49, likely to be partners of women aged 15–49. We used these data to estimate the proportion of men having sex with supposedly monogamous women who actually had multiple partners during the past year. To estimate this indirect risk among married women at low to moderate direct risk, we assumed their partners' behavior was the same as all currently married men. We based estimates for formerly and never-married women on the behavior of all men as reported in the DHS.

Condom use by women at risk for STIs

We tabulated levels of condom use according to women's direct risk for STIs from DHS surveys. Condom use was classified as a contraceptive if so reported, though this may also be for STI prevention; women who did not report relying on condoms as a contraceptive, but said they used a condom the last time they had sex with at least one of their partners were classified as "other" condom users.

Women who had sex in the last year were considered to have always used condoms if they reported a condom was used at all acts of intercourse with all partners in the past year (Table 30). We did not make estimates for subregions with no available data and therefore did not make estimates for the developing world or Africa or Asia because they contain subregions for which no estimates were made.

Major curable STIs—infection and treatment

STIs other than HIV receive relatively little attention even though they are extremely common and can have serious health consequences in addition to the infection itself. Many women with STIs have few or no symptoms, and those with symptoms may not seek or obtain care because of social stigma, poor access or other reasons. Screening and testing for STIs is largely unavailable in low-

income countries because of the costs of the diagnostic tests and the laboratory infrastructure to process them, as well as weak and overstretched health systems in general. In most countries, including those in developed regions, surveillance of STI incidence and prevalence is weak.[203,204] In the *Adding It Up—2014* report, we focused on four major curable STIs for which global incidence estimates are available.[205]

Need. The numbers of women acquiring chlamydia, gonorrhea, syphilis or trichomonas in 2014 were estimated by applying WHO regional estimates of disease incidence in 2008 among women aged 15–49[205] to country-level numbers of women 15–49, assuming the same infection-specific incidence level across all countries in each region. We did not project changes over time in incidence levels. The resulting estimates reflect the number of new cases of each infection estimated to have occurred in 2014. Unfortunately, data are lacking on how many women infected with each STI is infected more than once in a year or how many are infected by more than one of the four focus STIs. We therefore follow WHO precedents, assuming that the estimated summed number of cases represented the total number of infected women in 2014.[206,207]

Coverage. We estimated the numbers of women with symptomatic infection with one of the four STIs from available literature, assuming the proportions of women infected who are likely to have symptoms are 15% of those infected with chlamydia, 60% of women with gonorrhea, all those with syphilis and 30% of women with trichomonas.[205] Together, this yielded an overall estimate that 66% of infected women are asymptomatic.

Separately, we tabulated DHS survey information to estimate the proportions of women in each country with signs or symptoms consistent with having an STI (i.e., women reporting that, in the past year, they had had a disease they got through sexual contact or they had had bad-smelling abnormal genital discharge or a genital sore or ulcer), using subregional or regional averages from countries with data to estimate proportions for countries without DHS survey information. Similarly, using DHS surveys, we tabulated the proportions of women reporting they had had an STI or symptoms who sought treatment or advice from a medical source. We applied the DHS-based proportions of women with STI symptoms who sought medical care to the proportion of women estimated to have been infected with chlamydia, gonorrhea, syphilis or trichomonas to estimate current coverage for treatment.

Proportions of all women and of sexually active women by STI infection or symptoms and whether they sought care from a medical provider are shown in Table 31, along with breakdowns by women's wealth quintile.

Note: Screening and treatment of pregnant women for syphilis during antenatal care (and treatment of newborns of infected untreated women) were estimated separately as part of antenatal and of newborn care (see above). Estimates of women and newborns treated as part of maternal and newborn health services were assumed to be in addition to coverage of women estimated in

this section.

Drugs, supplies and personnel requirements for treating each STI were based on WHO recommendations.[179,208] See Appendix A: STI treatment. Given the widespread lack of STI screening and testing and reliance on symptomatic treatment, we did not include diagnosis requirements. Screening and treatment of pregnant women for syphilis during antenatal care (and treatment of newborns of infected untreated women) were estimated separately as part of antenatal and of newborn care (see above).

Pelvic inflammatory disease from untreated STIs

Some common STIs—including gonorrhea and chlamydia—can lead to pelvic inflammatory disease (PID). If left untreated, 25% of women with PID will develop infertility,[205] for which treatment is largely unavailable in developing countries. Infertility carries a high social cost because women in many societies are expected to have children, and inability to do so can result in the dissolution of marriages.

