GUTTMACHER INSTITUTE

ADDING IT UP

Investing in Sexual and Reproductive Health 2019

Methodology Report

Adding It Up: Investing in Sexual and Reproductive Health 2019 Methodology Report

Guttmacher Institute

By Taylor Riley, Elizabeth A. Sully, Naomi Lince-Deroche, Lauren Firestein, Rachel Murro, Ann Biddlecom and Jacqueline E. Darroch

Acknowledgments

This report was written by Taylor Riley, Elizabeth A. Sully, Naomi Lince-Deroche, Lauren Firestein, Rachel Murro, Ann Biddlecom and Jacqueline E. Darroch—all of the Guttmacher Institute. The report was edited by Jenny Sherman, of the Guttmacher Institute.

The authors thank Eva Weissman, independent consultant, for her contributions on interventions and for evaluating and compiling direct cost data. They also acknowledge the following Guttmacher colleagues (in alphabetical order): Suzette Audam, for data compilation and processing; Jonathan Bearak, Cynthia Beavin and Anna Popinchalk, for abortion and unintended pregnancy estimates; Marielle Kirstein, for research assistance; and Onikepe Owolabi, for her guidance and medical expertise on treatment assumptions.

We thank Eman Aboaldahab ElSayed, independent consultant, for data processing; Vladimíra Kantorová, Population Division, United Nations (UN) Department of Economic and Social Affairs, for guidance on country-specific estimates of family planning indicators; John Stover, Avenir Health, for guidance on data and estimation from the Spectrum AIDS Impact Model; and Doris Chou, the World Health Organization (WHO), for specialized tabulations of maternal mortality estimates.

Donor Support

This report was made possible by UK Aid from the UK Government and grants from the Bill & Melinda Gates Foundation, The Children's Investment Fund Foundation, the Dutch Ministry of Foreign Affairs and United Nations Population Fund (UNFPA). The findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the donors. The Guttmacher Institute gratefully acknowledges the unrestricted funding it receives from many individuals and foundations—including major grants from the William and Flora Hewlett Foundation and the David and Lucile Packard Foundation—which undergirds all of the Institute's work.

Suggested citation: Riley T et al., *Adding It Up: Investing in Sexual and Reproductive Health 2019—Methodology Report*, New York: Guttmacher Institute, 2020.

https://www.guttmacher.org/report/adding-it-up-investing-in-sexual-reproductive-health-2019-methodology

Table of Contents

Abbreviations

AIU-2019	Adding It Up 2019
AMTSL	active management of third stage of labor
ANC	antenatal care
ART	antiretroviral therapy
DHS	Demographic and Health Surveys
EmOC	emergency obstetric care
FABM	fertility awareness–based methods
FGM	female genital mutilation
GBD	Global Burden of Disease
GGS	Generations and Gender Survey
IHME	Institute for Health Metrics and Evaluation
IPTp	intermittent preventive treatment in pregnancy
ITN	insecticide-treated bed net
LARC	long-acting reversible contraceptive
LiST	Lives Saved Tool
LMIC	low- and middle-income countries
MICS	Multiple Indicator Cluster Survey
PAC	postabortion care
PAPFAM	Pan Arab Project for Family Health
PID	pelvic inflammatory disease
PMA	Performance Monitoring for Action
RHS	Reproductive Health Survey (Centers for Disease Control and Prevention)
SRH	sexual and reproductive health
UN	United Nations
UN IGME	UN Inter-agency Group for Child Mortality Estimation
UN MMEIG	UN Maternal Mortality Estimation Inter-Agency Group
WHO	World Health Organization
WHO-MCEE	World Health Organization Maternal Child Epidemiology Estimation
WPP	World Population Prospects

Section 1: Introduction

1.1. Objective of this report

This report provides methodological details on the estimates presented in *Adding It Up: Investing in Sexual and Reproductive Health 2019*[1] (referred to in this report as AIU-2019) and related publications. Adding It Up is a recurrent Guttmacher Institute study in which researchers estimate the need for and use, costs and impacts of various sexual and reproductive health (SRH) services in low- and middle-income countries (LMICs). Specifically, it examines the SRH services that women* of reproductive age (15–49) and their newborns need and use, and identifies gaps in services that, if filled, could improve their health. We also make related estimates for adolescent women (aged 15–19).

The goal of producing the Adding It Up estimates is to illustrate the investments required to meet all needs for essential SRH services for decision makers at global, regional and country levels. These estimates build on prior Adding It Up reports that have provided estimates of the need for and costs and impacts of SRH services periodically since 2003. In this methodology report, we describe the analytical framework, data sources and calculations behind the AIU-2019 estimates. Our objective is to provide users with the necessary information to understand the results, assumptions and limitations of the estimates provided in AIU-2019.

1.2. Comparability with prior Adding It Up estimates

These estimates build on prior Adding It Up reports that provided estimates of the need for and costs and impacts of SRH services in 2003, 2008, 2012, 2014 and 2017, as well as a 2016 adolescent report.[2–8] Though the fundamental purpose and approach remain unchanged, the estimation methods have been refined, the package of care has expanded and the countries included in the analysis have shifted. Whereas prior reports presented total estimates for developing regions, which were defined geographically by the United Nations (UN),[9] the 2019 report presents estimates for LMICs, as defined by the World Bank.[10] AIU-2019 therefore excludes high-income countries in developing regions† (which account for approximately 3% of women of reproductive age in those regions) and includes 11 LMICs in Eastern Europe and Southern Europe.‡ The following additional adjustments were made to the AIU-2019 methodology:

*We use the term "women" to match the data available in nationally representative household surveys, although we recognize that not all people have binary gender identities.

†The following high-income countries and administrative regions located in developing regions were excluded in the shift to LMICs in AIU-2019: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Bahrain, Barbados, British Virgin Islands, Brunei Darussalam, Cayman Islands, Chile, Curaçao, Cyprus, Falkland Islands, French Polynesia, Guam, Hong Kong (China), Israel, Kuwait, Macao (China), Montserrat, New Caledonia, Northern Mariana Islands, Oman, Palau, Panama, Puerto Rico, Qatar, Republic of Korea (South Korea), Saint Barthélemy, Saint Kitts and Nevis, Saint Martin, Saudi Arabia, Seychelles, Singapore, Trinidad and Tobago, Turks and Caicos Islands, United Arab Emirates, United States Virgin Islands and Uruguay. The following countries are in developing regions but do not have an income classification from the World Bank and are therefore excluded from AIU-2019: Cook Islands, French Guiana, Guadeloupe, Martinique, Mayotte, Niue, Pitcairn, Réunion, Tokelau, Wallis and Futuna Islands and Western Sahara.

‡The following countries in Eastern and Southern Europe were added in AIU-2019: Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Montenegro, North Macedonia, Republic of Moldova, Romania, Russian Federation, Serbia and Ukraine.

- Estimates of contraceptive need and use were aligned with model-based country estimates from the UN Population Division.[11]
- New country-level modeled estimates of abortions and unintended pregnancies were used.[12]
- The classification of sexual activity among unmarried women was changed from three months prior to the survey to one month prior to the survey, which aligns with the Demographic and Health Surveys (DHS) Program[13] and UN Population Division[11] definitions.
- Eighteen new pregnancy-related and newborn care interventions were added (see Methodology Report Appendix Table MA1.2).
- Many sources of information and data inputs were updated to include the most recent data, and these updates are detailed in this report and the corresponding methodology report appendix tables.

Because of the methodological changes made for each new round of Adding It Up, the reports do not provide valid time trends and should not be used as a time series. Methodology summaries and details on data sources and methods can be found for most prior Adding It Up reports.[4,5,14–17]

1.3. Other recent estimates

AIU-2019 is one of several recent efforts to estimate the resources required to meet the need for SRH services. Several initiatives have published relevant, multicountry estimates in recent years that make a case for investing in SRH, including the Disease Control Priorities project;[18] the Reproductive Health Supplies Coalition's Community Gap Analysis;[19] the World Health Organization (WHO) cost estimates of achieving the health-related Sustainable Development Goals;[20] and Sheehan et al.'s case for global investment in adolescents.[21] Other relevant multicountry initiatives aim to improve SRH, including Every Woman Every Child's Global Strategy for Women's, Children's and Adolescents' Health,[22,23] the Global Financing Facility[24] and the Family Planning 2020 initiative.[25,26]

In addition, numerous researchers and organizations are also working to track resources committed annually for reproductive health activities.[19,27–34] The Adding It Up project has benefited from these efforts and from prior estimation work carried out by the United Nations Population Fund (UNFPA),[35] Women Deliver,[36] the High-Level Taskforce on Innovative International Financing for Health Systems,[37] and other cost and impact analyses.[38,39]

The estimates published by these organizations and initiatives differ from one another because each includes a different subset of sexual, reproductive and child health services, different costing methodologies, and varying scenarios of coverage. Estimates may also differ in terms of geographic coverage. For example, Family Planning 2020 focuses on 69 countries with per capita income of $2,500 or less, whereas the Countdown to 2030 collaboration focuses on the 81 countries where more than 90% of maternal and child deaths occur.[40]

AIU-2019 covers 132 LMICs, as determined by the 2019 World Bank classifications,[10] and presents the health impacts and associated costs of providing services at internationally defined standards of care. AIU-2019 assumes that scaling up services to fulfill unmet needs would occur immediately (within a one-year time frame); though in reality scale-up would take longer, this approach helps to illustrate for stakeholders the full magnitude of investments required to meet all SRH needs. AIU-2019 contributes to evidence on SRH needs, impacts and costs by:

- Presenting a comprehensive set of SRH services covering contraception, pregnancy-related and newborn care, and STI treatment
- Estimating the fulfillment of all need for services versus fulfillment of only a certain proportion of need
- Presenting the full costs required to meet all service provision needs versus presenting only the additional costs of expanding services
- Demonstrating the total investment needed, which includes direct costs and programs and systems costs (such as infrastructure, management and training of health personnel)
- Illustrating the cost savings that can occur when investing in contraceptive and pregnancy-related and newborn care simultaneously

Under the aegis of the STEP UP project, Guttmacher Institute researchers worked with other colleagues involved in estimating impacts of contraceptive use to identify similarities and differences in various models' inputs and assumptions.[41] Estimates from previous Adding It Up analyses have been adopted for harmonizing the estimates of unintended pregnancy, abortion and maternal death across the different models.[42]

1.4. Guide to this report

This report describes the analytical framework behind the AIU-2019 estimates and contains the following sections:

- Section 2 provides an **overview** of the AIU-2019 analytical approach.
- Section 3 describes the methodology and data sources for the **demographic data** used in AIU-2019, including population numbers of women by marital status, pregnancies by intention status and outcome, and maternal and newborn deaths.
- Section 4 describes how we estimated need for and use of **contraception**.
- Section 5 provides information on how we estimated need for and coverage of **pregnancy-related and newborn care**.
- Section 6 describes how we estimated need for and coverage of treatment of major curable **STIs** for all women of reproductive age.
- Section 7 describes how we estimated the **impacts** of SRH services.
- Section 8 provides information on how we estimated service **costs**.

Each section of the report is accompanied by supplementary methodological materials that are hyperlinked and referenced throughout. These include the statistical programs (referred to as Stata do-files) used to produce these estimates, and appendix tables, which present the input and underlying data and sources used in AIU-2019. The Stata do-files provide specific detail on data sources, calculations, estimation approaches, assumptions and imputations; they can be found on the Open Science Framework. The methodology report appendix tables are available in a single Microsoft Excel 2016 workbook or as individual tables, indicated throughout this report (clicking on a table hyperlink will automatically download the Excel file). Each section of this report largely follows the same outline: the objective of the component, key terms (if relevant), data sources used, analysis approach taken,

assumptions made, adolescent-specific assumptions made, and links to the relevant Stata do-files and methodology tables.

1.5. Tables

The relevant appendix tables for this section are:

- **Methodology Report Appendix Table MA1.1:** LMICs in the AIU-2019 analysis by UN Population Division region and subregion, according to income group, other regional designations and inclusion in selected classifications
- **Methodology Report Appendix Table MA1.2:** Modern contraception, pregnancy-related and newborn care interventions, and other SRH care interventions
- **Methodology Report Appendix Table MA1.3:** Details on drugs, supplies and personnel required for modern contraception, pregnancy-related and newborn care, and other SRH treatment interventions

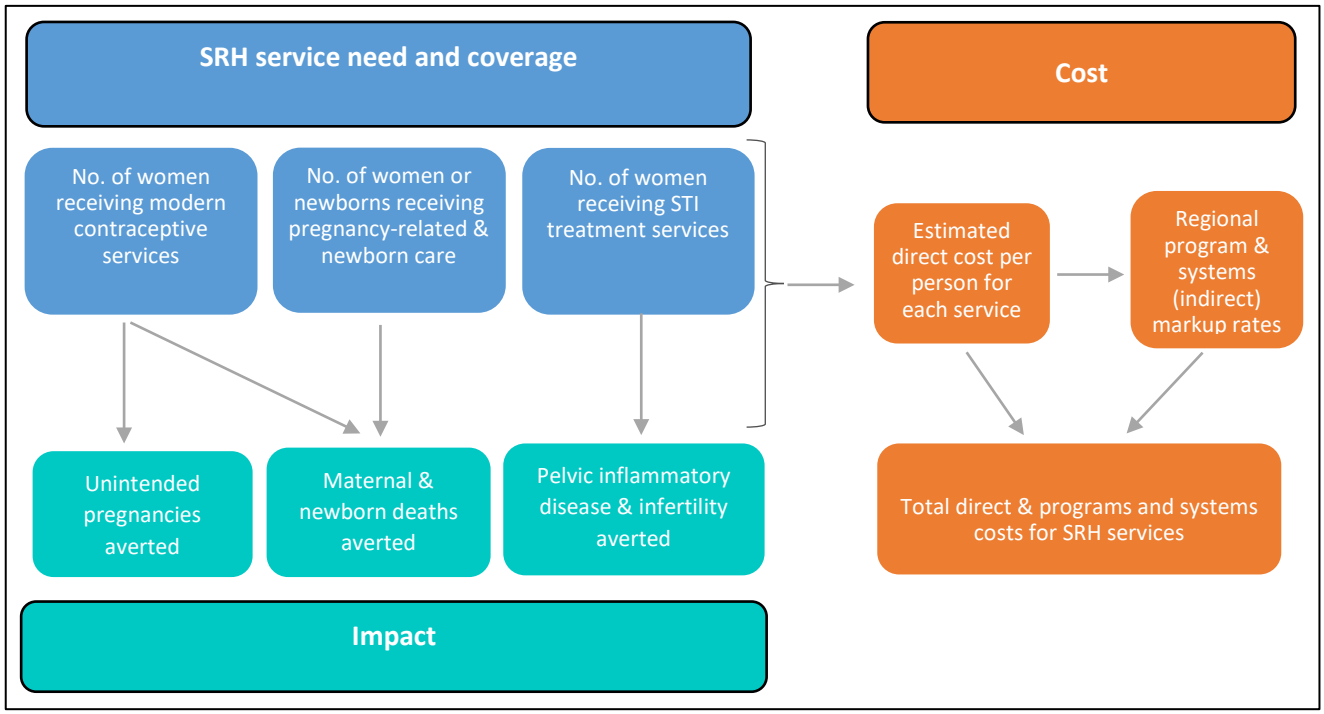
Section 2: Adding It Up Approach

2.1. Objective

This section describes AIU-2019's scenario-based approach to estimating SRH service needs, coverage, impacts and costs. AIU-2019 assesses the numbers of women who need and receive contraceptive services, pregnancy-related and newborn care, and treatment for major curable STIs. It then provides estimates of the health impacts of different levels of service coverage and of the total costs of services[§] by comparing current use of SRH services with hypothetical scenarios of service provision to show the immediate impacts of meeting women's and newborns' needs.

Figure 2.1 provides a schematic of the key components of the AIU-2019 analysis, and the following sections in this report describe the data sources and details of these components. All estimates were based on country-specific demographic estimates of population, pregnancies and deaths (described in Section 3). We then estimated the need for SRH services and the proportion of those in need who receive care (referenced throughout as "need and use" or "need and coverage"). We estimated need and coverage for modern contraception (described in Section 4), pregnancy-related and newborn care (described in Section 5) and treatment for major curable STIs for women of reproductive age (described in Section 6). We quantified the impacts of meeting the needs for modern contraception and pregnancy-related and newborn care in terms of unintended pregnancies and maternal and newborn deaths averted for each scenario (described in Section 7). Estimation of the impacts of treatment of major curable STIs was limited to pelvic inflammatory disease (PID) and infertility averted (described in Section 6). Finally, we estimated the total costs of providing modern contraception, pregnancy-related and newborn care, and treatment of STIs (described in Section 8).

Figure 2.1. The AIU-2019 approach to estimating SRH service needs, coverage, impact and costs



§Including direct costs and indirect costs (referred to in this report as programs and systems costs) that support service provision.

2.2. Analysis approach

Scenarios

To show the impacts of meeting the needs for contraceptive services and pregnancy-related and newborn care, AIU-2019 compared current levels of service provision with the following hypothetical scenarios:

1. *No care:* This scenario is used to show the health impact of current services by estimating outcomes if no contraceptive or pregnancy-related and newborn care were provided.
2. *Meeting the need for modern contraception* and *meeting the need for pregnancy-related and newborn care:* These two scenarios show the costs and impacts of fully investing in just one set of services, assuming the other set remains at current levels.
3. *Fully meeting the need for both sets of services simultaneously:* This scenario demonstrates how full provision of contraceptive services would reduce the need for pregnancy-related and newborn care, which would in turn result in greater impact and cost-savings than investing in either set of services alone.

In addition, the study estimates the costs of current services for treating the four main curable STIs—chlamydia, gonorrhea, trichomoniasis and syphilis—as well as the impact and costs if all need for such care were fully met.

Table 2.1. Hypothetical scenarios of different levels of service provision of contraceptive services, pregnancy-related and newborn care, and treatment of curable STIs

Scenario		Contraceptive services	Pregnancy-related and newborn care	Treatment of curable STIs
1	No provision of care	No use	No use	No use
2a	Meeting the need for modern contraception	All needs met	Current level	Current level
2b	Meeting the need for pregnancy-related and newborn care	Current level	All needs met	Current level
4	Fully meeting the need for all SRH services simultaneously	All needs met	All needs met	All needs met

The scenarios set contraceptive use to different levels of coverage (none, current levels and a level sufficient to meet all contraceptive needs) because contraceptive use reduces the numbers of pregnancies, births, miscarriages and abortions by averting unintended pregnancies. Therefore, contraceptive use levels affect the need for pregnancy-related and newborn services.

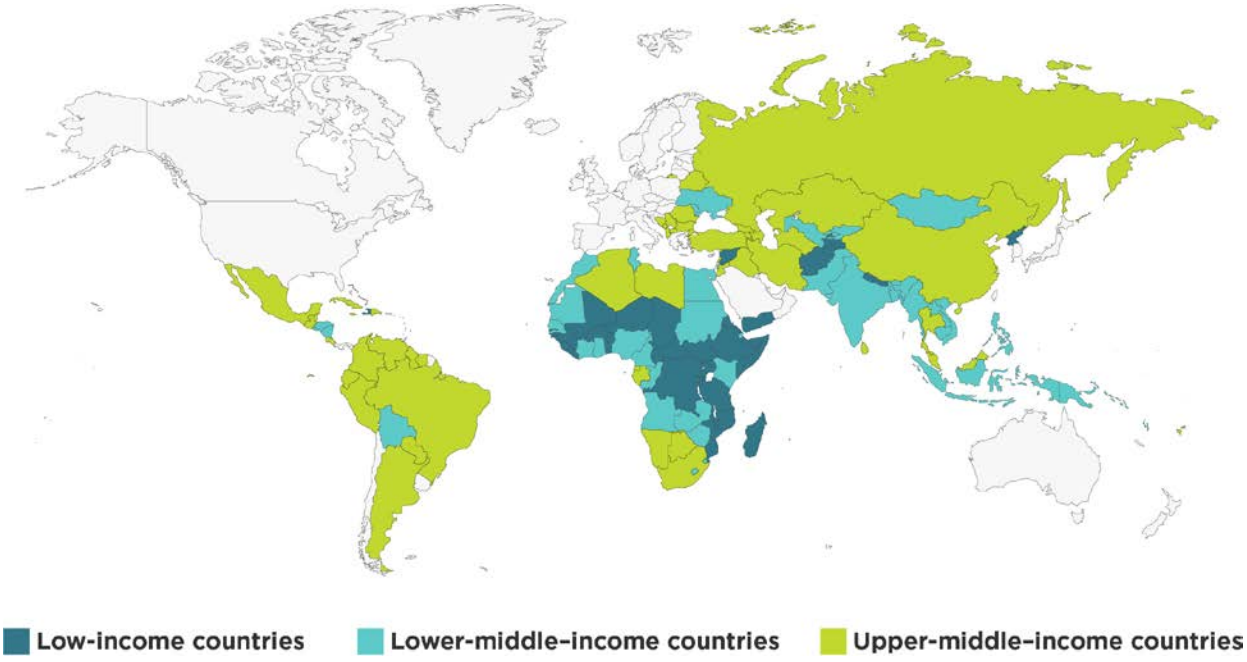
Time period of estimates

AIU-2019 estimates were aligned to 2019 demographic estimates (population, births, deaths, etc.) and 2019 U.S. dollars. AIU-2019 drew from the most recently available data, adjusted to 2019, and illustrated the gains from immediately fulfilling unmet SRH needs. We recognize that the necessary increases in service coverage cannot be achieved immediately, especially because many of them depend on improvements in health services infrastructure. However, we use the same year for all scenarios to allow for easier interpretation of the magnitude of changes needed, as compared with the current situation.