Need. We assumed that 40% of women infected with gonorrhea or chlamydia who lack treatment develop PID.[205] Our estimates do not include care for women with PID from other causes, chronic PID from prior infection or treatment of infertility caused by PID.

Coverage. We assumed the proportion of women with PID from untreated gonorrhea or chlamydia who received needed care was equal to the proportion who deliver in a health facility with emergency obstetric care coverage. Requirements for PID treatment were taken from WHO; see Appendix A: treatment of pelvic inflammatory disease.[179]

SECTION 7: Impacts of Interventions

We estimated these impacts of services by comparing varying scenarios of health care coverage for women and newborns in need:

- Current (2014) levels of care
- A scenario in which no service needs were met
- A scenario in which those receiving basic types of care, such as professional antenatal care and facility delivery, would receive all WHO-recommended components of regular care and care for complications
- An ideal goal scenario in which all women and newborns in need would receive full WHO-recommended care

In addition, we estimated some scenarios combining different levels of needs met for modern contraception and for maternal and newborn health care or HIV-related care for pregnant women. We estimated impact by comparing scenario results, usually in terms of events averted through increased coverage for needed care. For instance, the impact of the current scenario is the difference in health and cost measures from between that scenario and the no-needs-met scenario; the impact of the full-needs-met scenario is the difference between it and the no-needs-met scenario.

Contraceptive Use

Impacts of contraceptive use were based on differences in the numbers of unintended pregnancies and their outcomes under varying contraceptive use scenarios, assuming conditions of stable proportions of women wanting to avoid pregnancy and in need of contraception. The scenarios are:

- No modern contraceptive use and stable proportions of those in need using traditional methods
- Current (2014) use patterns
- 100% of family planning need met by modern contraceptive method use

Table 20 shows the numbers of women in 2014 who were using modern contraceptives and the numbers with unmet need for modern contraception (i.e., using traditional or no methods). Table 32 shows the assumed distribution of modern methods that would be used by women with unmet need for modern contraception in 2014 if they all used modern methods with the same method distribution of women in their country according to their marital status and childbearing intention subgroups. This table also shows the numbers of women assumed to be using each specific contraceptive method with 100% of need met, i.e., the sum of current users of each method and the assumed new users resulting from movement of those with unmet need for modern contraceptives to modern methods.

Unintended pregnancies

Pregnancy rates. To estimate the number of unintended pregnancies from each scenario, we estimated country- and method-specific rates of pregnancy among women wanting to avoid pregnancy, for each contraceptive or nonuse category. Since such rates are not available for most countries, we began with aggregate estimates of failure rates for contraceptive methods from published literature. We supplemented estimates of use-failure rates in the first 12 months of contraceptive use from 19 DHS surveys conducted in 2002–2009[90] with data from the United States[209] or from a few developing countries (Table 33).[210]

For the "initial" pregnancy rate for women wanting to avoid pregnancy but using no method, we used a rate of 40%. The commonly used estimate of 85% represents the estimated pregnancy rate during the first 12 months of couples attempting to get pregnant.[209,211] The 40% pregnancy rate is likely more realistic for a general population of couples who are at risk of unintended pregnancy but are not using a contraceptive method because it reflects probable lower levels of sexual activity and fecundity among actual nonusers, many of whom have not become pregnant despite being sexually active and not using a method for more than 12 months.[209,212–214] Also, based on the DHS approach to categorizing women as having unmet need and using no contraceptive method, nonusers wanting to avoid pregnancy include women who identify their current pregnancy as unintended or are experiencing postpartum amenorrhea after an unintended pregnancy.

Adjustments to pregnancy rates. We multiplied the numbers of women in 2014 wanting to avoid pregnancy by the "initial" method-specific pregnancy rates to estimate the total number of unintended pregnancies in developing regions and the distribution of those pregnancies by method used. In doing so, we assumed that all users of a specific method had the same average use-failure rate (Table 33), with no adjustments for differences by marital status, childbearing intention or country of residence. The resulting total number for all developing regions was 23% higher (90.574 million) than the number of unintended pregnancies estimated from available data on pregnancies by intention in developing regions in 2014 (73.735 million; Table 5). A mismatch between the two estimates is not surprising: the "initial" pregnancy rates are estimates covering the first 12 months of segments of use while exposed to the chance of becoming pregnant, however, use-failure rates tend to decrease over time and women wanting to avoid pregnancy comprise varying lengths of method use. Also, estimating total unintended pregnancies in a year's time from annual failure rates and numbers of users based on survey responses assumes that the point-in-time survey-based need and method-use distribution reflects annual use patterns.

Lacking data to more closely reconcile the two estimation approaches, we calculated "adjusted" use-failure rates based on the total *number* of unintended pregnancies from the external sources described above (see Table 5) and the *distribution* of unintended pregnancies by contraceptive method used from the multiplication (weighting) of the number of method users by method-specific pregnancy rates. To do this, we estimated adjustment ratios of the externally estimated number of unintended pregnancies to the number estimated by multiplication and we multiplied

the resulting ratio for each country by each method-specific rate. This adjustment ensured that the total number of unintended pregnancies in each subregion in the current-use scenario would equal the number estimated from external sources and that the relationships between the "initial" pregnancy rates would be maintained. Table 33 shows the resulting overall pregnancy rates for each method and their magnitude relative to nonuse among women at risk.

Table 34 shows the adjustment ratios and the estimated distributions of unintended pregnancies in 2014, by contraceptive method and according to subregion and other country groupings. The median country adjustment ratio was 0.792 and the unweighted average was 0.809, with an interquartile range of 0.580 to 0.995. Differences across country groupings in the distributions of unintended pregnancies reflect the combined impacts of differences across groups in method use among women wanting to avoid pregnancy and the relative differences in pregnancy rates across contraceptive methods/no method use.

Unintended pregnancies averted by modern contraceptive use. We applied the adjusted use-failure rates to the numbers of women wanting to avoid pregnancy using each method in the scenarios of no use of modern contraceptives and 100% modern method use to estimate the numbers of unintended pregnancies under the different contraceptive use scenarios. The unintended pregnancies in the scenarios of no modern contraceptive use and 100% modern method use were distributed by outcome based on the current outcomes of unintended pregnancies in 2014 (Table 6). The pregnancy rate adjustments and estimates of unintended pregnancies by outcome in each impact scenario were carried out on the country level for purposes of calculation, but the results should not be taken as actual country-level use-failure estimates, because the external numbers of unintended pregnancies are based, in large part, on subregional estimates of intention status of births and numbers of abortions and because the same "initial" pregnancy rates are used for all countries.

The estimated numbers of pregnancies by intention and outcome in each scenario are shown in Table 35 for selected country groupings along with estimates of the numbers of unintended pregnancies averted by contraceptive use. The impact of current modern contraceptive use is the difference between the number of unintended pregnancies in the scenario of no modern method use versus that in the current scenario; additional pregnancies that would be averted under a scenario of 100% of modern contraceptive use among women wanting to avoid pregnancies is the difference between the 100% needs-met scenario and current use; and the total number of pregnancies that would be averted by 100% of needs met with modern contraceptive use is the sum of these two values (and also the same as the difference between the 100% needs-met scenario and the number that would occur if no women used modern methods).

Mortality and morbidity

Rates and ratios of deaths and DALYs. We chose not to use the overall maternal mortality ratio for estimating deaths in each estimation scenario or the numbers averted through the impact of

contraceptive use on unintended pregnancy levels. As discussed above, the ratio of all maternal deaths per 100,000 comprises deaths from many causes, including induced abortion (Table 8). Lacking other data, we assumed that the likelihood of maternal death from causes other than induced abortion is similar for intended and unintended pregnancies, but that all deaths related to induced abortions were from unintended conceptions. Since impacts of different patterns of contraceptive use affect only unintended pregnancies, estimates of related mortality and morbidity needed to take into account that deaths from induced abortions make up a larger proportion of maternal deaths from unintended pregnancies than they do of all pregnancies.

We therefore estimated rates of deaths per 100,000 safe and unsafe abortions and a nonabortion maternal mortality ratio of maternal deaths from all other causes per 100,000 live births (Table 36). We applied the nonabortion maternal mortality ratio to the number of live births from both intended and unintended pregnancies, and we applied mortality rates from safe and unsafe abortions to the number of safe and unsafe abortions, respectively, that result from unintended pregnancies. As discussed earlier, we assumed the same distribution of maternal DALYs by cause as for maternal deaths; and we used the same approach for estimating maternal DALY ratios and rates (Table 36).