Geographic coverage

The 2019 estimates include all countries classified as LMICs by the World Bank (see Figure 2.2).[10] Low-income countries are those with a 2018 gross national income (GNI) per capita of $1,025 or less, lower-middle-income countries have a GNI per capita of $1,026–3,995 and upper-middle-income countries have a GNI per capita of $3,996–12,375. The following countries and territories are classified as LMICs but do not have UN population or births data and are therefore excluded from the AIU-2019 analysis: American Samoa, Dominica, Marshall Islands, Nauru and Tuvalu. Following UN World Population Prospects (WPP) classifications, Kosovo is collapsed with Serbia for all calculations.

Figure 2.2. Map of LMICs included in the AIU-2019 analysis



2.3. Data sources and availability

AIU-2019 used a wide range of data sources to estimate the cost and impact of meeting SRH needs in LMICs. Each section of this report describes the data sources used for each component of the analysis.

The survey data used in the analysis include DHS, UNICEF's Multiple Indicator Cluster Survey (MICS), Centers for Disease Control and Prevention's Reproductive Health Survey (RHS), Performance Monitoring for Action (PMA) survey, Generations and Gender Survey (GGS), Pan Arab Project for Family Health (PAPFAM) survey and other national survey data. Restrictions apply to the availability of some of these data, which were used under license for the current study, and so are not publicly available. Data are available online for free from many of the sources (e.g., the DHS Program, UNICEF and PMA) or by request from country statistical offices. Legal access agreements do not allow the sharing of data sets with unregistered researchers. This study is a secondary data analysis and does not involve human subjects and is therefore exempt from Institutional Review Board review.

2.4. General estimation approach

To estimate the need for and coverage of SRH services, we used the most recent available national survey data or reports from the survey data sources described earlier. For countries with missing data, we substituted the following data (listed in order of priority):

1. Weighted subregional estimates (using UN Population Division definitions of subregions)[43]
2. Data from a neighboring country in that subregion (done in only two instances: data from Jordan was used for the State of Palestine, and data from Kiribati was used for Micronesia)
3. Estimates from a proxy subregion, which was generally a neighboring subregion with similar characteristics (for instance, data from Southeast Asia were used when there were no data for countries in Melanesia, Micronesia or Polynesia)
4. Weighted regional estimates (using UN Population Division definitions of regions)[43]

Estimates for all LMICs, regions, subregions and other country groupings were based on weighted country data for 2019. Country estimates were weighted by the relevant numbers of women, pregnancies, births, etc. (rather than using the unweighted average or median), using countries as the unit of analysis. Confidence intervals were not estimated for AIU-2019, given the use of a large number of data sources, including national censuses, national surveys, model-based estimates and recent estimates from the literature. Calculations of distributions, rates and numbers for AIU-2019 were made from unrounded data. The estimates presented in the AIU-2019 appendix tables and methodology report appendix tables are unrounded to facilitate their use in further calculations, but this does not indicate precision.

The AIU-2019 analysis was conducted in Stata 16,[44] except for the costing component, for which per user costs were calculated in Excel and then imported into Stata for analysis.

2.5. Stata do-files

Table 2.2 provides a list of all of the Stata do-files used for this analysis and that are publicly available on the Open Science Framework. The sections below will refer to these Stata do-files when they provide the detailed calculations and supplemental information for the report.

Table 2.2. List of Stata do-files used for the AIU-2019 analysis

Demographic estimates	Contraceptive (CP) need and use	Pregnancy-related and newborn care (PRNC)	Treatment of curable STIs
Demo_01_Calculations for demographics file.do	CP_01_ Estimation and imputation for missing data.do	PRNC_01_Estimation and imputation for missing data.do	STI_01_Need and coverage.do
Demo_1A_Adolescent abortion calculations.do	CP_1A_Estimation for incomplete data from reports.do	PRNC_1A_Estimation for malaria indicators.do	STI_02_Impact.do
Demo_1B_Miscarriage calculations.do	CP_1B_Estimation for incomplete data among never-married women.do	PRNC_1B_Estimation for pregnancy-related HIV indicators.do	

Demo_1C_Maternal and newborn mortality calculations.do	CP_02_Calculate CP numbers by subgroups.do	PRNC_2A_Input assumptions_need_current.do	
	CP_03_Adjustment to UN Population Division model-based estimates.do	PRNC_2B_Input assumptions_coverage_current.do	
	CP_04_Calculate modern CP use and unmet need totals.do	PRNC_2C_Input assumptions_all needs met.do	
	CP_05_Calculate CP numbers by scenarios.do	PRNC_03_Calculate need numbers by scenarios.do	
	CP_06_Calculate unintended pregnancies by scenarios.do	PRNC_04_Calculate coverage numbers by scenarios.do	
	CP_07_Calculate impacts.do	PRNC_05_Calculate impact _maternal deaths.do	
		PRNC_06_Calculate impact_newborn deaths.do	

Section 3: Demographic Estimates

3.1. Objective

This section describes the demographic data used throughout the AIU-2019 analysis and is organized into five subsections: population size and composition, pregnancies by outcome and intention, abortion safety, maternal deaths and newborn deaths. The number and characteristics of women of reproductive age (population size and composition), the distribution of pregnancies by intention and outcome, abortion safety, and the cause-specific number of maternal and newborn deaths were used in the calculations to assess the need for and impact of SRH services. Unless otherwise stated, we used the same assumptions for adolescents (aged 15–19) that we did for all women of reproductive age (aged 15–49).

3.2. Population size and composition

Definitions

- **Total population:** all inhabitants, regardless of age or sex
- **Women of reproductive age:** women aged 15–49
- **Currently married:** married, in union, cohabiting
- **Formerly married:** widowed, divorced or previously in union
- **Never married:** never married or in union

Data sources

Data	Geographic level	Sources
Population	Country	WPP 2019[43]
Marital status	Country	UN estimate of married women 2018[45]
		DHS and other national surveys
		UN World Marriage Data 2017[46]
Residence, wealth and parity	Country	DHS and other national surveys
		UN residence data by marital status, age and sex 2018[47]

Analysis approach

We obtained 2019 estimates for the total population and the number of women of reproductive age by single-year age-groups for each country.[43] We estimated marital status by age-group for currently married, formerly married and never-married women. We took the age-specific proportion of 15–49-year-old women (in five-year age-groups) in each country in 2019 who are currently married from the UN estimates of married women.[45] We drew from the most recent age-specific marital status distributions among unmarried women to calculate the age-specific distribution of unmarried women who were formerly married or never married. We used the most recent source for each country with available data, which was either a national survey with data on unmarried women or the UN World Marriage Data 2017 revision.[46] The resulting marital status distribution—currently, formerly or never married—for each age-group was applied to the number of women in that age-group in 2019 in each country.

We also calculated country-level proportions of women aged 15–49 by marital status, according to each of the following subgroups: household wealth quintile, residence (rural or urban) and parity (no births or at least one birth) from DHS and other national surveys or UN residence data set.[47] Country-specific sources can be found by downloading Methodology Report Appendix Table MA3.1.

3.3. Pregnancies by outcome and intention

Definitions

- **Pregnancy outcomes:** live births, induced abortions, miscarriages and stillbirths
- **Miscarriage:** pregnancy that ends spontaneously after lasting long enough to be noted by the woman (typically no earlier than 6–7 weeks after the last menstrual period) but before 28 weeks' gestation
- **Stillbirth:** death of a fetus weighing at least 1,000 g or death of a fetus at or after 28 weeks' gestation[48]

Data sources

Data	Geographic level	Sources
Live births	Country	WPP 2019[43]
Maternal age at time of birth	Country	DHS and other national surveys
Household wealth quintile at time of birth	Country	DHS and other national surveys
Birth intention	Country	Bearak et al. 2020,[12] Bearak et al. 2019[49]
Induced abortions	Country	Bearak et al. 2020,[12] Bearak et al. 2019[49]
Induced abortions (adolescent-specific)	Country	Available estimates for countries with data[50–55]
Unintended pregnancies ending in induced abortion	Country	Bearak et al. 2020,[12] Bearak et al. 2019[49]
Miscarriages	All LMICs	Leridon 1977, Table 4.20,[56] Bongaarts and Potter, 1983[57]
Stillbirths	Country	Blencowe et al. 2016[58]

Analysis approach

1. **Births**
   Distributions of births by maternal age at birth and by household wealth quintile at time of survey were obtained from DHS and other national surveys. For birth intention status, we took the proportion of births among women of reproductive age in each country in 2019 that were intended or unintended from model-based estimates for 2015–2019[12,49] and applied these proportions to 2019 births.

2. **Induced abortions**
   We used the country-specific model-based estimates of the annual number of abortions and the annual number of births in 2015–2019 in each country to calculate the ratio of abortions to births for each country.[12] These abortion estimates underwent country consultations with WHO and were produced by a Bayesian hierarchical time series model, which was informed by data on abortion incidence and the percentage of births or pregnancies that were unintended.[49] We applied this ratio to the number of births in 2019 from WPP[43] to estimate the number of abortions

among all women in each country in 2019. Following the model's assumptions, we assumed all abortions occurred among women experiencing unintended pregnancies.

We calculated the proportion of abortions that occurred among adolescents for 33 countries with available data compiled from multiple sources.[50–55] The weighted subregional, proxy subregion or regional average of this proportion was applied to each country that was missing data. Each country-specific proportion was multiplied by the total number of abortions to estimate the number of abortions among adolescents in each country.

3. **Miscarriages and stillbirths**
We first estimated the total combined number of miscarriages and stillbirths as equivalent to 20% of pregnancies ending in birth and 10% of pregnancies ending in induced abortion.[56] These proportions were used to estimate miscarriages and stillbirths separately by the intention status of the pregnancies that resulted in births or abortions. These proportions are based on studies estimating that for every 100 pregnancies at six weeks' gestational age, roughly eight will result in miscarriage by week 10, another eight will end in miscarriage or stillbirth in the remaining weeks of pregnancy, and 84 will result in live births.[56] The 20% assumption used for AIU-2019 is approximately the ratio of miscarriages or stillbirths to births (16% / 84%). The 10% assumption is approximately the ratio of miscarriages less than 10 weeks' gestational age to the number of remaining pregnancies at week 10 (8% / 92%).

a. Stillbirths. Using the Blencowe et al.[58] stillbirth rates per 1,000 total live births and stillbirths, we calculated stillbirth ratios (stillbirths per 1,000 live births) and estimated the number of stillbirths in each country by applying the ratio for each country to the total number of live births in 2019.

b. Miscarriages. To estimate the number of miscarriages, we subtracted the estimated stillbirths from the total combined estimate of miscarriages and stillbirths. We assumed that 80% of miscarriages estimated from live births occur at less than 14 weeks' gestation and 20% at 14–27 weeks' gestation.[56,57] We assumed that all miscarriages estimated from numbers of induced abortions occur before week 14.

3.4. Abortion safety

Definitions
Abortion safety is based on the revised WHO definition from 2017.[59]

- **Safe abortions:** those that use a WHO-recommended method appropriate to the pregnancy duration and are done by a trained provider
- **Less safe abortions:** those that meet only one of these criteria
- **Least safe abortions:** those that meet neither criterion
- **Unsafe abortions:** the sum of less safe and least safe abortions

Data sources

Data	Geographic level	Sources
Abortion safety	Subregion	Ganatra et al. 2017[59]
	Country	Recent nationally representative studies in Bangladesh,[60] Ethiopia,[61] India[62] and Nepal[63]

Analysis approach

We used the abortion safety definitions and classifications from Ganatra et al.[59] to classify induced abortions in 2019 as safe, less safe and least safe by country. We summed less and least safe abortions to estimate the total number of unsafe abortions. In addition, subregional estimates were replaced with country-specific data for four countries (Bangladesh,[60] Ethiopia,[61] India,[62] Nepal[63]) where estimates of the proportion of abortions occurring in safe versus unsafe conditions were available.

3.5. Maternal deaths

Definition

- **Maternal death:** per WHO, "death during pregnancy, childbirth or up to 42 days after the pregnancy ended, 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"[64]

Data sources

Data	Geographic level	Sources
Maternal mortality	Country	UN MMEIG 2017[65]
Maternal mortality by age	Country	GBD 2017 study conducted by IHME[66]
Cause of maternal mortality	Country	GBD 2017 study conducted by IHME[66]
Timing of maternal deaths from hemorrhage	Region	Say et al. 2014[67]
Maternal mortality from miscarriage	All LMICs	Åhman et al. 2011[68]

We used the UN Maternal Mortality Estimation Inter-Agency Group (UN MMEIG) estimates for the number of maternal deaths in AIU-2019 for two reasons. First, the UN MMEIG estimates use the same source for population and birth estimates that AIU-2019 uses (WPP[43]). Second, the UN MMEIG uses an extensive country consultation process to examine the data sources and model assumptions that produced the resulting estimates.[64] We used the Institute for Health Metrics and Evaluation (IHME) cause-of-death estimates from the Global Burden of Disease (GBD) 2017 study[66] because they are the most recent estimates of causes of maternal death. We excluded late maternal deaths (those occurring 42 days or more after the pregnancy ended) from this analysis to be consistent with the WHO definition of maternal mortality.

Analysis approach

1. **Number of maternal deaths**
   We first calculated the country-specific maternal mortality ratio in 2017 for all women of reproductive age from the unrounded number of maternal deaths from UN MMEIG[65] estimates and the number of births among women aged 15–49 in 2017 from WPP.[43] We then applied this ratio to the number of births in 2019 to estimate the number of maternal deaths in 2019 for women aged 15–49.

   To estimate maternal deaths among adolescents, we used age-specific maternal mortality estimates from IHME[66] to calculate the proportion of all maternal deaths that were among adolescents. We then applied this proportion to the estimated number of maternal deaths in 2019 to generate the number of adolescent maternal deaths.

2. **Causes of maternal death**
   After excluding late maternal deaths, we calculated the proportion of maternal deaths from each cause for all women of reproductive age and for adolescents from IHME.[66] We distributed the proportion of maternal deaths from hemorrhage into two groups—ante- or intrapartum hemorrhage, and postpartum hemorrhage—based on regional estimates from Say et al.[67]

3. **Abortion-related maternal deaths**
   For each age-group, IHME produced a combined estimate of maternal deaths due to both abortions and miscarriages.[66] To separate abortion-specific and miscarriage-specific maternal deaths, we used estimates cited by Åhman and Shah[68] of one maternal death per 100,000 miscarriages occurring at a gestational age of 14–27 weeks.

   We assumed that there were two maternal deaths for every 100,000 safe abortions. This is at least double the reported rate for women having safe abortions in high-income countries[69] and is based on the assumption that differences in health system capacity would contribute to higher mortality in LMICs. For each age-group, we subtracted the estimated number of maternal deaths from miscarriages and from safe abortions from the source number of maternal deaths from abortions and miscarriages combined, and the result was the number of maternal deaths from unsafe abortions. Lacking information on the relative mortality rates from less safe versus least safe abortions, we estimated maternal deaths only from all unsafe abortions.

3.6. Newborn deaths

Definition

- **Newborn death:** death in the first 28 days of life[70]

Data sources

Data	Geographic level	Sources
Newborn mortality	Country	United Nations Inter-agency Group for Child Mortality Estimation (UN IGME) 2019[70]
Cause of newborn mortality	Country	World Health Organization Maternal Child Epidemiology Estimation (WHO-MCEE) 2017[71]

3.7. Stata do-files

The AIU-2019 Demographic estimates master do-file.do provides a description of the purpose and summary of each Stata do-file that calculates the demographic estimates.

3.8. Tables

The relevant appendix tables for this section are:

- **Methodology Report Appendix Table MA3.1:** Number and percentage distribution of women aged 15–49, by marital status for each age-group; and source of information for distribution of unmarried women into formerly married or never-married categories—all according to LMIC, 2019
- **Methodology Report Appendix Table MA3.2:** Number and percentage distribution of women aged 15–49, by selected characteristics; and number of births, by maternal age at birth—all according to LMIC, 2019
- **Methodology Report Appendix Table MA3.3:** Estimated annual number of pregnancies among women aged 15–49, by intention status and outcome, according to selected grouping of LMICs, 2019
- **Methodology Report Appendix Table MA3.4:** Number and percentage distribution of maternal deaths among women aged 15–49, by cause of death, according to age-group and selected grouping of LMICs, 2019
- **Methodology Report Appendix Table MA3.5:** Number and percentage distribution of newborn deaths, by cause of death, according to selected grouping of LMICs, 2019

Section 4: Contraceptive Need and Use

4.1. Objective

This section describes the AIU-2019 calculations for estimating contraceptive need and use for women aged 15–49 for LMICs. To calculate the contraceptive need and use distribution, we grouped women into three broad categories: women wanting to avoid pregnancy and using modern contraceptives; women wanting to avoid pregnancy and not using modern contraceptives; and women not at risk of unintended pregnancy. Women in the first two categories were further subdivided by intention to space births or limit childbearing, and those using modern contraceptives were categorized by specific method used.

4.2. Key terms and definitions

4.2.a. Pregnancy intentions

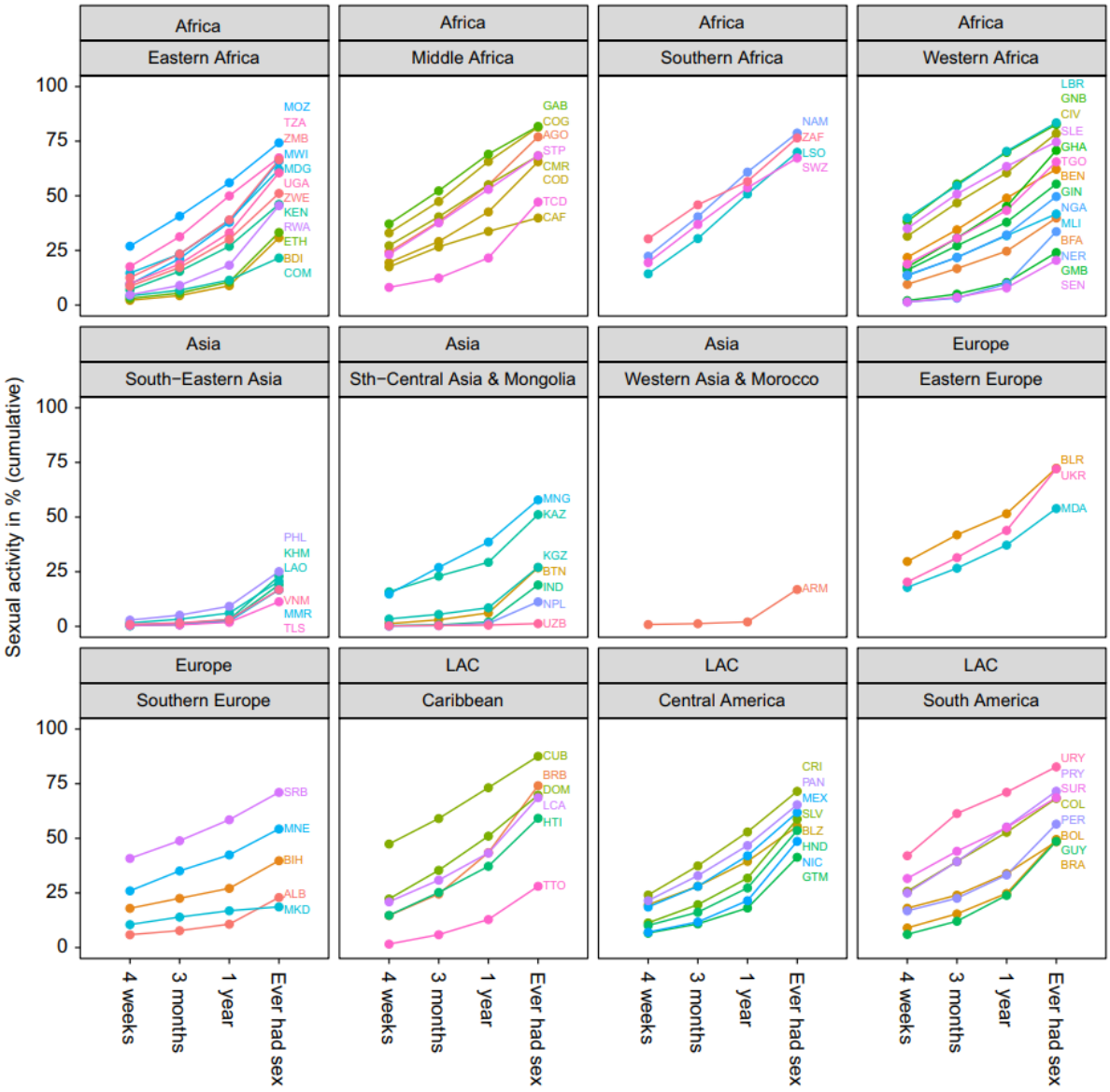
- **Wanting to avoid a pregnancy and in need of modern contraception.** Women are classified as wanting to avoid a pregnancy and needing modern contraception if they fall into any of the following categories:[13]
    - Are currently using a contraceptive method
    - Are currently married or are unmarried and sexually active (in the 30 days prior to the survey interview), are able to become pregnant, and do not want a child in the next two years or at all
    - Identify their current pregnancy as unintended
    - Are experiencing postpartum amenorrhea after an unintended pregnancy
- **Not at risk of unintended pregnancy.** All other women are classified as not currently wanting to avoid a pregnancy; these are women not at risk of having an unintended pregnancy and therefore not considered to be in need of contraceptives. Following the DHS methodology,[13] these include unmarried women who have not been sexually active in the 30 days prior to the survey interview, infecund women, women who want to have a child in the next two years, women who are currently experiencing a pregnancy they identify as intended and women experiencing postpartum amenorrhea from a pregnancy they identify as intended.