We assumed that mortality and DALY rates for live-born newborns and for infants in the first year after birth were the same regardless of mother's pregnancy intention (Table 8).

Numbers of deaths and DALYs. Tables 37 and 38 show the numbers of maternal and newborn deaths and DALYs estimated to be associated with total, intended and unintended pregnancies in each contraceptive use scenario and the numbers averted by modern contraceptive use currently and under the 100%-needs-met scenario.

Maternal and Newborn Health Care

Estimating the total impact of maternal and newborn care on mortality and morbidity is difficult because studies typically assess the impact of specific interventions in isolation. Where available, we took condition-specific effectiveness rates of components of maternal and newborn care in reducing maternal and newborn deaths from specific causes from LiST.[215] Lacking other information, we assumed the same effectiveness in reducing DALYs as for deaths. Since LiST effectiveness estimates were not available for all the interventions in our report and because we could not model all the interventions for which LiST provides estimates, we underestimate the impacts of care.

We used the intervention effectiveness rates, country-specific maternal and newborn deaths and DALYs (by cause), and numbers of women and newborns needing and receiving cause-specific treatment (in each scenario), to estimate cause-specific mortality and DALY rates. We applied these rates to the numbers of women and newborns in each scenario who received or had unmet need for each intervention to estimate the numbers of deaths and DALYs among those in need of

maternal and newborn care in each scenario.

Cause-specific mortality rates

LiST takes information from numerous studies and literature reviews to estimate intervention effectiveness—the proportion of deaths from a specific cause that are reduced by the intervention, the affected fraction and the proportion of deaths due to a specific cause that might potentially be impacted by a specific intervention.[98] From this and other information, presented earlier, we estimated cause-specific mortality rates for women and for newborns receiving relevant interventions and for all other women giving birth and newborns not receiving each intervention. Table 39 shows the maternal mortality causes and interventions for which we were able to make estimates and Table 40 shows this information for newborn mortality. We did not make estimates of the impacts of health care, with or without antiretroviral medicines, on mortality or DALYs among pregnant women living with HIV or their newborns.

When only one intervention was associated with a cause of death, effectiveness (the estimated reduction from the mortality rate among women or newborns not receiving the intervention) equals Effectiveness * Affected fraction. For example, for ectopic pregnancy, the effectiveness of hypertensive case management for women receiving this intervention is 0.50 * 1.00 = 0.50. When more than one intervention was relevant for a cause of death, the joint effectiveness was estimated by applying each successive intervention's effectiveness to the proportion of potential 100% effectiveness remaining after accounting for other interventions. For example, the joint effectiveness of hypertensive disease case management and preeclampsia management with magnesium sulfate was estimated as 0.50+(1.00–0.50) * 0.59 = 0.795.

We matched, to the extent possible, the Adding It Up and LiST interventions. We took numbers of women with live births and stillbirths, numbers of newborns covered and not covered by each intervention and the estimated numbers of deaths for relevant causes from our country-level estimates (see above). Using data from the current scenario for 2014, we estimated the rate of deaths from a specific cause among all women with births or all newborns who received no care relevant to that cause of death. These estimates used the following approach, where, for example,
X = the no-care mortality rate for the specific cause of death; maternal death rate = 0.64; proportion of women receiving intervention = 0.32; intervention effectiveness = 0.80

Maternal death rate from cause among all women giving birth = [% of women receiving intervention(s) * (1-intervention effectiveness) *X]+[% of women not receiving intervention(s) * X]

0.64 = [.32 * (1–0.80) * X]+[(1.00–0.32) * X]
0.64 = [.32 *0 0.20* X]+[0.68 * X]
0.64 = 0.064 X +0 0.68 X
0.64 = 0.744 X
0.64/0.744 = X = 0.86

The no-care mortality rate is 0.86, i.e., 860 out of every 1,000 women with births who did not receive the intervention. The mortality rate if all women giving birth had access to the intervention (i.e., in the full-needs-met scenario) would be 0.86 * (1–0.80) = 0.86 * 0.20 = 0.172, or 172 out of every 1,000 women.