4.2.b. Related definitions used in pregnancy intentions categories

- **Sexual activity**
    - All currently married women were assumed to be sexually active. Although this is the standard assumption made by DHS and others in measuring unmet need, this definition overestimates sexual activity among married women in many LMIC settings.[72] A study on recent sexual activity in 94 LMICs found that roughly 50–94% of married women reported sexual activity in the past month.[73] Despite this variation, we retained this definition of sexual activity for married women to align with other estimates in the field.
    - Unmarried women were considered sexually active if they had had sex in the 30 days prior to the survey interview. Past Adding It Up estimates classified unmarried women as sexually active if they had had sex in the past three months. This change aligns with the

DHS definition,[13] UN Population Division estimates[11] and other evidence on measurement.[74] The level of sexual activity is likely to be underestimated among unmarried women in certain contexts due to underreporting as a result of the stigma around nonmarital sex. Findings from Ueffing et al.[73] show large variation in reported timing of sexual intercourse among unmarried women by regions, and by countries within regions, as seen in Figure 4.1 We made adjustments and estimates for these probable underestimates of sexual activity among unmarried women; more details can be found in sections 4.3.c and 4.3.d.

Figure 4.1. Timing of last sexual intercourse among unmarried women by country



Source: *"Timing of last sexual intercourse among unmarried women by country based on DHS and MICS micro datasets; most recent estimates for each country (between 1987 and 2016)" from Ueffing et al. 2019,[73] published by Cambridge University Press, was resized for clarity and reproduced as an Open Access article, distributed under the terms of the Creative Commons Attribution 4.0 International license (CC BY 4.0).*

- **Infecundity.** Women were classified as infecund if they reported that they were infecund, had had a hysterectomy or were menopausal. Per the DHS definition, we also defined women as infecund if they were not using contraceptives and were neither pregnant nor experiencing postpartum amenorrhea but had not had a menstrual period for six months or longer; or were married, had not used a contraceptive method during the past five years, had not had a birth in the past five years and were not currently pregnant.[13]
- **Intention to limit childbearing.** Women wanting to avoid a pregnancy were classified as intending to limit childbearing if they wanted no (more) children in the future.
- **Intention to space births.** Women wanting to avoid a pregnancy were classified as intending to space births if they wanted a child in the future, but not in the next two years; this includes women wanting to delay a first birth and those wanting to pause between births.

4.2.c. Contraceptive use

- **Categorization of methods.** There are a number of approaches to categorizing contraceptive methods.[75,76] While acknowledging that no one classification system meets the needs for all users, providers or researchers, the terms "modern" and "traditional" have been most often used in monitoring method use. In general, these terms distinguish methods with lower and higher use-failure rates, recognizing that use-effectiveness for many methods depends heavily on correctness and consistency of their use. We chose this categorization of methods as best suited for assessing how successfully women and their partners are able to meet their own goals for the number of children and timing of childbearing.[77]
- **Modern methods.** AIU-2019 generally followed WHO Department of Reproductive Health and Research and USAID recommendations (also followed by DHS) regarding the classification of contraceptives as "modern."[75] One small variation was with the lactational amenorrhea method (LAM), which WHO and USAID recommended to classify as modern in regions where LAM is promoted, taught and used. We were unsuccessful in identifying such regions or countries and decided to classify LAM as a modern method in all countries where its use was reported. Given the low levels of LAM use (0.39% of total method use in all LMICs in 2019), we believe this difference in classification does not have a large impact on our estimates. The UN Population Division uses a similar method classification to AIU-2019, except that it includes fertility awareness–based methods (FABM) as traditional rather than modern.[78] Because we adjusted our estimates to align with the UN Population Division's model-based estimates, we accounted for this difference in classification during the adjustment. These details are described in Section 4.5.
- **Traditional methods and nonuse.** We classified other methods as traditional, including other periodic-abstinence methods and withdrawal. We followed the WHO and USAID recommendation to classify women reporting use of herbs, charms and vaginal douching as their contraceptive methods as using no method because there is no scientific basis for these methods being effective in preventing pregnancy.[75]

4.2.d. Need and unmet need for modern contraception

All women who want to avoid a pregnancy are classified as having a need for modern contraception, including women not wanting a child in the next two years (spacing) and those wanting to cease or prevent childbearing altogether (i.e., those wanting to limit births). These women are then categorized as having one of the following:

- **Met need for modern contraception** (those who are in need and currently using modern contraceptives)
- **Unmet need for modern contraception** (those who are in need but are currently not using a method or are using a traditional method)

Other studies may not define women who are using traditional methods as having unmet need, but AIU-2019 focuses on the need for modern contraceptives because women using traditional methods face higher risk of unintended pregnancy than those using modern methods, given the generally higher use-failure rates of traditional methods.[79–85] Modern methods are most likely to help women and couples successfully meet their stated goals to postpone or stop childbearing.[77] 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 only women using no contraceptive method.

Figure 4.2 illustrates the contraceptive need and use classifications used in AIU-2019. We estimated numbers and percentages of women aged 15–49 by marital status, five-year age-groups and country, according to the categories displayed.

Figure 4.2. Classifications of the contraceptive need and use distribution

Not wanting to avoid a pregnancy	Wanting to avoid a pregnancy		
Not in need	Met need for modern contraception	Unmet need for modern contraception	
	Modern methods*	Traditional methods*	No method* (nonusers in need)
• Unmarried women who are not sexually active in past month • Women who are infecund • Women who want to have a child in the next two years, or those who are currently experiencing a pregnancy they report as intended • Women who are experiencing postpartum amenorrhea after an intended pregnancy	• Short-acting methods: injectable, pill, patch/ring, emergency contraceptive pills, male or internal (female) condom, LAM, FABM or other supply methods (e.g., spermicide foam and diaphragm) • Long-acting reversible methods: IUD, implant • Permanent methods: female or male sterilization	• Periodic abstinence/rhythm • Withdrawal • Abstinence/long-term abstinence • Breast-feeding/ long-term breast-feeding • Other nonsupply methods	• Women using no contraceptive method and wanting to delay/space childbearing for at least two years or to prevent childbearing altogether • Women who are pregnant or experiencing postpartum amenorrhea from an unintended pregnancy • Women using an ineffective method (herbs, charms, folk methods or vaginal douching)

**Those wanting to avoid pregnancy were distributed by their intention to space or limit pregnancies across contraceptive methods or reasons for nonuse.*

4.3. Data sources and estimation approaches

Data on contraceptive need and use were taken from each country's most recent national survey: DHS, MICS, Centers for Disease Control and Prevention's RHS, PMA survey, GGS, PAPFAM survey or other nonstandard national survey. For some countries, we used two or more available sources, usually applying recent (if incomplete) data (e.g., from a preliminary report of national survey findings) to update information from a prior survey. Full data on the contraceptive need and use distribution were available for 66% of all women aged 15–49 in LMICS, ranging from 55% of never-married women to 70% of formerly married women and currently married women. Download Methodology Report Appendix Table MA4.1 for the sources and data coverage on contraceptive need and use by marital status for each country. The following sections describe the imputation done for missing data.

4.3.a. Estimation approach for countries with partial data

There were varying degrees of data availability for the components of the contraceptive need and use distribution. The subsections below describe the primary types of data gaps and related assumptions made. Generally, when only partial data were available, we prioritized using weighted subregional estimates to fill the gaps, and where subregional estimates were not available, we used a proxy subregion's weighted estimate or weighted regional estimates. These estimates were weighted on the basis of relevant population numbers of women.

1. **No data on the subcategories of women not in need**
   Some countries had data on the proportion of women not wanting to avoid a pregnancy and therefore not in need of contraception, but did not have data on the distribution across subcategories of women not in need (see Figure 4.2). When this was the case, we assumed that the distribution of women across the subcategories of not in need was the same as the weighted subregional distribution of women of similar age and marital status who were not in need. If information was not available for the country's subregion, we used a proxy subregion or the weighted regional distribution.

2. **No data on women wanting to avoid a pregnancy and using no method (nonusers in need)**
   Some countries had no data on the proportion of women wanting to avoid pregnancy and not using a method, referred to in the report as "nonusers in need." When this was the case, we used the weighted subregional distribution of nonusers in need who wanted to space or limit pregnancies. If information was not available for the country's subregion, we used a proxy subregion or the weighted regional distribution.

3. **No data on wanting to space or limit births**
   Some countries had data on contraceptive method use but did not have data on the proportion of women using contraceptives to either space or limit births. When this was the case, we used the weighted subregional or regional proportions of women using a method for spacing/limiting births to allocate contraceptive method use by pregnancy intention status. Some countries had data on nonusers in need but no data on whether these women wanted to space or limit childbearing. When this was the case, we used the weighted subregional or regional distribution of nonusers in need.

4.3.b. Estimation approach for countries with no recent data

Some countries lacked recent national survey data, and we found no other suitable published data; other countries lacked data for either never-married women or formerly married women. We therefore

made estimates for these countries, accounting for 12% of all women aged 15–49 in LMICs. While we estimated contraceptive need and use distribution for only 1% of currently married women, estimation was required for 25% of formerly married and 39% of never-married women. In the general estimation approach for countries with no data, we assumed that the distributions of women by need for contraception, childbearing intention and contraceptive use were similar to women in the same age and marital status in other countries in the same subregion, a proxy subregion or region.

4.3.c. Estimation approach for never-married women in Asia and Northern Africa

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 for countries in Asia and Northern Africa, where social acceptance of sexual activity outside of marriage for women is particularly low.[73] Unmarried women are largely excluded from national surveys in Asia and Northern Africa, and where they are included, underreporting of their sexual activity is likely to be extensive. Therefore, to estimate contraceptive need and use among all sexually active women, we used data for unmarried women in countries in Eastern Asia, Southeast Asia, Oceania, Western Asia and Northern Africa from the UN Population Division's model-based estimates, which estimated sexual activity among unmarried women in countries with low or underreported sexual activity.[11,86] We used these estimates for countries in these subregions where there were no data for never-married women and for the few countries in Asia where the reported level of sexual activity was lower than these subregional estimates. These estimates were made for never-married women aged 20–49; we separately made estimates specific to adolescent women (aged 15–19), described in subsection 4.3.d.

We used the UN Population Division's model-based subregional distributions of four categories of contraceptive need and use: 1) women in need and using modern methods; 2) women in need and using traditional methods; 3) nonusers in need; or 4) women not in need. Using these UN estimates for these four categories in these subregions, we distributed women not in need and women in need of modern contraceptives into subcategories of childbearing intention and method-type (including no method). These subcategories were based on the AIU-2019 weighted distribution of never-married women in countries in Asia with available data.

4.3.d. Estimation approach for sexually active, never-married adolescent women

We used country-specific studies to estimate sexual activity for never-married adolescent women aged 15–19. We estimated that 4% were sexually active in Southern Asia, on the basis of a six-state study in India; [87] 4% were sexually active in Eastern Asia, on the basis of data from China[88] and the Mongolia 2013 MICS; 2% were sexually active in Central Asia, on the basis of the Kazakhstan 2015 MICS; and 4% were sexually active in Southeast Asia, on the basis of the Philippines 2017 DHS. We used these subregional values for countries in each subregion that lacked data or had a survey estimate of sexual activity that was lower than these levels. For countries in Northern Africa and Western Asia, we used the weighted average of 4% from other subregions in Asia.

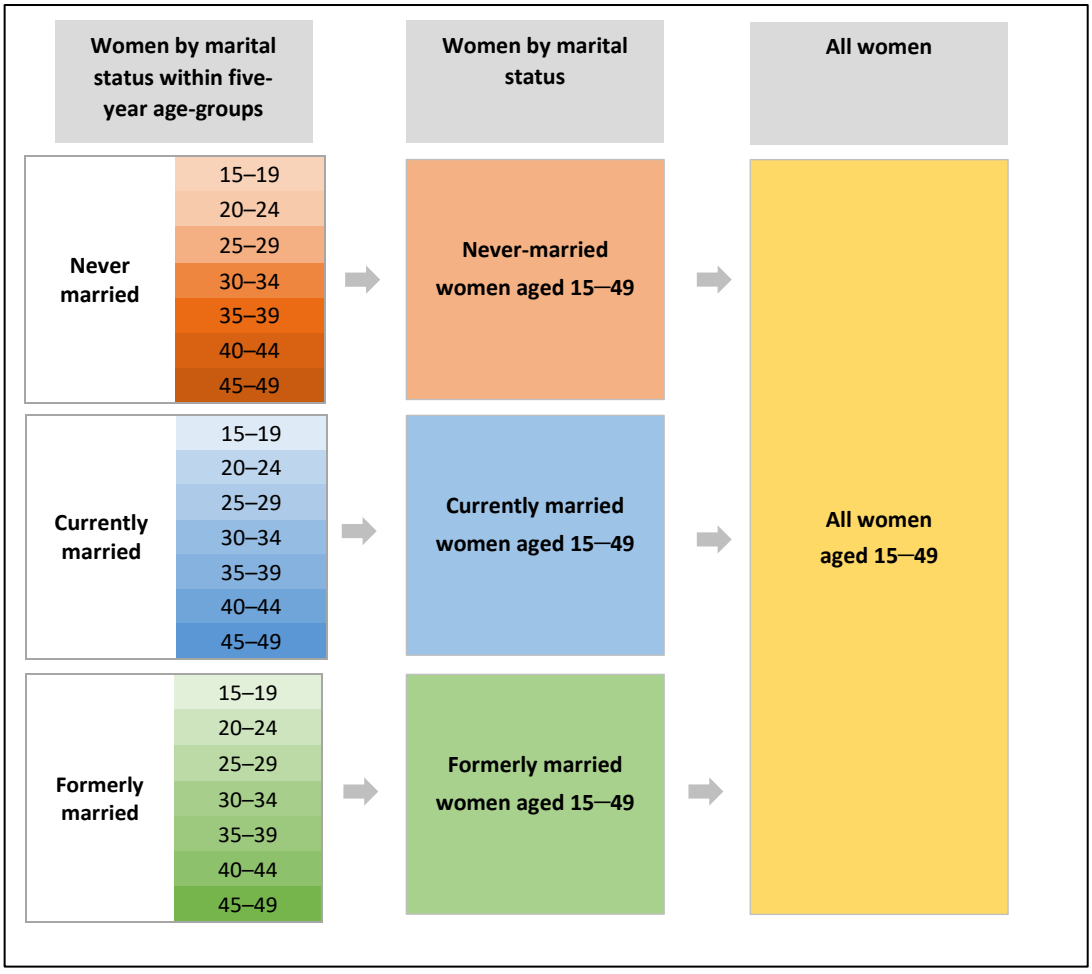
After imputing these sexual activity estimates for adolescents in these subregions, we finalized the distribution of contraceptive method use and unmet need for contraception using the weighted regional estimates of countries in Asia with available survey data.

Stata do-files CP_01_Estimation and imputation for missing data.do and CP_1B_Estimation for incomplete data among never-married women.do provide the calculations and more details of estimation.

4.4. Analysis approach

Estimates of contraceptive need and use were calculated separately for currently married, formerly married and never-married women by five-year age-groups and summed to obtain estimates for women by marital status and for all women of reproductive age (Figure 4.3). We applied the contraceptive need and use percentage distributions to the estimated numbers of women in 2019 by age and marital status, and summed these age-group estimates to calculate the numbers and distribution of contraceptive need and use for all women aged 15–49 and for each marital status category. This approach yielded total estimates that reflect the age and marital status distributions of women aged 15–49 in 2019, rather than the distribution of contraceptive need and use at the time of the survey data collection for each country.

Figure 4.3. Analytical approach to obtain contraceptive need and use estimates for women by marital status and for all women of reproductive age



We also estimated the contraceptive need and use distribution of women aged 15–49 according to marital status by three other subgroups: household wealth quintile, residence (rural or urban) and parity (none or one birth or more). We needed to ensure that the estimated sums of the contraceptive need and use distribution for women in the wealth, residence and parity subgroups were consistent with the totals in our age-specific tabulations. To do this, we multiplied the resulting numbers in each need and use category by the ratio of the total number of women aged 15–49 by marital status in 2019 to the sum of the comparable estimates for each subgroup (wealth, residence, parity). Full details and calculations of this approach can be found in Stata do-file CP_02_ Calculate CP numbers by subgroups.do.

4.5. Adjustment to UN Population Division's model-based estimates of family planning indicators

After estimating the full contraceptive need and use distribution for all countries and accounting for any missing data, we aligned the distribution with the UN Population Division's model-based estimates of the proportions of married and unmarried women using contraceptives and having unmet need in 2019.[11]

The UN model-based estimates provided the number of married and unmarried women classified as: 1) using modern contraceptives, 2) using traditional methods or 3) nonusers in need. First, to account for the entire contraceptive need and use distribution, we calculated the number of women not wanting to avoid a pregnancy and therefore not in need of modern contraception (this fourth group is referred to as "not in need"). We calculated the number not in need as the remaining population (from WPP 2019)[43] not accounted for in the first three groups.

Second, we aligned AIU-2019 estimates with the UN model–based estimates of married and unmarried women in each country who are: 1) using modern contraceptives, 2) using traditional methods 3) nonusers in need or 4) not in need. For each of the four groups, we calculated country-specific adjustment ratios for married and unmarried women by dividing the UN model–based estimate by the AIU-2019 estimate. For this adjustment only, AIU-2019 aligned with the UN classifications and considered FABM and herbs/roots to be traditional methods. Out of total method use, only 0.03% was FABM and 0.001% was herbs/roots for all LMICs. These country-specific married and unmarried adjustment ratios were applied to all respective marital status groups within each age-group and subgroup (wealth, residence and parity) in that country.

Third, we had to account for both inflation and deflation when the sum of the number of modern contraceptive users, traditional users, nonusers in need and women not in need was either more or less than a country's WPP 2019 population numbers after the adjustment. Therefore, we had to make another adjustment to ensure that a country's population numbers aligned with WPP 2019 age and marital status population numbers, and that a country's total number of modern contraceptive users, traditional users and nonusers in need in AIU-2019 was equivalent to the UN model–based estimates to meet our goal of aligning with these estimates. Consequently, we made a further adjustment, if needed, to maintain the population total for each marital status or age-group. When there was an excess population in an age-group or marital status group, we subtracted this excess population from the number of women not in need. When there were too few total women compared with the age- or marital-status group population, we added this difference to the number of women not in need. Adjustments were made to the group of women not in need because of the goal of aligning with the UN estimates of modern contraceptive users, traditional users and nonusers in need. Alignment on

contraceptive users and women with an unmet need was prioritized, given the particular relevance of these grounds toward estimating the current and expanded provision of contraceptive services. When the difference between the WPP 2019 population numbers and the postadjustment population was less than 1,000 women, we maintained the population number postadjustment because the difference was minimal. Stata do-file CP_03_Adjustment to UN Population Division model-based estimates.do contains all of the calculations of this adjustment.

4.6. Assumptions used across scenarios

As discussed in Section 2.2, we estimated levels of contraceptive need and use across scenarios of no care and meeting all needs for contraception, and made some assumptions across these scenarios.

- In the hypothetical no-care scenario, we assumed that all women wanting to avoid a pregnancy would not use modern methods and that there would be no change in the proportions of women wanting to avoid a pregnancy or in women currently using traditional methods or no method. We assumed no change in the factors affecting the proportions of women wanting to avoid a pregnancy, such as marital status, sexual activity, fecundity and childbearing intention.
- In the scenarios where all needs for modern contraception were met, we assumed that women wanting to avoid a pregnancy and currently using either 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 assumed that additional modern contraceptive users would adopt the same method mix (i.e., percentage distribution) of modern methods as current modern method users in their country with the same characteristics—age, marital status and childbearing intentions. We assumed no change in the proportions of women wanting to avoid a pregnancy.

4.7. Stata do-files

The AIU-2019 Contraceptive need and use master do-file.do provides a description of the purpose and summary of analysis steps for each do-file within the contraceptive need and use component of this analysis.