When multiple interventions were related to a cause of death, calculation was expanded to take into account the numbers of women giving birth covered by each intervention and the total number covered by none of the relevant interventions. The no-care mortality rate therefore reflected the condition of no coverage by no relevant intervention for that cause of death. The full-needs-met mortality rate assumed coverage and effectiveness of the most complete intervention relevant to the cause of death. For example, the full-needs-met assumption for intrapartum and postpartum hemorrhage was that all women had access to emergency obstetric care and active management of the third stage of labor. The estimated reductions in mortality for various interventions, by cause of maternal and newborn mortality are shown in Tables 39 and 40.

When LiST estimates of intervention effectiveness and affected fractions did not match an intervention included in our estimates, we estimated no impact, except that we assumed that facility delivery reduces maternal mortality from other direct causes by 50%, the same assumption we used in our earlier estimates.[10] We assumed no impact of the interventions we included on maternal mortality from indirect causes or from miscarriages less than 27 weeks or on newborn mortality from congenital causes. Likewise, LiST contains some interventions and outcomes that we did not include in our estimates or that could not be matched with how we estimated them. Both of these factors mean that the reductions in mortality and morbidity that we have estimated underestimate the full impacts of maternal and newborn health care.

Mortality across care scenarios and deaths averted

Tables 41 and 42 present the resulting estimates of total and cause-specific mortality rates and ratios and numbers of deaths for women and newborns across scenarios of no-care, current-care and full-needs-met. The tables also show the numbers of deaths averted by current care, compared with no care, and the additional deaths that would be averted by fully meeting needs for the estimated types of care, compared with the current scenario. In Table 41, mortality ratios are expressed per 100,000 live births plus stillbirths. This differs from the common maternal mortality ratio, which expresses mortality as maternal deaths per 100,000 live births,[60] but the larger group of women with live births and stillbirths better matches the population of women at risk for most of the outcomes that are estimated. However, we show abortion mortality both as ratios per 100,000 live births plus stillbirths and as rates per 100,000 safe or unsafe abortions. Further, we show the impacts of different levels of postabortion care provided to women with unsafe abortions and the impacts that would occur if women with unsafe abortions were able to obtain them under safe conditions, including availability of postabortion care.

DALYs across care scenarios and DALYs averted

As discussed above, estimates of DALYs were taken from WHO.[72] Only total maternal DALYs were available, by MDG region. We assumed these were distributed by cause as maternal deaths in each region were distributed. In Table 41, we show numbers and impacts of care on total maternal DALYs. Estimates of DALYs by cause can be calculated by multiplying the ratio of total maternal DALYs to total maternal deaths by the cause-specific numbers of deaths.

DALYs in the newborn period (0–27 days after birth) were available, by MDG region, according to neonatal causes (preterm birth complications, birth asphyxia and birth trauma, neonatal sepsis and infections and other neonatal conditions) and other causes (syphilis, tetanus, congenital abnormalities and other causes). We used these cause-specific DALYs (adjusted to 2014, see above) to estimate newborn care scenarios and DALYs averted. The results are shown in Table 42.

Contraceptive Use and Maternal and Newborn Health Care

As discussed above and shown in Table 35, different levels of contraceptive use lead to different levels of unintended and total pregnancies, births, miscarriages and induced abortions. To assess impacts of differing contraceptive use scenarios on maternal and newborn health care needs and impacts of varying levels of both contraceptive use and maternal and newborn health care impacts, we estimated a number of overlapping scenarios. Table 43 shows results of the different scenarios in terms of their impacts on maternal and newborn deaths and DALYs for all developing countries and for the main regions.

Prevention of Mother-to-Child Transmission of HIV

The average probability of mother-to-child transmission of HIV varies by whether the woman was on antiretroviral drugs before the pregnancy or how early in pregnancy antiretroviral care is begun.[98] In the no-use scenario, we assumed no use of antiretroviral medicines for prophylaxis or therapy among pregnant women, and in the current scenario, coverage was based on the most recent national program data in AIM.[192] In the full-needs-met scenario, we assumed all pregnant women would use the WHO-recommended lifelong ART (Option B+) and that 80% of women would continue ART use begun before their current pregnancy, while 20% would begin Option B+ during the current pregnancy.

We took estimates of the number and proportion of births to women living with HIV that would be infected perinatally (assumed to be within the first six weeks after birth), or through breast-feeding, from AIM estimates under scenarios of no, current and full ART. We estimated data for countries missing data from weighted subregional averages from countries with data from AIM. To estimate mother-to-child transmission of HIV in the scenario with no modern contraceptive use or the scenario in which all women wanting to avoid pregnancy used modern methods, we used the AIM current scenario proportions of women giving birth who would be infected with HIV and proportions of those births that would result in HIV transmission under different scenarios of ART.

Table 44 shows the resulting estimates of numbers of births to women living with HIV and mother-to-child HIV transmission for the different combinations of scenarios.

STI Treatment

We did not estimate deaths or DALYs from treatment of the four curable STIs included in our report, except for those arising from mother-to-child transmission of syphilis (Table 42)[113,216–218] or from pelvic inflammatory disease and infertility resulting from untreated chlamydia or gonorrhea.

SECTION 8: Service Costs

Costs were estimated separately for each component of care for which we could make estimates. All costs were estimated in 2014 U.S. dollars and the 2014 cost estimates were used for each of the health care coverage scenarios. Components of service costs that were expressed for other years were projected to 2014 based on the International Monetary Fund's gross domestic product deflator for the United States.[219]

Direct Costs

For direct costs, a bottom-up, or ingredients-based, costing methodology was employed. A list was compiled for each intervention of all inputs required to treat an average case: contraceptive commodities, drugs, supplies (gloves, syringes, sutures etc.), labor (time in minutes) for each type of staff needed to provide the intervention, and, where relevant, the direct costs of hospitalization not captured by the program and system cost estimates (e.g., food costs). Inputs were based on prior work for UNFPA's Reproductive Health Costing Tool[98] and the OneHealth Model[102] with updates from more recent sources, noted in presentation of service requirements in Sections 4–6. These costs of drugs, supplies, labor and hospitalization were summed to arrive at an average direct cost per client for each intervention component. We combined estimated proportions of women and newborns needing specific care components and the proportions receiving them with the component-specific costs to estimate total direct costs in each scenario.

Contraceptive commodity costs

Contraceptive commodity costs were estimated for each country and method on the basis of average unit costs incurred by donors for the most recent three-year time period (2011–2013), as documented in the Reproductive Health Interchange database.18 The cost data in the database include the total landed cost for the commodity (unit price, shipping, insurance, any related test, fees etc.). We did not have data to adjust for in-country transportation costs. Using the detailed information provided by the database on total costs and number of units per method-specific shipment, unit costs per shipment were calculated by dividing total shipment cost by the total number of units per shipment. All unit costs were checked for plausibility. Obviously flawed unit costs, mainly caused by probable typos in the amounts or total cost numbers in the database, were eliminated. The individual method-specific unit costs were then averaged over the total number of shipments to obtain an average unit cost per method per country. For methods for which there were no shipment records over the three-year period, an (unweighted) average of country costs in the subregion or region was used. Costs were inflated 3.1% from the 2011–2013 midpoint of 2012 to 2014 U.S. dollars.[220]

We based estimates of the average amount of contraceptive commodities needed for one year of use on the analyses behind the 2011 updates to the USAID couple-years of protection (CYP) conversion factors.[221–223] Calculation of CYP conversion factors includes assessment and adjustment

for use-effectiveness (all methods), duration of use for long-acting and permanent methods and fertility awareness methods (continuation rates and age), coital frequency and consistency of use (for coitus-dependent methods such as condoms and spermicides) and wastage (for user-controlled short-acting methods, like pills, condoms and spermicides). Since AIU estimates account for method use–effectiveness in a separate step (see Section 7), we estimated commodities needed for one year of use by recalculating CYP factors to take out the contribution of method use–effectiveness.

For long-term methods and permanent methods, the 2011 CYP estimates assume 100% use-effectiveness and estimate the following average durations of method use:
Copper IUD: 4.6 years of use
Levonorgestrel IUD: 3.3 years
Implanon implant: 2.5 years
Sino-Implant: 3.2 years
Jadelle implant: 3.8 years
Sterilization: 13 years in Bangladesh, India and Pakistan and 10 years in other developing countries

We converted country-specific unit costs for these methods to annual costs by dividing total lifespan method costs for insertion, follow-up and removal by the expected average number of years of use. Annual costs for short-term methods were estimated by multiplying commodity unit costs by the number of units assumed to be needed during an average year of use. The CYP factors for injectable methods are based on the number of injections required per year of use, assuming 100% use-effectiveness. We also assumed an average year of injectable method use requires four three-month injections, six two-month injections or 13 one-month injections.