4.8. Tables

The relevant appendix tables for this section are:

- **Methodology Report Appendix Table MA4.1:** Data source and extent of data coverage for contraceptive need and use distribution, by marital status, according to LMIC
- **Methodology Report Appendix Table MA4.2:** Number and percentage distribution of women aged 15–49, by contraceptive need and method use for each marital status, according to LMIC, 2019
- **Methodology Report Appendix Table MA4.3:** Number and percentage distribution of adolescent women aged 15–19, by contraceptive need and method use, according to LMIC, 2019
- **Methodology Report Appendix Table MA4.4:** Number and percentage distribution of women aged 15–49, by contraceptive need and method use, according to marital status and selected grouping of LMICs, 2019

- **Methodology Report Appendix Table MA4.5:** Number and percentage distribution of women aged 15–49, by contraceptive need and method use—all according to age-group, household wealth, residence, parity and selected grouping of LMICs, 2019
- **Methodology Report Appendix Table MA4.6:** Number and percentage distribution of women aged 15–49 wanting to space or limit births, by contraceptive need and method use, according to selected grouping of LMICs, 2019
- **Methodology Report Appendix Table MA4.7:** Number of additional and total users of modern contraceptive methods among women aged 15–49 if all needs for modern contraception were met, according to selected grouping of LMICs, 2019

Section 5: Pregnancy-Related and Newborn Care Need and Coverage

5.1. Objective

This section describes the process for estimating the need for and coverage of essential pregnancy-related and newborn care in LMICs. AIU-2019 includes a set of 84 interventions deemed essential pregnancy-related and newborn care, according to guidance from WHO and other international sources or experts.[89–93] The interventions comprise a wide range of health care services, organized into the following groupings by type of care:

1. Induced abortion services
2. Postabortion care (PAC) for induced abortion or miscarriage complications
3. Ectopic pregnancy care
4. Antenatal care (ANC)
5. Care before labor and for preterm labor
6. Care for obstetric complications
7. Care for noncomplicated deliveries
8. Postnatal care
9. Newborn care
10. HIV care for pregnant/postpartum women and their newborns

For each pregnancy-related and newborn care intervention, we estimated:

- **Need** as the proportion of pregnant women by subgroup of pregnancy outcome (live birth, stillbirth, miscarriage or induced abortion) for whom care is recommended
- **Coverage** as the proportion of women in need of each intervention who were estimated to receive the relevant care

The subsections below describe the need and coverage assumptions used for each of the 84 interventions (see Methodology Report Appendix Table MA1.2 for a list of all interventions). Each intervention is numbered for ease of reference throughout this section and in the relevant methodology report appendix tables and Stata do-files. The following Stata do-files provide details on and calculations of the estimated need and coverage estimates for all pregnancy-related and newborn care interventions for the current-levels-of-care and all-needs-met scenarios:

- **Current levels of care:**
  - PRNC_2A_Input assumptions_need_current.do
  - PRNC_2B_Input assumptions_coverage_current.do

- **All needs met:** We assumed 100% coverage (i.e., that all needs would be fully met) for most interventions. Details for interventions where we assumed less than 100% coverage or different levels of need are outlined in the tables in this section. These exceptions are also detailed in Stata do-file PRNC_2C_Input assumptions_all needs met.do.

All treatment assumptions for each intervention can be found in Methodology Report Appendix Table MA1.3 (which follows the same intervention numbering).

5.2. Data sources

Need. On the basis of service recommendations or from published estimates of incidence or prevalence of specific pregnancy-related conditions, we defined need for each intervention as the estimated proportion of pregnant women or newborns in each country who required the intervention. We estimated the proportions of women in need of services by subgroup of pregnancy outcome (live birth, stillbirth, miscarriage or induced abortion). We then applied these proportions to the relevant numbers of births, stillbirths, miscarriages or induced abortions by pregnancy intention (intended or unintended). Details on the need assumptions for each intervention are outlined in the subsections below.

Coverage. For each intervention, we defined coverage as the estimated proportion of pregnant women or newborns in each country who received the needed intervention. These "met need" estimates were drawn from survey information for the most recent birth in the time period covered in the national survey—usually the past two years, as with MICS, or three years, as with DHS—and other published studies, including estimates developed for the Lives Saved Tool (LiST),[94] the OneHealth Tool[95] and the Spectrum AIDS Impact Model.[96] We applied these coverage proportions to the relevant numbers of births, stillbirths, miscarriages or induced abortions defined as in need of each intervention.

The following tables provide the intervention number, the intervention name, and the data sources and assumptions we used to define need and coverage for each intervention. Many of these estimates were taken from tabulations of DHS and other national surveys; other data sources used in the estimates are cited in the tables. See Methodology Report Appendix Table MA5.1 for the national surveys used for each LMIC.

5.3. Estimation approach

Wherever possible, we used the most recent country-specific data available. If data were not available, we used the following estimates, in order of priority, to impute missing data: the country's subregion, a neighboring country, or a proxy subregion or region. These estimates were weighted by the relevant number of births. The Stata do-file PRNC_01_Estimation and imputation for missing data.do provides further details on imputation for countries with missing data.

Assumptions used across interventions. For many interventions, there were no specific coverage data available from national surveys (e.g., DHS, MICS) or other sources. We therefore used coverage for two health services as proxies: four or more ANC visits and level of emergency obstetric care (EmOC). We used four or more ANC visits because we assumed that if pregnant women received this level of ANC, then certain services would have been provided to them and complications could have been identified and addressed. The level of EmOC—either basic or comprehensive—was used as a proxy for interventions that would require corresponding care (i.e., basic or comprehensive).

1. **Four or more ANC visits**
   We considered women who had four or more antenatal visits—at least one of which was with a skilled provider (i.e., midwife, nurse or doctor)—as having received the standard level of care.[93] In 2016, WHO updated its minimum recommended level of care from four antenatal visits to eight contacts with the health system during pregnancy, including through community outreach.[90] However, the survey data are not sufficiently detailed to measure this updated standard of care, as the available data cannot be used to distinguish antenatal visits from the broader contacts with the health system.

In DHS, MICS and other national surveys, women are asked to identify the type of health provider who provided them with ANC. We used country classifications to define which types of providers were considered skilled for each country. In most countries, this included physicians, midwives and nurses. For countries with data available only from reports, rather than data sets, we often had only data on the proportion of women who had four or more ANC visits and therefore assumed that these women had had at least one visit with a skilled provider. Methodology Report Appendix Table MA5.3 provides estimates of the proportions of women with live births who had received any ANC from a skilled provider and the proportions who had made four or more or eight or more ANC visits—at least one of which with a skilled provider—by selected country groupings.

2. Level of EmOC

Not all facilities at which women deliver may be equipped to provide care for the range of complications that may occur. EmOC comprises a suite of services that address complications that may arise during pregnancy and childbirth, and health facilities can be defined as having a certain level of EmOC services available. Basic EmOC facilities are assumed to meet WHO's guidelines for basic emergency services that treat or refer women with pregnancy-related complications and newborns with complications.[97] Examples of such services include administering parenteral antibiotics, oxytocics and anticonvulsants.[97] Comprehensive EmOC facilities are assumed to meet WHO's guidelines for basic essential services to treat complications in addition to having surgical capacity, for such procedures as cesarean section, and the ability to perform blood transfusions.[97] A list of the type of care available at each facility level can be found in Methodology Report Appendix Table MA5.2.

For interventions lacking specific coverage data, we assumed that coverage was equivalent to the proportion of deliveries in basic EmOC facilities if the intervention did not require surgical care. When an intervention did require surgical care, we assumed that coverage was equivalent to the proportion of deliveries in comprehensive EmOC facilities. Lacking national-level estimates of the proportion of births in basic or comprehensive EmOC facilities, we used the assumptions from LiST[94] outlined in Table 5.1. Using an analysis of a small and limited subset of health facility assessments conducted in a few countries, LiST assumed a distribution across levels of emergency care capability based on the proportion of total country deliveries that occur in any health facility.[98] For example, in a country where 75% of deliveries are in a facility, we assumed that 15% of facility deliveries were in a basic EmOC facility and that all women delivering in a basic EmOC facility received any intervention that can be provided in such a facility.

Table 5.1. LiST assumptions of levels of EmOC

% of deliveries that occur in facilities	% distribution of deliveries in each level of EmOC facility			
	Neither basic nor comprehensive EmOC facilities	Basic EmOC facilities	Comprehensive EmOC facilities	Total
<30	90	0	10	100
30–49	50	30	20	100
50–94	25	15	60	100
≥95	0	0	100	100

5.4. Analysis approach

This section describes the need and coverage assumptions for all 84 pregnancy-related and newborn interventions, organized by type-of-care groupings.

1. Induced abortion services

For women having an abortion, WHO recommends the least invasive abortion procedures, depending on gestation (the number of weeks since the woman's last menstrual period).[91,92] Procedures include manual or electric vacuum aspiration, dilation and evacuation, or medication abortion (using the drugs mifepristone and misoprostol, or misoprostol alone where mifepristone is not available).

#	Intervention	Need	Coverage
101–102	Induced abortion services for safe and less safe abortions	We assumed that women obtaining abortions need to obtain abortions in safe conditions.[91,92,99]	We assumed that all abortions classified as safe meant that women receive safe abortion care. For abortions classified as less safe, we assumed an abortion method distribution by geographic region based on expert opinion, found in Methodology Report Appendix Table MA5.8. We assumed that no direct health systems costs are incurred for least safe abortions, so we did not estimate service provision for least safe abortions. Estimation of the safety of induced abortions in each country—based on Ganatra et al.[59] and country-specific estimates, when available[60–63]—is described in Section 3.4. We also produced a hypothetical scenario to assess the health impact and cost if all abortions were safely provided, thus reducing the risk of complications and death. Under this hypothetical scenario, coverage of safe abortion care would include all women who receive unsafe abortions.

2. Postabortion care for induced abortion or miscarriage complications

Some women who have an induced abortion or a miscarriage experience complications requiring medical care. WHO provides guidelines for management of postabortion complications, such as hemorrhage or infection, which are most likely to occur when abortions are performed in unsafe conditions. In addition to medical treatments for specific complications, WHO standards call for vacuum aspiration or treatment with misoprostol, rather than more invasive surgical methods, for incomplete first-trimester abortions. WHO guidelines recommend contraceptive counseling and services for all

abortion patients;[91,92] we included the need for and coverage of contraceptive counseling and services for all women wanting to avoid a pregnancy under the contraceptive interventions (described in Section 4) and did not include them separately as part of PAC.

We used estimates from country-specific studies, prior AIU estimates and abortion safety classifications to make assumptions about estimated abortion complications that require PAC. Given the lack of data on differential abortion complications between less and least safe abortions, we summed less and least safe abortions for the total number of unsafe abortions.

- Complication rate for safe abortions: For countries in Eastern Asia, Southern Europe and Eastern Europe, we followed prior estimates that 1% of safe abortions in these subregions result in complications.[17] For the remaining countries, we estimated that 3% of safe abortions result in complications, on the basis of country-specific data available on abortion from Nepal and Ethiopia.[61,100]

- Complication rate for unsafe abortions: For countries in Eastern Asia, Southern Europe and Eastern Europe, we assumed that unsafe abortions in these subregions have the same complication rate as safe abortions because almost all of the unsafe abortions in these subregions are classified as being less safe, meaning they are performed either by trained providers or using the recommended methods.[59] Because it is likely that these less safe abortions result in fewer complications than least safe abortions (i.e., those performed neither by a trained provider nor using a recommended method), and because of a lack of any data on complication rates, we assumed the same complication rate for safe and unsafe abortions in these subregions.

  For the remaining countries, we used prior research on abortion complications in settings where unsafe abortion is prevalent that found that 40% of all abortions result in complications.[99] Estimating that 3% of safe abortions result in complications, we calculated that 62% of unsafe abortions would result in complications in order for all safe and unsafe abortions together to result in 40% with complications. We made two country exceptions, given country-specific estimates, and estimated an unsafe abortion complication rate of 44% for both Nepal[63] and Bangladesh.

We classified abortion complications as either severe or nonsevere because of the different types of treatment required for these two types of complications. We made assumptions based on abortion researchers' expert opinion and review of literature[63,101–105] describing the proportions of types of complications, which can be found in Table 5.2. Because of a lack of data, we assumed the same proportions of types of complications regardless of abortion safety. We also used the same proportions in the scenario where we assumed that all abortions are provided safely, which likely overestimated the severity of complications and thus PAC costs in that scenario.

Table 5.2. Proportion of types of abortion complications, applied to all LMICs

Complication type	% of abortion complications
Nonsevere	
Incomplete abortion	77
Nonsevere bleeding	57
Severe	
Severe hemorrhage	32
Shock	7
Uterine perforation/cervical laceration	6
Sepsis	13
Total	192

Abortion complications can entail more than one type of complication; a woman can experience both bleeding (considered nonsevere) and sepsis (considered severe). This means that the sum of the number of abortions with each type of complication can be greater than the total number of abortions with any complication. Therefore, we summed the number of abortions with each specific nonsevere or severe complication and divided the total of the two sums by the total number of abortions with any complication. This resulted in our estimating that 70% of complications are nonsevere and 30% severe. See Stata do-file PRNC_2A_Input assumptions_need_current.do for these calculations.

#	Intervention	Need	Coverage
PAC for complications from induced abortion			
201	PAC for incomplete abortion and nonsevere bleeding	We assumed complication rates as described and that 70% of these complications are nonsevere.	We assumed that all complications from safe abortions receive PAC. We assumed that all complications from unsafe abortions in Eastern Asia, Southern Europe and Eastern Europe receive PAC. We assumed that 60% of all abortion complications in countries outside of Eastern Asia, Southern Europe and Eastern Europe are treated, on the basis of an estimate of abortion complications and care from 14 countries where unsafe abortion is prevalent.[99] Using this estimate and our assumption that all safe abortions with complications received treatment, we estimated that 58% of unsafe abortions with complications receive treatment in countries outside of Eastern Asia, Southern Europe and Eastern Europe. See Stata do-file PRNC_2B_Input assumptions_coverage_current.do for these calculations.
202	PAC for abortion complications needing comprehensive EmOC	We assumed complication rates as described and that 30% of these complications are severe and need comprehensive EmOC.	
203	Prereferral management of abortion complications	We assumed that the need for prereferral management of abortion complications is equivalent to the proportion of women needing treatment	We assumed that coverage is equivalent to the proportion of deliveries not receiving care in comprehensive EmOC facilities.

#	Intervention	Need	Coverage
		in a comprehensive EmOC facility who do not receive care in a comprehensive EmOC facility or receive no medical care.	
PAC for complications from miscarriage			
204	Miscarriage care for miscarriage at 14–27 weeks' gestation	We assumed that 20% of miscarriages that occur at less than 28 weeks' gestation take place in weeks 14–27.[56,57] See Section 3.3 for more details on estimating miscarriages by gestational age. We assumed that all women with miscarriage at 14–27 weeks need care.[106]	We assumed that coverage is equivalent to the proportion of deliveries in EmOC facilities.
205	Miscarriage care for miscarriage at 6–13 weeks' gestation	We assumed that 80% of miscarriages that occur at less than 28 weeks' gestation take place in weeks 6–13.[56,57] See Section 3.3 for more details on estimating miscarriages by gestational age. We assumed that 25% of miscarriages at 6–13 weeks need care.[106,107]	We assumed that coverage is equivalent to the proportion of deliveries in health facilities because this intervention generally requires less-intensive care than interventions at later gestations.

3. Ectopic pregnancy care

An ectopic pregnancy is a complication of pregnancy in which the embryo implants outside of the uterine cavity. Most ectopic pregnancies occur in a fallopian tube, but implantation can also occur in the cervix, ovaries or abdomen. We assumed that ectopic pregnancies are equal to 2% of live births plus induced abortions, on the basis of an analysis of data from the early 1990s by researchers at the Centers for Disease Control and Prevention.[108]

#	Intervention	Need	Coverage
301	Ectopic pregnancy evaluation	We assumed that all ectopic pregnancies need evaluation.	Lacking specific coverage data, we assumed that coverage is equivalent to the proportion of women with at least 4 ANC visits.
302	Ectopic pregnancy case management	Following assumptions used in the OneHealth Tool model,[95] we assumed that half of all ectopic pregnancies (i.e., 1% of live births plus induced abortions) need surgical treatment, including a laparoscopy or laparotomy.	We assumed that coverage is equivalent to the proportion of deliveries in comprehensive EmOC facilities, because this intervention requires surgical treatment.

4. Antenatal care

Essential interventions for ANC were based primarily on WHO recommendations.[90,93,109–118] The testing and treatment of pregnancy-related STIs, including syphilis, gonorrhea and chlamydia, are included within ANC. (Section 6 describes the estimation of need and coverage for the treatment of major curable STIs for all women of reproductive age.)

We assumed that women having a miscarriage before 28 weeks' gestation require the same care as other pregnant women at this stage of their pregnancy. Because miscarriage can occur at any point up to 28 weeks' gestation, we assumed that the average occurrence of a miscarriage is around 12–14 weeks, or approximately the length of one trimester. Therefore, we assumed that miscarriage care is needed for one-third (one out of three trimesters) of a full-term pregnancy. The specific assumptions for estimating need and coverage for women having a miscarriage or women giving birth (whether live birth or stillbirth) are noted for each of the following ANC interventions. We assumed that women with live births and those with stillbirths receive care at the same levels.

#	Intervention	Need	Coverage
401	Basic ANC	We assumed that all women giving birth need at least 4 ANC visits. For women having a miscarriage before 28 weeks' gestation, we assumed that they require an average of 2 visits prior to the miscarriage.	We used the number of ANC visits reported by women in the DHS and other national surveys as current coverage. For the all-needs-met scenario, we assumed that all women giving birth have the WHO-recommended 8 visits and that those having a miscarriage before 28 weeks' gestation have at least 2 visits.
402	Breast-feeding counseling during ANC	WHO recommends that women be counseled to breast-feed exclusively for 6 months after delivery; 2 such counseling sessions should occur during ANC. We assumed that all women giving birth need 2 antenatal sessions for breast-feeding counseling.	Lacking specific coverage data, we assumed that half of women with at least 4 ANC visits receive the 2 recommended breast-feeding counseling sessions.
403	Tetanus toxoid immunization	Neonatal tetanus can be prevented by immunizing women of childbearing age with tetanus toxoid, which protects the mother and her baby (through a transfer of tetanus antibodies to the fetus).[119] We assumed that all women giving birth and all women having a miscarriage before 28 weeks' gestation need 2 doses of tetanus immunization during pregnancy.[119]	We used the proportion of women with live births who receive at least 2 tetanus injections during pregnancy from tabulations of DHS, MICS and other national surveys. For women having a miscarriage before 28 weeks' gestation, we made estimates for coverage based on tabulations of tetanus toxoid coverage from available survey

#	Intervention	Need	Coverage
			data. We assumed that those with fewer than 2 visits have at least 2 tetanus shots, in a ratio of 39% of the country's level among women giving birth, and that those with at least 2 visits have a ratio of 97% of the country's level among women giving birth.[17,120] See Stata do-file PRNC_2B_Input assumptions_coverage_current.do for this calculation.
404	Syphilis screening	WHO recommends that all pregnant women be screened for syphilis at their initial ANC visit and shortly before birth, and that they be treated, if needed, for their own health and to prevent mother-to-child transmission.[109,121] We assumed that all women giving birth or having a miscarriage before 28 weeks' gestation need to be screened for syphilis.[121]	We assumed that coverage is equivalent to the country-specific proportion of pregnant women who receive syphilis screening reported in Supplementary File 2, in Korenromp et al.,[122] multiplied by the proportion of women with any ANC from a skilled provider from the DHS and other national surveys.
405–406	Syphilis treatment	All women who test positive for syphilis need treatment. Recommended treatment differs if the country has a high prevalence of syphilis (defined as >5%) versus a low prevalence.[110] Therefore, we included separate interventions for syphilis treatment in low- and high-prevalence countries. Estimates of maternal syphilis prevalence are from Supplementary File 2 in Korenromp et al.[122]	We assumed that coverage is equivalent to the country-specific proportion of pregnant women who receive both syphilis screening and treatment reported in Supplementary File 2, in Korenromp et al.,[122] multiplied by the proportion of women with any ANC from a skilled provider from the DHS and other national surveys.
407	Gonorrhea treatment	WHO does not explicitly recommend routine screening for gonorrhea during pregnancy. However, WHO does recommend treatment of gonococcal conjunctivitis in newborns,[123] and estimating need for gonococcal conjunctivitis treatment requires estimating maternal infection prevalence. We assumed that women with gonorrhea during pregnancy need treatment for their own health and to prevent transmitting gonorrhea to their newborns.[124] We assumed that the proportion of women giving birth or having a miscarriage before 28 weeks' gestation who need treatment of gonorrhea is equal to the regional incidence rates of gonorrhea for women of reproductive age from Rowley et al.[125]	We assumed that current treatment coverage would apply to symptomatic women only because of a lack of data on the availability of etiological testing. We assumed that symptomatic cases would be identified via syndromic management that would occur throughout the course of ANC. We used the estimate that 34% of women with gonorrhea are likely to develop symptoms from Supplementary File 4 in Newman et al.[126] Thus, given the absence of specific coverage data, we assumed that coverage is equivalent to the proportion of women giving birth

#	Intervention	Need	Coverage
			who have at least 4 ANC visits multiplied by the estimated 34% of women with gonorrhea who are likely to have symptoms. For women having a miscarriage before 28 weeks' gestation, we assumed that coverage is equivalent to the proportion of women with at least 2 ANC visits multiplied by the same symptomatic rate.
408	Chlamydia treatment	WHO does not explicitly recommend routine screening for chlamydia during pregnancy. However, WHO does recommend treatment of chlamydial conjunctivitis in newborns,[123] and estimating need for chlamydial conjunctivitis treatment requires estimating maternal infection prevalence. We assumed that women with chlamydia during pregnancy need treatment for their own health and to prevent transmitting chlamydia to their infants.[111,124] We assumed that the proportion of women giving birth or having a miscarriage who need chlamydia treatment is equal to the regional incidence rates of chlamydia for women of reproductive age from Rowley et al.[125]	We assumed that current treatment coverage would apply to symptomatic women only because of a lack of data on the availability of etiological testing. We assumed that symptomatic cases would be identified via syndromic management that would occur throughout the course of ANC. We used the estimate that 17% of women with chlamydia are likely to develop symptoms from Supplementary File 4 in Newman et al.[126] Thus, given the absence of specific coverage data, we assumed that coverage is equivalent to the proportion of women giving birth who have at least 4 ANC visits multiplied by the estimated 17% of those with chlamydia who are likely to have symptoms. For women having a miscarriage before 28 weeks' gestation, we assumed that coverage is equivalent to the proportion of women with at least 2 ANC visits multiplied by the same symptomatic rate.
409	Calcium supplementation for prevention of preeclampsia	WHO recommends that all pregnant women in populations with low dietary calcium intake receive calcium supplementation to reduce the risk of preeclampsia.[112]	Lacking specific coverage data, we assumed that all women giving birth who have at least 4 ANC visits receive calcium supplementation.