One year of oral contraceptives requires 13 pill cycles. The CYP pill conversion factor of 15 reflects an estimate of 13 pill cycles for annual coverage plus roughly one cycle to account for use-failure and one cycle for pills wasted by clients who lose, destroy, discard or otherwise fail to use them. We assumed that one year of pill use requires an average of 14 pill cycles, excluding the adjustment for use-failure and including the wastage adjustment.

The conversion factor of 120 condoms per CYP reflects prior estimates and is 11.4% higher than the 105 condoms per CYP estimated to be need to account for the average of 5.6 sexual acts per month tabulated from DHS data (67 condoms per year) and another 38 to account for use-failure, inconsistent use and use overlapping with amenorrhea, infecundity or use of other methods. Assuming that the difference between 120 and 105 condoms per CYP reflects wastage, we assumed one year of condom use requires, on average, 67.2 condoms for covering all sexual acts plus 10 (67.2*0.114), reflecting wastage, for a total of 77 condoms per year. Given the small numbers of women relying on a variety of other modern methods, we used condom costs for other modern method costs. Annual per user commodity costs for each country are shown in Table 45.

Other drug and supply costs

Because of data limitations, all other drug and supply costs were assumed to be the same across countries in all developing regions. The cost of ART treatment was based on data from WHO's Global Price Reporting Mechanism 2013.[198] Mifepristone cost was obtained from DKT India. Other drug costs (including those for treating STIs) were based on the median cost cited in the most recent Management Sciences for Health's International Drug Price Indicator.[224,225] Laboratory tests, other supplies and personnel costs specific to HIV treatment were estimated based on data from Botswana, Ethiopia, Nigeria, Uganda and Vietnam.[199] Costs for other supplies were taken from the most recent UNICEF Supply Catalogue.[226,227] Based on consultation with WHO colleagues, we added 45% to the base prices of all drugs and supplies to account for shipping and wastage. Drug and supply costs used in our analyses are shown in Table 46. Tables in Appendix A provide details on intervention treatment requirements and associated drug and supply costs.

Hospital costs

Direct costs of hospitalization were estimated at $.50 per person per day for food; other costs of hospitalization were assumed to be included in indirect costs. Tables in Appendix A show the interventions assumed to require hospitalization and the associated hospital food costs.

Personnel costs

Country-specific personnel salaries came from the WHO-CHOICE 2005 Database, the most recent available personnel cost estimates.[228,229] In the CHOICE project, regional expert teams provided the data on local costs for different categories of labor for reference countries in their regions. WHO-CHOICE also obtained supplementary information from other sources on country-specific costs of labor, most notably the International Labor Organization database on occupational salaries. They constructed a regression model to predict regional salaries for five grades of staff. The model uses a data set of 752 observations for 72 countries and controls for cross-country price level differences using per capita GDP, population density and WHO region. The predicted salaries refer to the gross wages received by the employee and includes paid vacation and regularly paid guarantees or allowances (such as social security). They do not, however include costs such as overtime, bonuses etc. We converted annual salaries to costs-per-minute of service provision assuming 48 weeks of work per year and 30 hours work per week.

The WHO-CHOICE model predicted salaries for five educational levels of staff in 2005 international dollars (a unit with the same purchasing power as the U.S. dollar in 2005 in the United States) for the 14 WHO regions, mapping the following types of sexual and reproductive health clinical staff by level: 1-community health workers, 2-assistant nurse, 3-nurses/midwives, 4-general physicians and 5-obstetricians. The regional salary estimates were converted to country-specific salaries based on purchasing power parity exchange rates reflecting the number of units of a country's currency required to buy the same amount of goods and services in the domestic market as a U.S. dollar would buy in the United States. Since our analysis is in 2014 U.S. dollars, we used country salary estimates converted to U.S. dollars based on 2005 exchange rates and inflated them

by 17.6% into 2014 U.S. dollars.[220] Table 47 shows the resulting 2014 country salary estimates used in our calculations. Staffing requirements for each intervention are shown in Appendix A.