#	Intervention	Need	Coverage
		Using recommendations from Cormick et al.,[127] we defined low intake as <800 mg/day, and assumed that all women giving birth and living in a country with a mean calcium intake <800 mg/day need calcium supplementation to reduce their risk of preeclampsia.[128] We assumed that women having a miscarriage did not need calcium supplementation.	
410	Hypertensive disorder case management: high blood pressure without proteinuria	Women with conditions associated with high blood pressure during pregnancy may develop a more serious condition during their pregnancy and therefore require monitoring and relevant treatment. We used regional estimates of preeclampsia and eclampsia from Abalos et al.[129] From Zhang et al., we estimated that 48.6% of women with hypertensive disorder of pregnancy develop preeclampsia and/or eclampsia.[130] We assumed that the need for treatment of high blood pressure without proteinuria among women giving birth is equivalent to the proportion of women with hypertensive disorder of pregnancy minus the estimated proportion of women with eclampsia and preeclampsia. As the majority of miscarriages are likely to occur before screening would be provided, we assumed that there is no need for treatment among women having a miscarriage.	We assumed that all women giving birth who have at least 4 ANC visits and a urine test receive hypertensive disorder case management.
411–412	Preeclampsia case management of mild cases	We assumed that all women giving birth with mild preeclampsia need treatment. We used regional estimates of preeclampsia from Abalos et al.,[129] and estimated that 78% of women with preeclampsia have mild preeclampsia.[130] Given the different treatment requirements for mild preeclampsia depending on gestational age, we included two interventions by gestational age. Lacking data on timing, we assumed that half of these women with preeclampsia develop it before 37 weeks' gestation and half at 37 weeks or later. As the majority of miscarriages are likely to occur before screening and treatment would be provided, we assumed that there is no need	For cases before 37 weeks' gestation, we assumed that coverage is equivalent to the proportion of women giving birth who have at least 4 ANC visits and receive a urine test during ANC. For cases at 37 weeks' gestation or later, we assumed that coverage is equivalent to the proportion of women giving birth who have at least 4 ANC visits and receive a urine test multiplied by the estimated proportion of births that occur in EmOC facilities, because treatment at ≥37 weeks' gestation

#	Intervention	Need	Coverage
		for treatment among women having a miscarriage.	involves care that requires EmOC capacity.
413	Preeclampsia case management of severe cases	WHO recommends that women with severe preeclampsia need magnesium sulfate to prevent and treat seizures.[113] We assumed that all women giving birth who have severe preeclampsia need treatment. We used regional estimates of preeclampsia from Abalos et al.,[129] and estimated that 22% of women with preeclampsia have severe preeclampsia.[130]	We assumed that coverage is equivalent to the proportion of women giving birth who have at least 4 ANC visits and receive a urine test multiplied by the estimated proportion of births that occur in EmOC facilities, because treatment involves care that requires EmOC capacity.
414	Soil-transmitted helminth infection treatment	Infection with soil-transmitted helminths causes intestinal bleeding that can lead to anemia and protein malnutrition, which can, in turn, result in poor pregnancy outcomes and maternal mortality.[131,132] WHO recommends treatment for these parasites in the second and third trimesters of pregnancy in countries where the prevalence of any soil-transmitted helminth infection (ascariasis, trichuriasis or hookworm infection) exceeds 20%.[114] We estimated country-specific prevalence of soil-transmitted helminths as the sum of ascariasis, trichuriasis and hookworm infection prevalence among women of reproductive age from the GBD 2017 study.[66] We assumed that women giving birth in countries where the prevalence is greater than 20% need treatment.[114] We assumed that pregnant women having a miscarriage do not need treatment.	We assumed that coverage is equivalent to the proportion of women giving birth who have any ANC from a skilled provider and who take medication for intestinal parasites during pregnancy, as reported in DHS and other national surveys.
415	Malaria prevention: insecticide-treated bed nets	Malaria infection during pregnancy can lead to anemia and severe disease, with a high risk of maternal mortality, pregnancy loss and poor infant outcomes.[133] Use of insecticide-treated bed nets (ITNs) is the primary strategy recommended for protection from infective mosquito bites.[134] We estimated that the need for ITNs among women giving birth is equivalent to the country-specific proportion of the total population at risk of malaria from the WHO	We assumed that coverage for women giving birth or having a miscarriage is equivalent to the proportion of women aged 15–49 who report sleeping under an ITN (data from DHS Program STATcompiler).[136]

#	Intervention	Need	Coverage
		2018 World Malaria Report.[135] We made the same assumption for women having a miscarriage before 28 weeks' gestation.	
416	Malaria prevention: intermittent preventive treatment in pregnancy	WHO recommends that pregnant women at risk for malaria in Africa receive intermittent preventive treatment in pregnancy (IPTp) with sulfadoxine/pyrimethamine during ANC.[115] There is currently insufficient evidence to support a general recommendation for the use of IPTp with sulfadoxine/pyrimethamine outside of Africa.[115] We assumed need for IPTp among women giving birth as equal to the proportion of the population at risk in countries in Africa from the WHO 2018 World Malaria Report.[135] We made the same assumption for women having a miscarriage before 28 weeks' gestation.	We assumed that coverage for women giving birth or having a miscarriage is equivalent to the proportion of most recent births where the mother received IPTp during ANC (data from DHS Program STATcompiler).[136]
417–420	Malaria diagnosis and treatment: nonsevere malaria cases during pregnancy	We estimated the need for diagnosis and treatment of nonsevere malaria among pregnant women in countries with a malaria incidence >0.[137] We included four interventions for diagnosis and treatment separately for both the first trimester and for the second and third trimester because of differentials in recommended treatment by trimester. We assumed that need among pregnant women in the first trimester is equivalent to one-third of the estimated annual incidence of malaria, and that need among pregnant women in the second and third trimester is equivalent to two-thirds of the estimated annual incidence of malaria.[137] We assumed that need among women having a miscarriage in the first or second trimester is equivalent to one-third of the estimated annual incidence of malaria for each trimester.[137]	We assumed that coverage in the first trimester is equivalent to the proportion of women who start ANC in the first trimester (data from DHS Program STATcompiler).[136] We assumed that coverage in the second and third trimester is equivalent to the proportion of women who have at least 4 ANC visits, as reported in DHS and other national surveys.

#	Intervention	Need	Coverage
421	Severe malaria treatment	We estimated need for treatment of severe malaria in the first trimester for countries with a malaria incidence >0.[137] On the basis of expert opinion,[138] we estimated severity by levels of ANC coverage using the assumption that higher ANC coverage would result in fewer women progressing to severe malaria. If less than 50% of women have ≥4 ANC visits, we assumed that 3% of nonsevere cases progressed to severe; if 50–74% of women have ≥4 ANC visits, we assumed that 2% of nonsevere cases progressed to severe; and if ≥75% of women have ≥4 ANC visits, we assumed that 1% of nonsevere cases progressed to severe.	We assumed that coverage is equivalent to the proportion of deliveries in a comprehensive EmOC facility because of the level of care required for treatment, including blood transfusions.[138]
422	Anemia screening	WHO recommends anemia screening to identify pregnant women with moderate anemia (defined as hemoglobin level of 7–11 g/dL) and severe anemia (defined as <7 g/dL).[116] We assumed that all women giving birth and women having a miscarriage before 28 weeks' gestation need anemia screening.[116]	We assumed that coverage for women giving birth is equivalent to the proportion who have any ANC from a skilled provider and have a blood sample taken during pregnancy. We assumed that women having a miscarriage before 28 weeks' gestation have the same likelihood of having been screened as women with only 1 ANC visit. We estimated from national surveys that the proportion of women giving birth who have only 1 ANC visit and a blood sample taken is 53% of the proportion of all women with any ANC from a skilled provider and with a blood sample taken.[17,120]
423	Anemia prevention for nonanemic pregnant women	WHO recommends that pregnant women who are not anemic take iron and folic acid supplementation to prevent development of anemia.[117] We assumed that all women giving birth and women having a miscarriage before 28 weeks' gestation without anemia need iron and folic acid supplementation. We used the proportion of pregnant women who are nonanemic (hemoglobin ≥11g/dL) from the WHO Global Health Observatory.[139]	We assumed that coverage for women giving birth is equivalent to the proportion of women who take iron supplements during pregnancy (data from DHS and other national surveys). We assumed that coverage for women having a miscarriage before 28 weeks' gestation is half that of women giving birth because of a shorter pregnancy duration and less time in ANC to obtain counseling and supplies.

#	Intervention	Need	Coverage
424	Anemia treatment	WHO recommends that anemic pregnant women take iron and folic acid supplementation.[117] We assumed that all women giving birth and women having a miscarriage before 28 weeks' gestation with anemia need treatment. We used the proportion of pregnant women who are anemic (hemoglobin <11 g/dL) from the WHO Global Health Observatory.[139]	We assumed that coverage for women giving birth is equivalent to the proportion of women who take iron supplements during pregnancy (data from DHS and other national surveys). We assumed that coverage for women having a miscarriage before 28 weeks' gestation is half that of women giving birth because of a shorter pregnancy duration and less time in ANC to obtain counseling and supplies.
425	Urinary tract infection treatment	Urinary tract infection (UTI) is a common infection that usually occurs when bacteria enter the opening of the urethra; if left untreated, it can lead to complications during pregnancy.[140] We assumed that 20% of women who give birth develop a UTI during pregnancy and need treatment.[140] On the basis of our assumption that miscarriages, on average, occur during the 1st trimester, we assumed that one-third of women giving birth who develop a UTI, or 6.67% of all women giving birth, is equivalent to the need for UTI treatment for women having a miscarriage before 28 weeks' gestation.	Lacking specific coverage data, we assumed that coverage for women giving birth is equivalent to the proportion of women with at least 4 ANC visits. We assumed that coverage for women having a miscarriage before 28 weeks' gestation is equivalent to the proportion of women with at least 2 ANC visits.
426	Asymptomatic bacteriuria treatment	Asymptomatic bacteriuria (ASB), the presence of bacteria in the urine without symptoms, is commonly associated with higher risk for UTIs, preterm birth and low birth weight.[90] WHO recommends that all pregnant women receive testing and treatment for ASB. An estimated 8% of women giving birth experience ASB and thus need treatment.[90] Based on our assumption that miscarriages, on average, occur during the 1st trimester, we assumed that need for women having a miscarriage before 28 weeks' gestation is equivalent to one-third of the 8% of women giving birth who develop ASB, or 2.67%.	We assumed that testing for ASB is included in urine analysis during basic ANC and that testing coverage for women giving birth is equivalent to the proportion of women who have at least 4 ANC visits and receive a urine test. We assumed that testing coverage for women having a miscarriage before 28 weeks' gestation is equivalent to the proportion who have at least 2 ANC visits. We assumed that all women who are tested and found to have ASB receive treatment.

#	Intervention	Need	Coverage
427	Ultrasound before 24 weeks' gestation	WHO recommends that all women giving birth have an ultrasound before 24 weeks' gestation.[118] We assumed no need for women having a miscarriage, given the shorter pregnancy duration.	Lacking specific coverage data, we assumed that coverage for women who give birth is equivalent to the proportion of women who have at least 4 ANC visits.
428	Tuberculosis screening	In settings where the tuberculosis (TB) incidence in the general population is >100 per 100,000 people, WHO recommends routine antenatal TB screening for all pregnant women.[90,141] We assumed that all women giving birth in countries with a TB incidence >100 per 100,000 people (from the WHO Tuberculosis Report)[142] need TB detection during ANC. We did not estimate tuberculosis screening for women having a miscarriage, given the shorter pregnancy duration.	Lacking specific coverage data, we assumed that coverage of TB screening for all women giving birth is equivalent to the proportion of women who have at least 4 ANC visits.
429	TB treatment	WHO recommends that pregnant women with TB receive treatment during ANC.[90] We assumed that need for TB treatment among women giving birth is equivalent to a country's TB incidence rate from the WHO Tuberculosis Report.[142] We did not estimate tuberculosis treatment for women having a miscarriage, given the shorter pregnancy duration.	Lacking specific coverage data, we assumed that coverage of TB treatment for women giving birth is equivalent to the proportion of women who have at least 4 ANC visits.
430	Deinfibulation	WHO recommends that pregnant women with Type 3 female genital mutilation (FGM) receive deinfibulation, a reconstructive surgery of the infibulated scar to prevent and treat obstetric complications.[143] We assumed that need for deinfibulation is equivalent to the proportion of women who experience Type 3 FGM (data from DHS Program STATcompiler, for countries with available data).[136]	We assumed that coverage is equivalent to the proportion of deliveries in comprehensive EmOC facilities, because deinfibulation is a surgical intervention.

5. Care before labor and for preterm labor

The following interventions involving care before labor were applied to all women giving birth, whether live birth or stillbirth.

#	Intervention	Need	Coverage
501	Antenatal corticosteroids for preterm labor	WHO recommends administration of corticosteroids and inpatient care for women experiencing preterm labor.[144] We followed WHO recommendations that births occurring at 24–34 weeks need corticosteroids.[145] Using a weekly delivery rate estimated from Vogel et al.,[146] we calculated that 51% of preterm births need corticosteroids. We applied this 51% need to country-level estimates of preterm birth from Chawanpaiboon et al.[147]	We assumed that coverage for women giving birth is equivalent to 50% of the proportion of deliveries in comprehensive EmOC facilities.[146] We arrived at this assumption using the findings from Vogel et al. that, in facilities with comprehensive EmOC capacity, 52% of births at weeks 22–34 and 55% of births at weeks 26–34 received corticosteroids.[146] These proportions are likely high because of study site selection of only comprehensive EmOC facilities, so we assumed that 50% of comprehensive EmOC facility deliveries at 24–34 weeks received corticosteroids.
502	Antibiotics and induction for preterm premature rupture of membranes	Premature rupture of membranes is the rupture of the amniotic sac before labor has begun. It can occur when the fetus is either immature (preterm, or before 37 weeks) or mature (at term). WHO recommends administration of oral antibiotics for women with preterm premature rupture of membranes (PPROM) to prevent infection and its consequences.[148] We assumed that 30% of preterm births experience PPROM.[149]	Following LiST, we assumed that coverage is equivalent to the proportion of deliveries in EmOC facilities.[94]
503	Induction of labor (beyond 41 weeks' gestation)	Maternal complications of pregnancy can increase after 41 weeks' gestation in low-risk women.[150] We estimated from Mya et al.[151] that 7.7% of births have a gestation of ≥41 weeks and that all of these births need induction of labor.	We used regional estimates of induction of labor from Mya et al.[151] and Guerra et al.[152] to estimate coverage, assuming: • 11% in Africa • 21% in Asia, Oceania, Southern Europe and Eastern Europe • 13% in Latin America and the Caribbean
504	Magnesium sulfate for preterm birth	WHO recommends that women with a preterm birth before 32 weeks be given magnesium sulfate before giving birth in order to prevent cerebral palsy in the newborn.[153] We assumed that all preterm births before 32 weeks' gestation need magnesium sulfate. We	Following LiST, we assumed that coverage is equivalent to the proportion of deliveries in EmOC facilities.[94]

#	Intervention	Need	Coverage
		estimated that 72% of preterm births occur at 32–36 weeks, from Vogel et al.,[146] and therefore 28% of preterm births occur before 32 weeks.	

6. Care for obstetric complications

Some women experience complications during pregnancy, labor and delivery that require emergency treatment. The following obstetric complication interventions were applied to all women giving birth, whether live birth or stillbirth.

#	Intervention	Need	Coverage
601	Antepartum hemorrhage treatment	Vaginal bleeding from 20 weeks' gestation until delivery requires diagnosis and care per WHO guidelines.[89] We estimated that 4% of women giving birth need care for antepartum hemorrhage (APH), on the basis of findings that the prevalence of antepartum bleeding of unknown origin in the second and third trimesters of pregnancy is 2%,[154] and that in half of APH cases, the causes are unidentified.[155,156]	Lacking specific coverage data, we assumed that coverage is equivalent to the proportion of deliveries in comprehensive EmOC facilities.
602	Soil-transmitted helminth infection treatment for women with APH	We assumed that women with APH in countries where soil-transmitted helminth infection is endemic need treatment.[89] WHO defines endemic levels as a prevalence of these infections that exceeds 20%.[114] (Prevalence data are from GBD 2017.[66])	We assumed that coverage is equivalent to coverage of APH treatment, i.e., the proportion of deliveries in comprehensive EmOC facilities.
603	Prolonged labor care	Prolonged labor is defined as regular, painful contractions accompanied by cervical dilation lasting longer than 24 hours without resulting in delivery. Women with prolonged labor require clinical assessment and, in some cases, intervention to augment labor or to deliver the baby.[157] We assumed that 10% of women giving birth experience prolonged labor and need clinical assessment and care.[38]	Lacking specific coverage data, we assumed that coverage is equivalent to the proportion of deliveries in EmOC facilities.
604	Assisted vaginal delivery	Assisted vaginal delivery is vaginal delivery performed with the help of forceps or vacuum extraction.	Lacking specific coverage data, we assumed that coverage is equivalent

#	Intervention	Need	Coverage
		We assumed that 6% of all women giving birth need assisted vaginal delivery, on the basis of estimates of prolonged labor and obstructed labor: Of the 10% of women giving birth estimated to experience prolonged labor,[38] 50% need assisted vaginal delivery,[158] and of the 6% of women giving birth estimated to experience obstructed labor, 10% need assisted vaginal delivery.[159]	to the proportion of deliveries in EmOC facilities.
605	Cesarean section for obstructed labor or preeclampsia/ eclampsia	Obstructed labor occurs when the fetus cannot descend through the pelvis, and an emergency cesarean section is sometimes necessary to deliver the baby.[160] If women with preeclampsia at term and women with eclampsia experience prolonged labor, or if there are fetal heart rate abnormalities, delivering the baby is the definitive treatment; cesarean sections are required for these women as well.[89] Of the estimated 6% of women giving birth who experience obstructed labor, we estimated that 90% of them need a cesarean section (which translates to 5.4% of all women giving birth).[159] Applying guidelines for managing preeclampsia and eclampsia and expert opinion, we estimated that 10% of severe preeclampsia cases and 67% of eclampsia cases need a cesarean section.[89,138,161–163]	We assumed that coverage is equivalent to the lowest value between either a) the proportion of births that end in cesarean section divided by the need for cesarean section for obstructed labor, preeclampsia or eclampsia; or b) the country's proportion of deliveries in comprehensive EmOC facilities. We estimated the proportion of cesarean deliveries from DHS and other national surveys or the WHO Global Health Observatory,[164] whichever was more recent.
606	Other cesarean section	According to WHO, population-level rates of cesarean section higher than 10% are not associated with reductions in maternal and newborn mortality.[165] We assumed that the need for other cesarean sections needed to not exceed the WHO-recommended level is equivalent to the lowest value between either a) 10% minus the proportion of deliveries that need and receive a cesarean section for obstructed labor or preeclampsia/eclampsia; or b) 10%.	We assumed that coverage is equivalent to either a) the proportion of births that end in cesarean section minus cesarean deliveries for obstructed labor or preeclampsia/eclampsia if the country's cesarean section rate is less than or equal to 10%; or b) 100%, if the country's cesarean section rate is greater than 10%.