Indirect Costs

For the 2008 and 2012 Adding It Up projects, we estimated indirect costs from work done by researchers at UNFPA.[10,14,15]They estimated total indirect costs for the following categories of program and systems costs related to sexual and reproductive health care services other than STI management and care related to HIV/AIDS.[12]

- Program management—developing and assessing policy, regulations, and strategic and operational plans for programs
- Staff supervision
- Monitoring and evaluation—establishing or integrating services into monitoring and evaluation frameworks and designs, conducting community surveys (such as DHS) and conducting facility-based surveys
- Human resources development—increasing training capacity and number of trained staff to scale up to target coverage levels, accounting for attrition; upgrading pre-service training; reviewing training materials; establishing refresher training courses; and establishing in-service training programs
- Transport and telecommunication—acquiring, running and maintaining vehicles and telecommunications systems for transporting patients, supervising staff, and performing training and outreach services
- Health education—mobilizing the community to raise awareness of family planning and maternal and newborn health–related issues using mass media (radio, TV) and printed material (posters, fliers)
- Advocacy—developing advocacy strategy and materials, and implementing advocacy activities
- Infrastructure—upgrading and maintaining existing facilities and building new ones
- Commodity supply systems—establishing, upgrading and maintenance
- Health management information system improvements

We investigated other major works in the hope of updating and expanding these indirect costs to include more recent information on cost components, to break total indirect costs into subcategories and to expand the investments covered.[230–233] The UNFPA estimates, for instance, did not cover costs for health financing and governance found in some of the other studies[232,233] and it is doubtful that any estimates include adequate costs for ensuring that information and care are delivered with high quality that is fully respectful of the human rights, life circumstances and needs of all groups within the population.

After extensive evaluation (see Appendix B), we judged that each approach was so unique that reconciliation was not possible and that there was no adequate basis at this time for changing to another source or making adjustments to the UNFPA indirect cost estimates. Therefore, in this

report, we continued to calculate indirect costs based on regional ratios of indirect to direct costs, as provided by UNFPA,[11] i.e., we assumed that UNFPA's estimated indirect cost ratio for 2008 (pre-scale-up) applies to the current scenario and the higher ratio for 2009 applies to scenarios in which all needs are met.[10,14,15] Given the inadequate levels of investment in recent years, we assumed it was appropriate to apply the higher 2009 indirect ratio to the future scenario to account for the costs of building capacity and improving services to fully meet the needs of all women who need sexual and reproductive services.

For the current scenario, indirect costs were estimated to account for 35% of sexual and reproductive health service costs in Sub-Saharan Africa, 56% in Northern Africa and Western Asia, 49% for developing countries in the rest of Asia and 57% in Latin America and the Caribbean.[11,234] For scenarios with improved and increased service coverage, indirect costs were estimated at 79% of service costs in Sub-Saharan Africa, 58% in Northern Africa and Western Asia, 53% for developing countries in the rest of Asia and 60% in Latin America and the Caribbean

Total Costs

Total costs are the sum of direct and indirect costs. These costs are paid for through a number of sources that vary in importance from country to country: national government budgets, external agencies and donors, employers (through insurance benefits) and service users themselves, through contributions to insurance coverage and out-of-pocket payments for services and supplies. We used a bottom-up costing methodology to estimate service costs because information on actual expenditures and the breakdown by source of payment is not available. Since most of the sources we used to estimate contraceptive commodities and other drugs and supplies reflect public-sector prices, the resulting service costs are likely to be underestimates, especially for countries with substantial private-sector service providers.

Table 48 presents the estimated annual per-user direct costs for each modern method, including contraceptive commodities, supplies and staff time, by selected country groupings. Table 49 lists the other sexual and reproductive health interventions for which we made estimates, noting what groups of women and newborns were covered by each intervention. Table 50 shows cost detailed cost estimates for selected country groupings. Total, direct and indirect costs are shown for the current service coverage scenario, for a scenario of current contraceptive use and full coverage of other types of care and for a scenario in which all sexual and reproductive health care needs addressed in the *Adding It Up 2014* report are covered. The table also shows differences in costs between the full-needs-met and current scenarios and cost savings that would result from moving to full coverage as well as costs per woman of reproductive age and per capita.

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