#	Intervention	Need	Coverage
607	Excess cesarean section	Per the WHO-recommended level of 10%,[165] we assumed that cesarean sections above that level are excess procedures.	We assumed that all women receiving a cesarean section reported in DHS and other national surveys or in the WHO Global Health Observatory[164] occurring beyond the 10% WHO-recommended level receive cesarean section care.
608	Eclampsia management	Eclampsia is the life-threatening onset of convulsions or coma resulting from high blood pressure and proteinuria associated with hypertensive disorders of pregnancy.[89] We assumed that need for eclampsia management is equivalent to the regional prevalence estimates of eclampsia from Abalos et al.[129]	Following LiST and eclampsia management recommendations that require monitoring and the availability of intensive care, we assumed that coverage is equivalent to the proportion of deliveries in comprehensive EmOC facilities.[94,166]
609	Maternal sepsis case management	Maternal sepsis is infection of the genital tract occurring 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 (with the presence of pus and/or an abnormal, foul odor) or delay in the rate of reduction of the size of the uterus (<2 cm/day during the first 8 days).[167] Applying 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 deliveries in facilities, 5.3% of cesarean deliveries and 5% of deliveries outside of facilities.[167] In the all-needs-met scenario, we assumed that 2.5% of vaginal deliveries in facilities and 2.9% of cesarean sections need sepsis management.[167]	Lacking specific coverage data, we assumed that coverage is equivalent to the proportion of deliveries in EmOC facilities.
610–611	Postpartum hemorrhage treatment	Postpartum hemorrhage (PPH) is defined as blood loss of ≥500 ml within 24 hours after birth.[89,168]	We assumed that coverage of PPH treatment and coverage of a second dose of tranexamic acid for continued bleeding is equivalent to the proportion of deliveries in

#	Intervention	Need	Coverage
		Using estimates from Calvert et al.,[169] we assumed that the following proportion of births were estimated to develop PPH: 9.5% of births with vaginal deliveries or assisted vaginal deliveries with active management of third stage of labor (AMTSL), and 21.9% of vaginal deliveries without AMTSL (see intervention 702 for estimates of AMTSL). In another intervention, we also accounted for the need of the estimated 30% of women with PPH who experience continued bleeding that requires a second dose of tranexamic acid. [170,171] In the all-needs-met scenario, we assumed that all vaginal deliveries receive AMTSL, so we only assumed that 9.5% of births with AMTSL develop PPH and need treatment.	comprehensive EmOC facilities.
612	Soil-transmitted helminth infection treatment for women with PPH	We assumed that women with PPH in countries where soil-transmitted helminth parasite infection is endemic need treatment.[89] WHO defines endemic levels as a prevalence of soil-transmitted helminth infections that exceeds 20%.[114] (Prevalence data are from GBD 2017.)[66]	We assumed that coverage is equivalent to coverage for treatment of PPH, i.e., the proportion of deliveries in comprehensive EmOC facilities.
613	Prereferral management of major labor complications	Some women have major complications during pregnancy, delivery or the immediate postpartum period that cannot be managed at lower-level health facilities and require referral to higher-level facilities. We assumed that women with major complications of pregnancy, including severe preeclampsia, antepartum hemorrhage, PPH, obstructed labor, eclampsia and sepsis, who seek care from a health facility not equipped to provide comprehensive EmOC need prereferral management of complications.	We assumed that coverage is equivalent to half of the proportion of comprehensive EmOC facility births out of all births in health facilities, because it is unrealistic to assume that all women needing a referral actually receive one.[172]

7. Care for noncomplicated deliveries

The following interventions involving care for noncomplicated deliveries were applied to all women giving birth, whether live birth or stillbirth.

#	Intervention	Need	Coverage
701	Routine vaginal delivery	We assumed that all women giving birth need to deliver in a health facility and have a routine vaginal delivery if they do not experience complications requiring assisted vaginal delivery or a cesarean section.	In the current scenario, we estimated the number of women receiving routine vaginal delivery care by subtracting the estimated number of deliveries that have an assisted vaginal delivery or cesarean section (see interventions 604–607) from all deliveries in a health facility. In the all-needs-met scenario, we assumed that all deliveries occur in a health facility.
702	AMTSL	AMTSL is an evidence-based, low-cost intervention used to prevent PPH that includes administration of a uterotonic agent, controlled cord traction to support the uterus and uterine massage after delivery of the placenta.[168,173] We assumed that all women undergoing routine vaginal delivery or receiving assisted vaginal delivery care need AMTSL.	We assumed that women who receive routine vaginal delivery care in a health facility and those who receive assisted vaginal delivery care in EmOC facilities receive AMTSL.

8. Postnatal care

The following postnatal interventions were applied to all women giving birth, whether live birth or stillbirth, except for breast-feeding counseling and support, which was applied only to women with live births. We included the need for and coverage of contraceptive counseling and services for all women wanting to avoid a pregnancy under the contraceptive interventions (see Section 4) and did not include them in postnatal care interventions.

#	Intervention	Need	Coverage
801	Preventive postnatal care	WHO recommends assessment and preventive care for maternal well-being within 24 hours after delivery.[174] We assumed that all women need this intervention after any delivery, either at home or in a facility.	We assumed that coverage is equivalent to the proportion of women who reported receiving postnatal care within 24 hours after delivery in DHS and other national surveys.

#	Intervention	Need	Coverage
802	Mastitis care	Mastitis is an inflammatory condition of the breast that may or may not be accompanied by infection and can occasionally be fatal if inadequately treated.[175] Mastitis is most common in the second and third week postpartum. We assumed that 15% of women giving birth need management of mastitis.[158,176]	We assumed that coverage is equivalent to the proportion of women who reported any postnatal care (data from DHS Program STATcompiler).[136]
803	Obstetric fistula repair	Obstetric fistula is a hole that forms in the vaginal wall between the bladder, rectum or both as a result of obstructed labor. Consequences may include urinary incontinence, fecal incontinence, irritation of the skin of the vulva due to constant leaking and secondary amenorrhea. Treatment can include reconstructive surgery, postoperative care, and counseling and support.[177] Using rates from Dolea and AbouZahr,[159] we assumed that 2.15% of women with untreated obstructed labor develop obstetric fistula. In the all-needs-met scenario, we assumed that there is no need for obstetric fistula treatment, as all obstructed labor would receive treatment.	We assumed that coverage is equivalent to the proportion of deliveries in comprehensive EmOC facilities, because treatment can require surgery.
804	Breast-feeding counseling and support	WHO recommends that women be counseled to breast-feed exclusively for 6 months after delivery, with 1 counseling session immediately after birth, 1 within the first week after birth, 1 at 6 weeks postpartum and 1 at 5–6 months postpartum.[178] As our estimates do not go beyond 6 weeks after delivery, we included only 2 sessions. We assumed that all women with live births need breast-feeding counseling and support.	We assumed that coverage is equivalent to half the proportion of women with live births delivering in a health facility.

9. Newborn care

We included basic newborn interventions that are low-cost, are simple to perform and should be integrated with maternal health care. We did not include more complex, long-term care that is not always available in LMICs, such as neonatal intensive care or surgery for congenital abnormalities. We included interventions for six weeks after delivery. The interventions below apply only to live births.

#	Intervention	Need	Coverage
901	Immediate newborn care	After delivery, newborns require immediate drying, skin-to-skin contact and initiation of breast-feeding.[116] We assumed that all newborns need immediate care.	Lacking specific coverage data, we assumed that coverage is equivalent to the proportion of deliveries in a health facility.
902	Neonatal resuscitation	Newborns who experience birth asphyxia do not get enough oxygen before, during or after birth and need resuscitation.[179] We assumed that 4.5% of live births need neonatal resuscitation, using the midpoint of the incidence estimate reported by Wall et al.[180]	Following LiST, we assumed that births in health facilities receive neonatal resuscitation, if needed.[94]
903	Newborn local infections treatment	Newborn infections include conjunctivitis, infection of the umbilical stump and other local infections. We assumed that 10% of newborns develop some type of local infection at current levels of care. In the all-needs-met scenario, we reduced this to 5%, assuming that all newborns receive clean delivery care in facilities in this scenario.[158]	Lacking specific coverage data, we assumed that coverage is equivalent to the proportion of deliveries in a health facility.
904	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 the hospital—has been proposed as an alternative to conventional neonatal care for low-birth-weight infants.[181–183] Birth weight of less than 2,500 g (5.5 lbs.) is considered low birth weight.[184] We assumed that all premature births at 32–36 weeks' gestation, which is 72% of total premature births,[146,147] and all small-for-gestational-age and low-birth-weight babies need kangaroo mother care.[116] We used estimates of low birth weight from Blencowe et al.[184] and estimates of preterm and small-for-gestational-age newborns from Lee et al.[185]	Lacking specific coverage data, we assumed that coverage is equivalent to the proportion of deliveries in a health facility.
905	Low birth weight treatment	We assumed that all premature births at 32–36 weeks' gestation, which is 72% of all premature births,[146,147] and all small-for-gestational-age and low-birth-weight babies[184,185] need supportive care.	Following LiST, we assumed that coverage is equivalent to the proportion of deliveries in EmOC facilities.[94]
906–907	Newborn sepsis treatment with injectable	Newborn sepsis treatment includes management with injectable antibiotics and full supportive care. We assumed that 10% of newborns develop sepsis, on the basis of a review of studies reporting rates of infection among infants through 60 days of life.[186]	We assumed that coverage for injectable antibiotics is equivalent to the proportion of deliveries in a health facility. We assumed that coverage for full supportive care is

#	Intervention	Need	Coverage
	antibiotics or with full supportive care	We assumed that 90% of newborns with sepsis can be treated with injectable antibiotics, and 10% will require full supportive care.[187] Thus, 9% of newborns need injectable antibiotics and 1% need full supportive care. In the all-needs-met scenario, we reduced the need by 50% from the current scenario because we assumed that immediate newborn care and safe delivery practices avert some sepsis infections.	equivalent to the proportion of deliveries in EmOC facilities.
908–910	Newborn vaccines: hepatitis B, polio and BCG	We included 3 vaccines recommended for all newborns at or within 6 weeks after birth: hepatitis B vaccine, polio vaccine and BCG vaccine for prevention of tuberculosis.[188–190] As our estimates do not go beyond 6 weeks after delivery, we did not include vaccines recommended beyond 6 weeks. We assumed that all newborns need these vaccines.	We assumed that coverage for all 3 vaccines is equivalent to the proportion of newborns vaccinated against hepatitis B, the only representative newborn vaccine data available (data from UNICEF).[191]
911	Congenital syphilis treatment	We assumed need for treatment for congenital syphilis for 3 categories of newborns in need: 1) newborns whose mothers have untreated syphilis, 2) newborns whose mothers were treated with penicillin-based regimens, but the treatment was ineffective, and 3) newborns whose mothers were treated with non-penicillin-based regimens.[121] To estimate the proportion of newborns needing syphilis treatment, we estimated the number of pregnant women with infections (see interventions 404–406). Then, to determine who may have been treated or not prior to giving birth, we used syphilis treatment rates (expressed as proportions) from Korenromp et al.[122] We assumed the following for each category of need: 1) Using estimates from Gomez et al.,[192] we determined that 25.6% of pregnancies experienced by women with untreated syphilis end in stillbirth or miscarriage, meaning that 74.4% end in live births. Gomez et al. also estimated that 15.5% of newborns born to women with untreated syphilis have clinical evidence of syphilis.[192] Therefore, we calculated that 20.8% of newborns born to women with untreated syphilis have clinical evidence of syphilis and need treatment (15.5%/74.4% = 20.8%).	Lacking specific coverage data, we assumed that coverage is equivalent to the proportion of births delivered in a health facility.

#	Intervention	Need	Coverage
		2) Korenromp et al. estimated that treatment during pregnancy reduces clinical disease in infants by 97%.[122] Therefore, we calculated that 0.624% of newborns born to mothers with treated syphilis have clinical syphilis (3% * 20.8% = .624%). We applied our calculation to newborns whose mothers were screened and treated with penicillin-based regimens during ANC to estimate newborns whose mothers had ineffective penicillin-based treatment. 3) We assumed that 10% of women who received treatment were treated with non-penicillin-based regimens because they reported allergy to penicillin.[193–195] We assumed that newborns born to women with non-penicillin-based treatment regimens need treatment for congenital syphilis. In the all-needs-met scenario, we assumed that all pregnant women with syphilis were identified and treated, but that newborns whose mothers received a non-penicillin-based regimen require treatment for congenital syphilis.	
912	Neonatal gonococcal conjunctivitis treatment	WHO recommends treatment of gonococcal conjunctivitis in newborns.[123] We assumed need for treatment of neonatal gonococcal conjunctivitis for the following categories of newborns: 1) We assumed that newborns born to women infected with gonorrhea who were not treated during pregnancy are at risk of conjunctivitis. However, of these newborns, some receive prophylaxis as part of immediate newborn care (intervention 901), resulting in a 70% reduction in conjunctivitis.[196] 2) The remaining newborns (i.e., who do not receive immediate newborn care or for whom the prophylaxis is ineffective) have a 40% risk of developing conjunctivitis because of untreated or ineffective treatment of gonorrhea at delivery.[197,198]	Lacking specific coverage data, we assumed that coverage is equivalent to the proportion of births delivered in a health facility.
913	Neonatal chlamydial conjunctivitis treatment	WHO recommends treatment of chlamydial conjunctivitis in newborns.[123] We assumed need for treatment of neonatal chlamydial conjunctivitis for the following categories of newborns:	Lacking specific coverage data, we assumed that coverage is equivalent to the proportion of births delivered in a health facility.

#	Intervention	Need	Coverage
		1) We assumed that newborns born to women infected with chlamydia who were not treated during pregnancy are at risk of conjunctivitis. However, of these newborns, some receive prophylaxis as part of immediate newborn care (intervention 901), resulting in a 70% reduction in conjunctivitis.[196] 2) The remaining newborns (i.e., who either do not receive immediate newborn care or for whom the prophylaxis is ineffective) have a 40% risk of developing conjunctivitis because of untreated chlamydia at delivery.[199,200]	

10. HIV care for pregnant/postpartum women and their newborns

Pregnancy-related HIV care includes interventions for diagnosing and treating HIV in women during pregnancy and newborns for six weeks after delivery, at which point it is assumed that antiretroviral therapy (ART) costs are transferred to existing HIV/AIDS programs. For pregnant women, we considered only women giving birth, whether live birth or stillbirth.

Women living with HIV who present for pregnancy-related care who are thought to already be taking ART (under the Option B+ regimen) are not included in the estimated number of pregnant women living with HIV who need ART in AIU-2019.[201] However, women living with HIV who are deemed to be following less-effective regimens (e.g., Option A) were grouped with women not taking ART and in need of treatment.

For all pregnancy-related HIV interventions, we followed WHO guidelines[201] and used available UNAIDS 2018 estimates, supplemented by data from Avenir Health's Spectrum AIDS Impact Model when UNAIDS estimates were unavailable,[96,202,203] and national surveys for the number of ANC visits. For countries missing UNAIDS or Spectrum data and with a generalized HIV epidemic, we imputed weighted subregional estimates. For countries missing UNAIDS or Spectrum data and with a nongeneralized HIV epidemic, we imputed the unweighted LMIC average because geographic subregional estimates were less informative than a typical LMIC with a nongeneralized HIV epidemic.

Some interventions were only applicable to countries with a generalized HIV epidemic, in accordance with WHO guidelines,[201] and are noted. Countries with an HIV prevalence greater than 1% were classified as having a generalized HIV epidemic.[204] We calculated country-specific HIV prevalence rates among pregnant women using the number of women in need of prevention of mother-to-child transmission (PMTCT) and the total number of births from the Spectrum AIDS Impact Model.[96]

#	Intervention	Need	Coverage
1001	Voluntary HIV counseling and testing: 1st test opportunity	WHO recommends routine testing and counseling during the first ANC visit for all pregnant women who are not using ART.[201] Women already using ART should	We assumed that coverage is equivalent to the proportion of women who receive HIV testing during ANC (data from DHS).

#	Intervention	Need	Coverage
		not be retested during pregnancy because of the risk of a false negative diagnosis. We estimated women in need to be all women giving birth who were not using effective ART regimens before pregnancy.[96,202,203]	
1002	Confirmatory testing and counseling for women screened as HIV-positive at 1st screening	WHO recommends that women who test positive for HIV during pregnancy receive an explanation of their results and diagnosis; counseling on health risks; referrals for other support services; and counseling for PMTCT of HIV that includes ART, partner testing, tuberculosis testing and HIV testing for the newborn.[201] We estimated need to be equivalent to all pregnant women giving birth and who are living with HIV and were not using ART before pregnancy.[96,202,203]	In countries with a generalized HIV epidemic, we assumed that coverage is equivalent to the proportion of women who initiated ART during pregnancy and started the treatment regimen ≥4 weeks before delivery.[96,202,203] In countries without a generalized HIV epidemic, we assumed that coverage is equivalent to the proportion of women who initiated ART during pregnancy.[96,202,203]
1003	Voluntary HIV counseling and testing: 2nd test opportunity	Because of the increased risk of infection during pregnancy, WHO recommends retesting for HIV-negative women living in high-prevalence settings during the third trimester, during labor or postpartum.[201] In countries with a generalized HIV epidemic, we estimated that need is equivalent to the proportion of women giving birth who were not using ART before pregnancy and had not initiated ART during pregnancy as a result of the 1st test.[96,202,203]	In countries with a generalized HIV epidemic, we assumed that coverage is equivalent to the proportion of women giving birth who had at least 4 ANC visits and received their HIV test results. The data on ANC visits and receipt of HIV test results during ANC come from the DHS.
1004	Confirmatory testing and counseling for women screened as HIV-positive at 2nd screening	In countries with a generalized HIV epidemic, we estimated that need for confirmatory testing and counseling after the 2nd screening is equivalent to the proportion of women giving birth who are living with HIV and were not using ART before pregnancy and had not initiated ART at ≥4 weeks prior to delivery.[96,202,203]	In countries with a generalized HIV epidemic, we assumed that coverage is equivalent to the proportion of women living with HIV who initiated ART <4 weeks prior to delivery.[96,202,203]

#	Intervention	Need	Coverage
1005	ART for women diagnosed as living with HIV during ANC	All pregnant women diagnosed with HIV during pregnancy require ART initiation.[201] We assumed that need is equivalent to the proportion of women giving birth who are living with HIV and not using ART.[96,202,203]	We assumed that coverage is equivalent to the proportion of women living with HIV who initiate ART during ANC. The data for timing of ART initiation in relation to pregnancy (before or during) come from the Spectrum AIDS Impact Model.[96,202,203]
1006–1007	Early infant diagnosis: women living with HIV	HIV may be transmitted to newborns during pregnancy, delivery or breast-feeding. Early infant diagnosis, or testing for infants exposed to HIV, is recommended for all newborns born to women living with HIV.[201] We assumed that women living with HIV include those using ART prior to pregnancy and those who initiated ART during pregnancy. We calculated need for two interventions that require different testing protocols, depending on a newborn's HIV status. 1) We assumed that the proportion of newborns born with HIV is equivalent to the proportion of women giving birth who were using ART prior to delivery, multiplied by the country-specific mother-to-child transmission rate at 6 weeks, which accounts for timing of ART initiation and use.[96,202,203] 2) We assumed that the proportion of newborns born without HIV and born to women living with HIV is equivalent to the proportion of women giving birth who were using ART prior to delivery, multiplied by the inverse of the mother-to-child transmission rate at 6 weeks.[96,202,203] In the all-needs-met scenario, we used the same formulas but applied the mother-to-child transmission rate for pregnant women living with HIV who were using ART before pregnancy,[96,202,203] because we assumed that all women will	We assumed that coverage is equivalent to the proportion of newborns with early infant diagnosis (estimates from UNAIDS).[205]

#	Intervention	Need	Coverage
		use ART during pregnancy in this scenario.	
1008–1009	ART for newborns born to women living with HIV	WHO recommends infant prophylaxis with ART for breast-fed newborns of mothers receiving ART and for newborns born to women living with HIV because these infants are at high risk of acquiring HIV whether or not they are breast-fed.[201] Newborns are considered at high risk of acquiring HIV if they are: 1) born to women with established HIV infection who had received <4 weeks of ART at the time of delivery, 2) born to women with established HIV infection who have a viral load >1000 copies/ml in the 4 weeks before delivery, if viral load measurement is available, 3) born to women with incident HIV infection during pregnancy or breast-feeding, or 4) born to women identified as living with HIV for the first time during the postpartum period. Given the available data in the Spectrum AIDS Impact Model, we identified two interventions that assumed need for ART for newborns born to: 1) women with established HIV infection who had received <4 weeks of ART at the time of delivery, regardless of breast-feeding status, or 2) breast-feeding women who had received ART ≥4 weeks prior to delivery.[96,202,203] This is likely an underestimate of need because we could not estimate the need for all high-risk groups detailed above.	For the first intervention, we assumed that coverage is equivalent to the proportion of women living with HIV who were not using ART before pregnancy or ≥4 weeks prior to delivery who had received ART <4 weeks before delivery (estimates from the Spectrum AIDS Impact Model).[96,202,203] For the second intervention, we assumed that all newborns born to breast-feeding women who had received ART ≥4 weeks prior to delivery are identified as needing ART and receive it.

5.5. Adolescent data gaps and assumptions

All of the pregnancy-related and newborn care interventions were estimated for pregnant women of reproductive age and adolescent women (aged 15–19). We obtained adolescent-specific data for some interventions, but many of the data sources for need and coverage lack adolescent-specific data.

None of our **need** assumptions were age-specific, and we therefore assumed the same need for pregnant women of reproductive age and adolescent women. One exception is the proportion of women with Type 3 FGM (intervention 430), which is from the DHS Program STATcompiler and is age-specific.[136]

We had adolescent-specific data for all **coverage** estimates sourced from DHS and other national surveys. The exceptions were:

- The proportion of women giving birth who slept under an insecticide-treated bed net and those undergoing intermittent preventive treatment in pregnancy (interventions 415 and 416), which come from the DHS Program STATcompiler[136] and were not age-specific, so we assumed the same coverage for women of reproductive age and adolescent women
- Data from UNAIDS and Avenir Health's Spectrum AIDS Impact Model[96,202,203] were not age-specific, so we assumed the same pregnancy-related HIV coverage for women of reproductive age and adolescent women.

5.6. Stata do-files

The AIU-2019 Pregnancy-related and newborn care master do-file.do provides a description of the purpose and summary of analysis steps for each Stata do-file within the pregnancy-related and newborn care component of this analysis.

5.7. Tables

The relevant appendix tables for this section are:

- **Methodology Report Appendix Table MA5.1:** Data sources used to estimate need and coverage for pregnancy-related and newborn care interventions, by LMIC
- **Methodology Report Appendix Table MA5.2:** Interventions expected to be performed in health care facilities by level of care
- **Methodology Report Appendix Table MA5.3:** Number of live births and proportion of live births among women aged 15–49 who needed and received selected ANC interventions, according to selected grouping of LMICs, 2019
- **Methodology Report Appendix Table MA5.4:** Number of live births and proportion of live births among women aged 15–49 delivered in a health facility; and percentage distribution of those births, by delivery type—all according to selected grouping of LMICs, 2019
- **Methodology Report Appendix Table MA5.5:** Proportion of live births among women aged 15–49 and of newborns who needed and received care for major complications, according to selected grouping of LMICs, 2019
- **Methodology Report Appendix Table MA5.6:** Number of live births and proportion of live births among women aged 15–49 who received ANC and delivered in a health facility, according to LMIC, 2019
- **Methodology Report Appendix Table MA5.7:** Number of live births and proportion of live births among women aged 15–49 who received ANC and delivered in a health facility, according to age-group, household wealth and selected grouping of LMICs, 2019

- **Methodology Report Appendix Table MA5.8a:** Percentage distribution of induced abortion methods, by method group, for safe abortions
- **Methodology Report Appendix Table MA5.8b:** Percentage distribution of induced abortion methods, by method group, for less safe abortions

Section 6: STIs

6.1. Objective

This section summarizes the approach for estimating need and coverage for treatment of four major curable STIs—chlamydia, gonorrhea, trichomoniasis and syphilis—in women of reproductive age in LMICs. (Section 5 includes management of syphilis, chlamydia and gonorrhea for pregnant women only.)

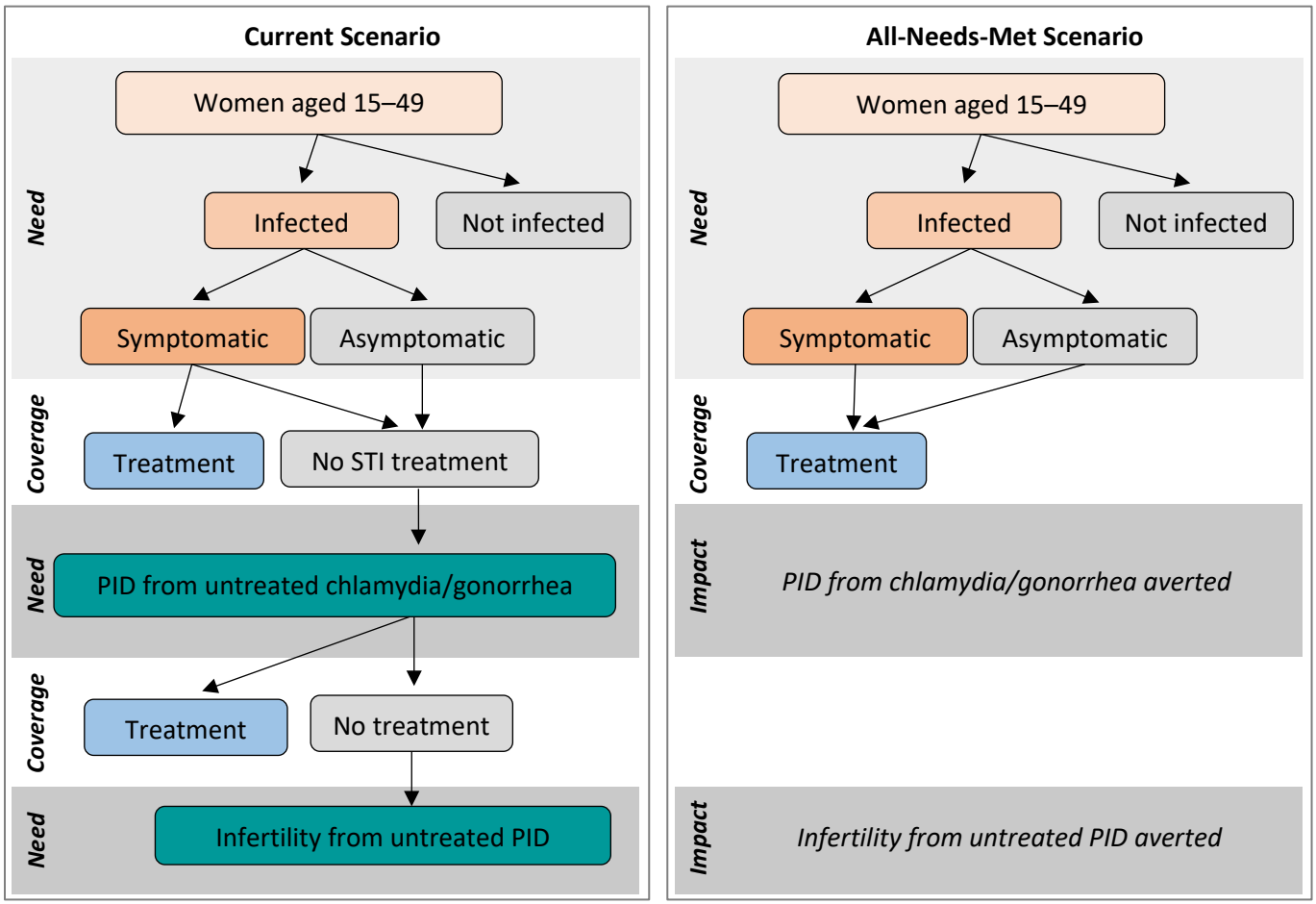
6.2. Key terms and definitions

- **STI incidence** refers to the number of new infections expected in a given year.
- **STI diagnosis** can be done via etiological testing or syndromic management. In AIU-2019, for women of reproductive age, STI diagnosis is assumed to occur via syndromic management, where a health care provider observes a cluster of symptoms, or a syndrome, that is indicative of an STI. Etiological testing involves diagnosing an STI by conducting a diagnostic test for the specific disease-causing pathogen. Although the WHO 2016–2021 strategy for reducing STIs includes guidance on etiological testing, where feasible, in AIU-2019, etiological testing is not included when estimating the costs of managing STIs for women of reproductive age because of the lack of data on the availability of this service.
- **STI treatment** can be pathogen-specific when the pathogen is known, or it can involve offering a combination of medications to treat all suspected causative pathogens. For AIU-2019, all treatment is pathogen-specific.

6.3. Analysis approach

The AIU-2019 estimates of need and coverage for treatment of major curable STIs are influenced by a number of key assumptions. Figure 6.1 outlines the conceptual framework. Need for treatment is estimated using STI incidence data. Although untreated STIs can result in numerous short- and long-term sequelae, we focused on PID caused by untreated chlamydia or gonorrhea and infertility caused by untreated PID to quantify the impact of STI services. In the all-needs-met scenario, where all infections are treated, progression to PID is eliminated, as is the potential for untreated PID from these infections to progress to infertility.

Figure 6.1. Conceptual model for STI need, coverage and impact calculations by scenario, for women of reproductive age



6.4. Data sources

We used the following data sources to estimate need, coverage and impact in terms of rate of disease progression:

Data	STI or condition	Geographic level	Sources
Need			
STI incidence among women	Estimated for all 4 major curable STIs	Estimates by WHO region[206]	Rowley et al. 2016[125]
Symptomatic rate in infected individuals	Chlamydia	Constant for all LMICs	Newman et al.[126] Suppl. File 4
	Gonorrhea		
	Syphilis		Expert opinion
	Trichomoniasis		Cotch et al. 1997[207]
Coverage			
STI treatment coverage	Assumed to be the same for all 4 major curable STIs	Country-specific	DHS

Data	STI or condition	Geographic level	Sources
Impact			
Rate of infection and disease progression	From untreated chlamydia or gonorrhea to PID	Constant for all LMICs	WHO 2006–2015 strategy on STI prevention and control[208]
	From untreated PID to infertility	Constant for all LMICs	WHO 2006–2015 strategy on STI prevention and control[208]

6.5. Estimation approach

Need and coverage: STIs

The numbers of women acquiring chlamydia, gonorrhea, syphilis or trichomoniasis—and thus needing treatment—in 2019 were estimated by multiplying regional estimates of disease incidence in 2016 among women aged 15–49[125] by 2019 population numbers of women aged 15–49 (see Methodology Report Appendix Table MA6.1). Unfortunately, data are lacking on how many women infected with each STI were infected more than once in a year or how many were infected with more than one of the four major curable STIs. We therefore followed WHO precedents, assuming that the estimated sum of cases represented the total number of infected women in 2019.[209,210] To estimate the number of infected women who were asymptomatic, we multiplied the number of women newly infected with each of the four STIs by the proportion expected to be asymptomatic (see Methodology Report Appendix Table MA6.1).[126,207]

In the current scenario, we assumed that coverage for STI treatment was equivalent to the proportion of symptomatic women who sought treatment or advice from a medical source, as reported in DHS. For countries without DHS data, we used the weighted subregional, proxy subregional or regional estimates. In the current scenario, we assumed that none of the other infected women received treatment (i.e., asymptomatic women and those with symptoms who did not seek medical care). In the all-needs-met scenario, we assumed that all women with any of the four STIs received treatment, regardless of whether they were symptomatic.

Need and coverage: PID

Using the most recent estimate available from the literature, we assumed that 40% of women with untreated chlamydia or gonorrhea developed PID and required treatment.[208] We did not estimate the number of PID cases from other causes. Because of a lack of other available data, we assumed that coverage for receiving PID treatment was equivalent to coverage for STI treatment (i.e., the proportion of symptomatic women who sought treatment or advice from a medical source, as reported in DHS). In the all-needs-met scenario, no women required PID treatment because all women with chlamydia and gonorrhea were treated, and thus no cases progressed to PID.

Impact

Using recent available estimates, we assumed that 25% of women with PID who did not receive treatment would develop infertility.[208] These cases would be averted in the all-needs-met scenario. Together, the averted PID and averted infertility constituted the impact of STI treatment for women of reproductive age.

We did not estimate the number of cases of infertility in women from other causes, nor did we estimate the need, impact or cost of diagnosing or treating infertility. In addition, although we acknowledge that STIs can lead to many adverse outcomes in pregnant women and their newborns, we did not estimate the number of pregnant or postpartum women or newborns with other adverse outcomes from an STI infection.

6.6. Stata do-files

The AIU-2019 STI master do-file.do provides a description of the purpose and summary of analysis steps for each Stata do-file within the STI treatment component of this analysis.

6.7. Tables

The relevant appendix table for this section is:

- **Methodology Report Appendix Table MA6.1:** STI incidence by WHO region

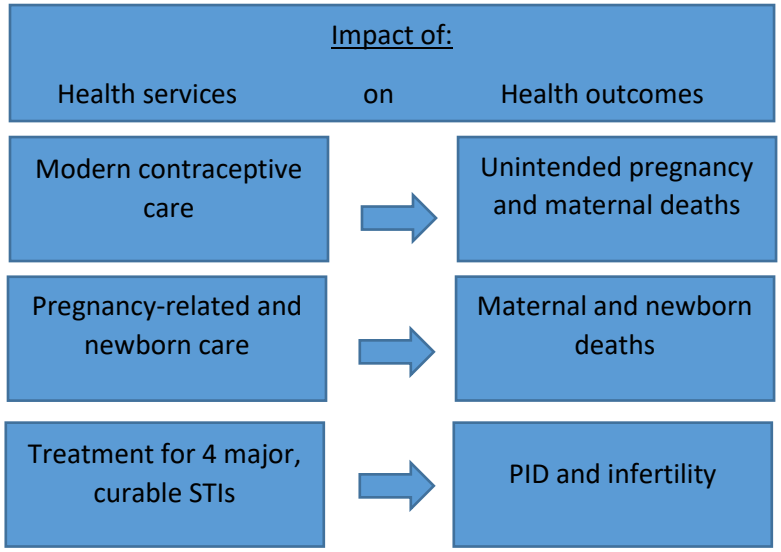
Section 7: Impacts of Interventions

7.1. Objective

We estimated the impacts of SRH services on key outcomes: unintended pregnancy, maternal deaths, newborn deaths, PID and infertility (Figure 7.1). This section describes the data sources used and analysis approach for estimating the impacts of contraceptive and pregnancy-related and newborn care on unintended pregnancy, maternal deaths and newborn deaths. (Section 6 describes the impact of treatment for major curable STIs on PID and infertility.)

We calculated impact over the four scenarios described in Section 2.2. The impact of current care is the difference in health outcomes between the current levels of care and the hypothetical no-provision-of-care scenario. The difference in impacts between the all-needs-met scenario and the current scenario represents the additional impact of fully meeting women's needs for services.

Figure 7.1. Impact of health services on health outcome measures



7.2. Overview and data sources: unintended pregnancies

We measured the impacts of contraceptive use with respect to the estimated number of unintended pregnancies and the associated outcomes of these pregnancies (i.e., live births, stillbirths, miscarriages and induced abortions). To estimate the number of unintended pregnancies, we multiplied the numbers of contraceptive users and nonusers in need within each five-year age-group by the age- and method-specific use-failure rates and pregnancy rate of nonusers in need. We then adjusted these unintended pregnancy estimates to align with the 2019 pregnancy outcome distribution, which was derived from model-based estimates of unintended pregnancy.[12,49] We estimated this impact under scenarios of no contraceptive use, current levels of use and when all women wanting to avoid a pregnancy are using modern contraceptives (as described in Section 2).

Table 7.1 describes the sources for each method-specific, use-failure rate used in calculating unintended pregnancies in AIU-2019. The age- and method-specific use-failure rates are in Methodology Report Appendix Table MA7.1.

Table 7.1. Sources and descriptions of method-specific use-failure rates

Contraceptive method	Description	Source
Modern methods		
Pill	Age-specific, 12-month use-failure rate estimates from a pooled analysis by Bradley et al. of 16 surveys assessed as having the most reliable data among available DHS in LMICs.[79]	Bradley et al.[79]
Injectable		
Male condom		
IUD		
Implant		
FABMs		Arévalo et al.[211]
Female/male sterilization		Trussell 2011[212]
LAM	We assumed a LAM use-failure rate of 1% for 6 months[213] and half of the 12-month condom use-failure rate for the remaining 6 months.[79]	Van der Wijden[213] and Bradley et al.[79]
Patch/ring	Lacking method-specific data, we used the Bradley et al.[79] pill use-failure rate.	Bradley et al.[79]
Emergency contraception		
Internal (female) condom	Lacking method-specific data, we used the Bradley et al.[79] male condom use-failure rate.	Bradley et al.[79]
Other modern methods		
Traditional methods		
Periodic abstinence	Age-specific, 12-month use-failure estimates from a pooled analysis by Bradley et al. of 16 surveys assessed as having the most reliable data among available DHS surveys in low- and middle-income countries.[79]	Bradley et al.[79]
Withdrawal		
Long-term abstinence, breast-feeding and other traditional methods	We used the average failure rates for all women for periodic abstinence and withdrawal from Bradley et al. to estimate the rate for users of other traditional methods.	Bradley et al.[79]

Pregnancy rate for nonusers in need

For the pregnancy rate for women wanting to avoid a pregnancy but not using a contraceptive method, we used a rate of 40%.[214] The commonly used estimate of 85% represents the estimated pregnancy rate during the first 12 months of couples attempting to get pregnant.[212,215] The 40% pregnancy rate is likely more realistic for a general population of couples who want to avoid a 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.[212,214,216,217] Also, using the DHS approach to categorizing women using no contraceptive method as having unmet need, we considered women who identified their current pregnancy as unintended or were experiencing postpartum amenorrhea after an unintended pregnancy to be nonusers wanting to avoid a pregnancy.[72] The inclusion of these women in the group of nonusers in need further lowered the overall pregnancy rate for this group.

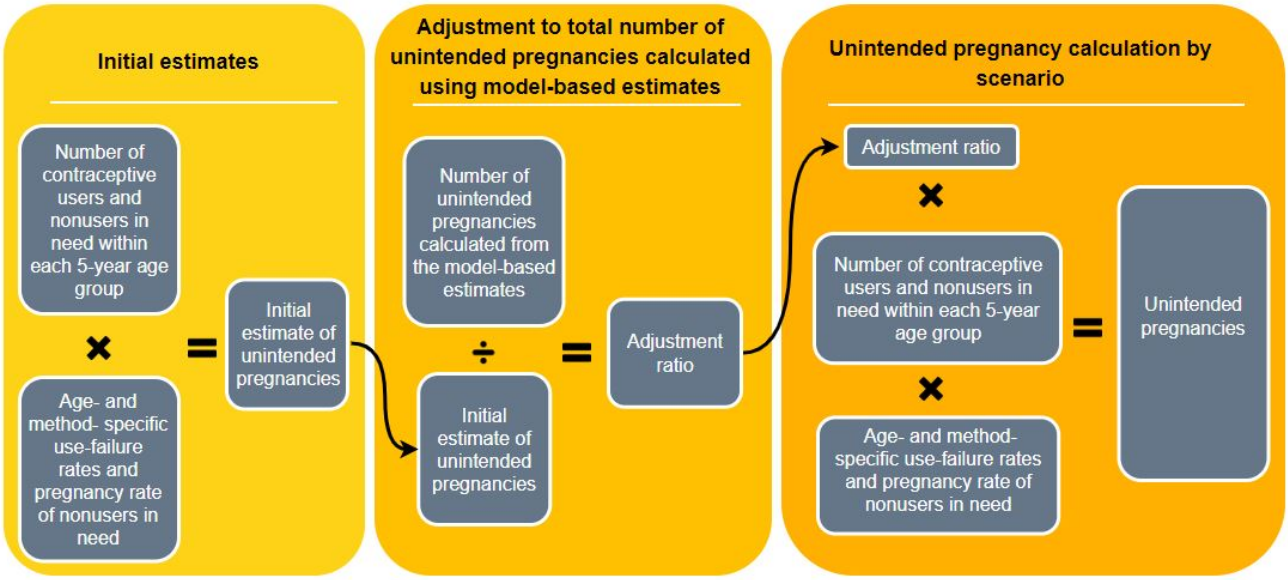
7.3. Analysis approach: unintended pregnancies

We followed three basic steps to calculate unintended pregnancies (illustrated in Figure 7.2):

1. We calculated initial unintended pregnancies using the age- and method-specific use-failure rates and pregnancy rate of nonusers in need.
2. We then adjusted these unintended pregnancy estimates to align with the estimated total number of unintended pregnancies in 2019, which was derived from a robust Bayesian hierarchical time-series model of unintended pregnancy and abortion.[12,49] Because we assumed the pregnancy rate for nonusers in need, we were able to calibrate this pregnancy rate against a robust external source. Details on the calculation of the total number of unintended pregnancies in 2019 using these Bayesian estimates can be found in Section 3.3.
3. Using country-specific adjustment ratios, we calculated an estimate of unintended pregnancies for current levels of care, for the scenario where there is no modern contraceptive use and for the scenario where all modern contraceptive needs are met.

All data used in our calculations to determine unintended pregnancies are country-specific, except for the use-failure rates and pregnancy rate of nonusers in need.

Figure 7.2. Calculation and adjustments of unintended pregnancies



1. Initial estimates

To estimate the number of unintended pregnancies, we multiplied the numbers of contraceptive users and nonusers in need within each five-year age-group by the age- and method-specific use-failure rates and pregnancy rate of nonusers in need for each country. This calculation assumes that all users of a specific method in an age-group had the same average use-failure rate, with no adjustments for differences by marital status, childbearing intention or country of residence. We refer to these estimates of unintended pregnancy as the "initial" estimates.

2. Adjustment to total number of unintended pregnancies calculated using model-based estimates

We adjusted our initial unintended pregnancy estimates to align with the total number of unintended pregnancies in 2019 calculated using the Bayesian hierarchical time-series model estimates of pregnancy.[12] The resulting initial number of unintended pregnancies for LMICs (87 million) was lower than the total number of unintended pregnancies calculated from the model-based estimates (111 million) in 2019. A mismatch between the two estimates is not surprising: the initial pregnancy rate refers to the first 12 months of use while exposed to the chance of becoming pregnant; however, use-failure rates tend to decrease over time, and women wanting to avoid a pregnancy have varying lengths of method use. Also, estimating total unintended pregnancies in a year's time from annual use-failure rates and numbers of users on the basis of survey responses assumes that the need and method-use distribution from a one-point-in-time survey reflects annual use patterns.

To make this adjustment, we calculated country-level adjustment ratios by dividing the estimated number of unintended pregnancies in 2019 calculated from the model-based estimates by the initial number of unintended pregnancies for that country. We multiplied the resulting ratio for each country to the use-failure rate for each method and the pregnancy rate for nonusers in need. This adjustment ensured that the total number of unintended pregnancies in each country in the current use scenario would equal the total number of unintended pregnancies in 2019, and that the relationship between the initial pregnancy rate across method-use categories (including nonuse) would be maintained. Methodology Report Appendix Table MA7.2 shows the adjustment ratios and the estimated distributions of unintended pregnancies in 2019 by contraceptive method, according to selected groupings of LMICs. The overall adjustment ratio for women wanting to avoid a pregnancy in LMICs was 1.28.

3. Unintended pregnancy calculations by scenario

We multiplied the adjusted use-failure rates and the pregnancy rate for nonusers in need by the numbers of women wanting to avoid a pregnancy using each contraceptive method or nonusers in need, respectively, in the no care and all-needs-met scenarios to estimate the numbers of unintended pregnancies under the different contraceptive-use scenarios. We assumed that the proportion of women wanting to avoid a pregnancy and in need of contraceptives and the mix of modern contraceptives used remained constant across scenarios.

7.4. Overview and data sources: maternal and newborn mortality

We estimated the impact of health services on cause-specific maternal and newborn mortality using estimates of effectiveness of interventions from LiST.[94] To estimate the numbers of deaths by cause of death for a single intervention or group of interventions, we multiplied the effectiveness and affected

fraction(s) and applied this product to the numbers of women and newborns in each scenario who received or had unmet need for each intervention.

Table 7.2. Data sources used in impact estimation on maternal and newborn mortality

Indicator	Definition	Source(s)
Maternal deaths	Death during pregnancy, childbirth or up to 42 days after the pregnancy ended	Number of maternal deaths from UN MMEIG;[65] cause-of-death distribution from GBD 2017[64]
Newborn deaths	Death in the first 28 days of life	Number of newborn deaths from UN IGME;[70] cause-of-death distribution from WHO-MCEE[71]
Intervention effectiveness	Proportion of deaths due to a specific cause that are reduced by the intervention	LiST[94]
Affected fraction	Proportion of deaths due to a specific cause that might potentially be affected by a specific intervention	LiST[94]

See Sections 3.5 and 3.6 for details on how we calculated cause-specific deaths.

7.5. Analysis approach: maternal and newborn mortality

Estimating the total impact of maternal and newborn care on mortality is difficult because studies typically assess the impact of specific interventions in isolation. Where available, we used cause-specific effectiveness of interventions aimed at reducing maternal and newborn deaths from specific causes from LiST.[94] We matched the AIU-2019 and LiST interventions to the extent possible. We used numbers of women with live births and stillbirths and numbers of newborns covered and not covered by each intervention and the estimated numbers of deaths for relevant causes from country-level mortality estimates. Using data from the current scenario for 2019, we estimated the rates of death from a specific cause among all women with births or all newborns who received no care relevant to that cause of death. We calculated death rate(s) for those receiving relevant care using the reduction from the no care death rate as estimated from LiST effectiveness and affected fraction(s).

We estimated cause-specific maternal and newborn mortality rates for the following causes:

Table 7.3. Causes of maternal and newborn mortality

Maternal death cause	Newborn death cause
Antepartum or intrapartum hemorrhage	Tetanus
Postpartum hemorrhage	Prematurity
Hypertensive disorder of pregnancy	Birth asphyxia or trauma
Sepsis	Acute respiratory infection
Ectopic pregnancy	Sepsis or other infectious condition of the newborn, including meningitis and encephalitis
Other direct cause, including obstructed labor	
Unsafe abortion	
Safe abortion	
Miscarriage at 14–27 weeks' gestation	
Indirect cause, including death aggravated by HIV/AIDS	

AIU-2019 likely underestimates impact on maternal and newborn mortality for two reasons. First, when AIU-2019 had an intervention that LiST did not have information on intervention effectiveness and affected fractions, we assumed no impact on maternal or newborn deaths for that intervention. Likewise, LiST contained some interventions that were not included in AIU-2019 or outcomes that could not be matched with how we estimated them. As a result, some interventions that would impact newborn mortality were not captured in AIU-2019. The causes of death for which we could not estimate impacts were newborn mortality from diarrhea, other communicable conditions, congenital anomalies, other noncommunicable diseases, HIV/AIDS and injuries.

Tables 7.4 and 7.5 illustrate the calculations for estimating impact with two examples: 1) only one intervention associated with a cause of death and 2) multiple interventions associated with a cause of death.

Example 1: Impact calculation with one intervention (ectopic pregnancy case management)

This example illustrates how we estimated cause-specific mortality rates for ectopic pregnancy and the data inputs used for this estimation. In this case, there is only one intervention—ectopic pregnancy case management—associated with the cause of death. As described in Section 5, we estimated that the number of ectopic pregnancies was equal to 2% of live births plus induced abortions, on the basis of an analysis of data from the early 1990s by researchers at the Centers for Disease Control and Prevention.[108] We assumed that coverage for ectopic pregnancy case management was equivalent to the proportion of deliveries in comprehensive EmOC facilities.

Using these data inputs, we estimated the rate of cause-specific death in a no-care scenario. The difference between estimated deaths from the no care mortality rate and the mortality rate with care is the impact of the intervention on reducing cause-specific maternal death.

First, we multiplied the effectiveness (column D) by the affected fraction (column E). The product (column F) was used to calculate the ineffectiveness (column G). This ineffectiveness reflects the proportion of women for whom the intervention is ineffective at preventing maternal death.

Table 7.4. Data inputs used in estimating impact on maternal mortality—one intervention example

A	*B*	*C*	*D*	*E*	*F*	*G*
Cause of maternal death	Intervention	No. treated	Effectiveness	Affected fraction	Effectiveness (*effectiveness * affected fraction*)	Ineffectiveness *(1 – effectiveness)*
Ectopic pregnancy	Ectopic pregnancy case management	No. of ectopic pregnancies with treatment	0.9	1	0.9 * 1 = 0.9	1 – 0.9 = 0.1

Second, using the ineffectiveness and estimates of women with cause-specific treatment, we estimated the no care mortality rate. We know that the number of cause-specific deaths is equal to:

$$Number\ of\ cause\ specific\ deaths = (\#women\ untreated * no\ care\ mortality\ rate) + (\#\ women\ treated * ineffectiveness * no\ care\ mortality\ rate)$$

Using this equation, we then solved for the no care mortality rate (deaths per 100,000 live births and stillbirths) in the equation below.

No care mortality rate $_{ectopic}$ =

$$\frac{Number\ of\ maternal\ deaths_{ectopic}}{Number\ of\ ectopic\ pregnancies\ with\ treatment * Ineffectiveness_{ectopic} + Number\ of\ ectopic\ pregnancies\ with\ NO\ treatment}$$

Mortality rate with care $_{ectopic}$ = $No\ care\ mortality\ rate_{ectopic} * Ineffectiveness_{ectopic}$

Example 2: Impact calculation with multiple interventions (maternal sepsis)

This example illustrates how we estimated cause-specific mortality rates for maternal sepsis, for which multiple interventions have been shown to reduce the likelihood of this cause of death. When more than one intervention was relevant for a cause of death, the calculation was expanded to take into account:

a) The numbers of women giving birth treated by each intervention (column C) and the total number not covered by the relevant interventions (calculated as all women giving birth minus those covered)

b) The joint effectiveness, estimated by applying each successive intervention's product of effectiveness and affected fraction to the proportion of potential 100% effectiveness remaining after accounting for other interventions (column G)

For example, if women giving birth received all three interventions for sepsis, their sepsis-related death rate would be 0.059 of the death rate for those receiving none of these interventions.

Table 7.5. Data inputs used in estimating impact on maternal mortality—multiple intervention examples							
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
Cause of maternal death	Intervention	No. treated (stepped coverage with multiple interventions)	Effectiveness	Affected fraction	Effectiveness (*effectiveness * affected fraction*)	Effectiveness of multiple interventions	Ineffectiveness *(1 – effectiveness)*
Sepsis	Antibiotics for PPROM	# of women with coverage for antibiotics for PPROM	0.8	0.33	0.8 * 0.33 = 0.264	0.264	1 – 0.264 = 0.736
	Clean birth practices in assisted delivery	# of women with facility delivery – # of women with coverage for antibiotics with PPROM	0.6	1	0.6 * 1 = 0.6	0.264 + (1 – 0.264) * 0.6 = 0.706	1 – 0.706 = 0.294
	Maternal sepsis case management	# of women with care for maternal sepsis – # of women with facility delivery – # of women with coverage for antibiotics with PPROM	0.8	1	0.8 * 1 = 0.8	0.706 + (1 – 0.706) * 0.8 = 0.941	1 – 0.941 = 0.059
Note: Order of interventions does not affect calculations.							

No care mortality rate $_{sepsis}$ (per 100,000 live births and stillbirths) =

$$\frac{Number\ of\ maternal\ deaths_{sepsis}}{\begin{array}{r}(\mathrm{N}_{PPROM} * \mathrm{I}_{PPROM} +\\ \mathrm{N}_{clean\ birth} * \mathrm{I}_{clean\ birth} +\\ \mathrm{N}_{sepsis\ care} * \mathrm{I}_{sepsis\ care} +\\ Number\ of\ births\ with\ NO\ treatment)\end{array}}$$

N=number of births treated with intervention specified in subscript with stepped coverage that takes into account births treated with preceding interventions (Table 7.5, column C)

I=joint ineffectiveness of intervention specified in subscript and the preceding intervention, if relevant (Table 7.5, column H)

Mortality rate with care $_{sepsis}$ = $No\ care\ mortality\ rate_{sepsis} * Ineffectiveness_{sepsis\ care}$

7.6. Adolescent data gaps and assumptions

The age-specific use-failure rates in calculating unintended pregnancies were by five-year age-groups and therefore adolescent-specific. The causes of maternal death from GBD 2017 were age-specific.[66]

The effectiveness and affected fractions from LiST were not age-specific, so we therefore assumed the same effectiveness of interventions for women of reproductive age and adolescent women.

7.7. Stata do-files

The AIU-2019 Contraceptive need and use master do-file.do and AIU-2019 Pregnancy-related and newborn care master do-file.do provide a description of Stata do-files that calculate impact in each component of the analysis.

7.8. Tables

The relevant appendix tables for this section are:

- **Methodology Report Appendix Table MA7.1:** Proportion of women aged 15–49 experiencing an unintended pregnancy during the first year of typical use of contraceptive or no method use, according to age-group
- **Methodology Report Appendix Table MA7.2:** Estimated number of unintended pregnancies and pregnancy rate adjustment ratio; and percentage distribution of unintended pregnancies by contraceptive method used, among women aged 15–49 wanting to avoid pregnancy—all according to selected grouping of LMICs, 2019
- **Methodology Report Appendix Table MA7.3:** Estimated number of pregnancies and unintended pregnancies among women aged 15–49, by outcome, according to contraceptive use scenario and selected grouping of LMICs, 2019
- **Methodology Report Appendix Table MA7.4:** Estimated number of maternal and newborn deaths, by pregnancy intention and outcome, according to contraceptive use scenario and selected grouping of LMICs, 2019
- **Methodology Report Appendix Table MA7.5:** Intervention effectiveness and affected fraction proportions of cause-specific maternal and newborn deaths reduced or potentially impacted by selected interventions, from LiST
- **Methodology Report Appendix Table MA7.6:** Affected fraction proportions of maternal deaths potentially impacted by selected interventions, from LiST, according to LMIC
- **Methodology Report Appendix Table MA7.7:** Estimated rate and ratio of maternal death among women aged 15–49, by pregnancy outcome, according to selected grouping of LMICs, 2019

Section 8: Costs

8.1. Objective

In this section, we provide an overview of how costs were calculated. We include a description of how average costs for individual interventions were assembled and the calculations undertaken to combine average costs with service volumes to produce total costs for each intervention in AIU-2019.

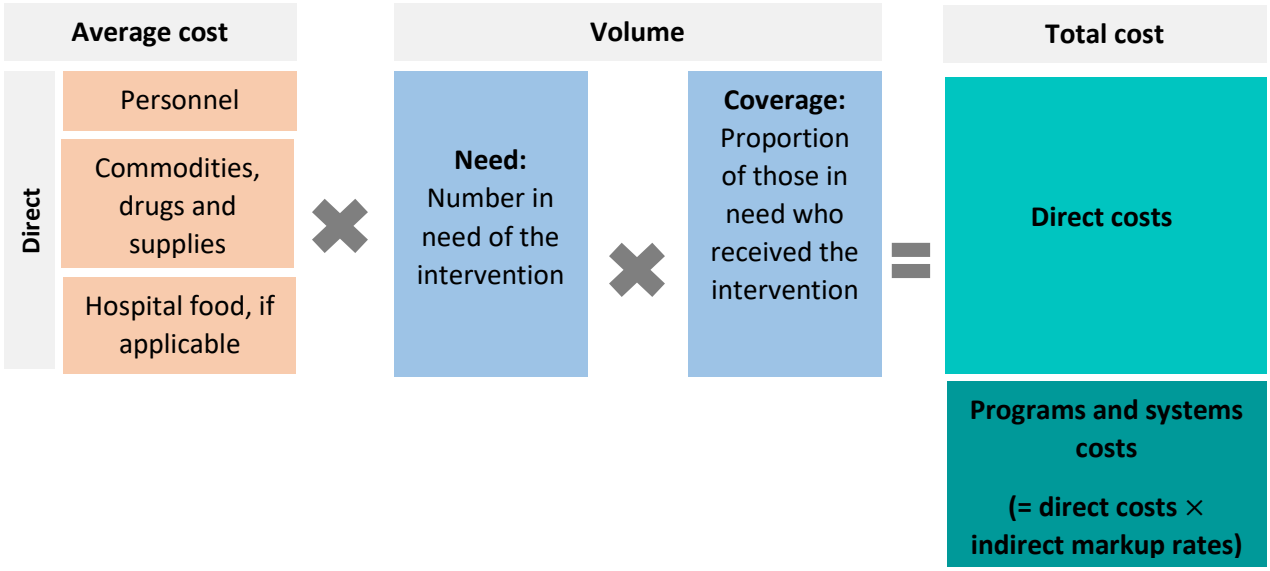
8.2. Key terms and definitions

- **Direct costs** include the costs of contraceptive commodities, drugs, supplies, personnel time and inpatient hospital food. Average direct costs reflect the cost to provide treatment for an average patient in need of the intervention. For example, if 10% of patients receive drug A and the remainder receive drug B, the average direct cost will represent a weighted average of the two drugs' costs. The total direct costs are calculated by multiplying intervention-specific average costs and the overall volume provided (see Figure 8.1).
- **Programs and systems costs**, also known as indirect costs, are defined as the costs of the programs and systems required to provide the interventions. They include program management, staff supervision, monitoring and evaluation, human resources development, transport and telecommunications, health education and outreach, advocacy, infrastructure and equipment, commodity supply systems and health information systems. They are calculated by applying indirect markup rates, or proportional increases, to the estimated direct costs. Further detail is provided in Section 8.4.b.
- **Unit costs** are the costs per intervention. If interventions are offered once per women in need, unit costs equal average direct costs. However, if an intervention is offered more than once to constitute the full service throughout pregnancy, the average cost and unit cost will differ.

8.3. Analysis overview and key assumptions

AIU-2019 includes interventions for modern contraceptive services, pregnancy-related and newborn care, and treatment of four major curable STIs. Estimating costs for individual interventions, or health services, followed the conceptual model in Figure 8.1.

Figure 8.1. Overview of cost calculation per intervention



8.3.a. Costing approach overview

We used a bottom-up, ingredients-based costing methodology for intervention-specific costs. These unit costs were estimated from the health system perspective for each country for all AIU-2019 interventions listed in Methodology Report Appendix Table MA1.3.

For the majority of the interventions, the intervention-specific average costs for each direct cost component (i.e., personnel cost, contraceptive commodity cost, drugs and supplies cost, and hospital food cost) were multiplied by the estimated number of women in need and the proportion covered by each intervention to produce the total direct cost. Then, all direct cost components were summed to produce the overall total direct cost per intervention. Separately, the indirect cost markup rates were multiplied by the total direct costs to produce the required programs and systems costs. Finally, the total direct costs and the programs and systems costs were summed to produce total costs.

All unit costs for direct cost components were estimated in 2019 U.S. dollars. If inflation of prices or costs to 2019 was necessary (see Section 8.4.a for personnel and drugs and supplies costs), we used the International Monetary Fund's gross domestic product (GDP) deflators,[218] capping year-on-year inflation at 200%. Inflation rates for countries missing deflator information were drawn from the World Bank[219] or imputed based on average annual inflation in the country's UN Population Division subregion.[43]

Imputation for missing cost component data, if needed, was done using averages for UN Population Division subregions or regions.[43] The only exception to this was the use of WHO regions to impute values for personnel cost data, which were supplied using WHO regions.[206]

8.3.b. Analysis assumptions

We assumed constant marginal costs for the direct cost components, i.e., that the average direct cost of providing services to each additional individual is the same as costs for the last individual served. This assumption was based on a lack of available data on expected changes in marginal costs. Thus, the model does not account for increasing marginal costs to accommodate individuals not served by

traditional service-delivery models; conversely, the model does not account for potential savings through economies of scale.

All scenarios represent service provision under ideal conditions, in that they assumed that all needed components are available and provided by appropriately trained staff (see Section 8.3.c. for more information). Also, the sources of price and cost information that we used largely represent service provision in public-sector settings, and thus may underestimate costs in countries with substantial proportions of private-sector service providers.

As noted in Section 2, when moving from the current levels of care to the all-needs-met scenarios, we assumed that the required investments and resulting gains are immediate—in 2019. Because scaling up to all needs met was assumed to be instantaneous, no discounting of costs or benefits is required. Also, as durable equipment was assumed to be included in the indirect cost markup rate, annualization was not required. The values of the direct cost components were held constant across the current levels of care and all-needs-met scenarios, meaning that the average direct cost per recipient of each intervention was the same regardless of the volume of care provided. In contrast, the indirect cost markup rates were varied when moving from the current levels of care to the all-needs-met scenarios (see Section 8.4.b for more information).

8.3.c. Treatment assumptions

Estimates of the types and quantities of resources required to provide contraceptive services, pregnancy-related and newborn care and STI care are based on assumptions from LiST[94] and the OneHealth Tool,[95] supplemented by literature, WHO policies and general recommendations, and expert review.

The treatment assumptions list, shown in Methodology Report Appendix Table MA1.3, include the following information for each intervention:

- The types of personnel and the number of minutes required to provide care and, in many cases, the specific care each would provide (e.g. counseling, injection)
- The types and quantities of all contraceptive commodities, drugs and supplies required
- The number of days spent as an inpatient, if applicable, and the food costs per day

For contraceptive methods, the assumptions include personnel and drugs and supplies for provision over a one-year period, including for the initial provision, refills and removal, if necessary.

8.4. Data sources and estimation approach

8.4.a. Direct costs

Table 8.1: Source of price and unit cost information for direct and programs and systems costs

Item	Description	Source
Direct costs	**Personnel costs:** country-specific costs per minute for various categories of health care worker	WHO-CHOICE[220]
	Contraceptive commodity and service costs: country-specific costs per contraceptive commodity type and category (e.g., pills, injectables)	Reproductive Health Interchange database[221]
	Other drug and supply costs: costs per medication or medical consumable	UNICEF supply catalog;[222] IDA Foundation;[223] Management Sciences for Health International Medical Products Price Guide;[224] CHAI;[225] UNFPA;[226] the Global Fund;[227] IMRES;[228] other online or single-country suppliers[229–235]
	Hospital food costs: country-specific daily costs for provision of food for inpatient services only	Estimated using assumptions
Programs and systems costs	Calculated using **indirect markup rates** that were applied to the total direct costs for each intervention	UNFPA Technical Division[35]

Personnel costs

Source: Country-specific personnel salaries are drawn from a 2018 publication by WHO-CHOICE that presented 2010 personnel cost estimates.[220] The researchers estimated annual wages for four skill levels of health personnel. The predicted salaries refer to the gross earnings received by the employee and include salary, paid vacation, and regularly paid guarantees or allowances, such as social security, health insurance and bonuses.

Estimation approach: Salaries were inflated from 2010 to 2019 as described. Following OneHealth Tool assumptions, we converted annual salaries to costs-per-minute of service provision assuming 48 weeks of work per year and 30 hours of work per week.[95]

To map the WHO-CHOICE salary skill levels[220] onto the various staff types included in AIU-2019, we consulted with health care professionals and heeded recent guidance on task-shifting of services.[236,237] As shown in Methodology Report Appendix Table MA8.1b, to estimate earnings for physicians, including both general and specialist physicians, we assumed salaries for skill level 4, which is equivalent to the second stage of tertiary education. For nurses and midwives offering any service, we followed Serje et al.[220] and used the average of salaries in level 3 (equivalent to the first stage of tertiary education) and level 4. We also used this average for X-ray and laboratory technicians. For assistant nurses and auxiliary

attendants offering pregnancy-related and newborn care, we used skill level 3. For community health care workers providing outreach and support for pregnancy-related and newborn care, we assumed salary skill level 1. For contraceptive service provision, we allowed for inclusion of assistant nurses and community health care workers interchangeably and thus used the average of salaries for skill levels 1 and 3.

The types of staff and the number of minutes required for each intervention are shown in the treatment assumptions list in Methodology Report Appendix Table MA1.3. Methodology Report Appendix Table MA8.1a shows the 2019 country-specific costs per minute for staff skill levels 1–4 and the WHO-CHOICE salary skill levels.

Contraceptive commodity and service costs

Source: The Reproductive Health Interchange (RHI) database supplies price data for contraceptive orders and shipments, and it reflects more than 80% of contraceptive supplies provided by donors to over 150 countries.[221] The RHI cost data include the total landed cost for a commodity, meaning they provide a commodity's unit price summed with other costs of provisioning the commodity, such as shipping, insurance and related fees. For AIU-2019, we used RHI contraceptive price information for a four-year period (January 1, 2015, to most current, December 31, 2018).

Estimation approach: We calculated the method-specific unit cost per contraceptive commodity shipment in the RHI data by dividing the total cost for the shipment by the total number of units in the shipment. Separately, we established a plausible range for the unit cost for each commodity. This range was based on review of price data over time, price estimates published by UNFPA[238–241] and discussion with contraceptive costing experts. Then, we checked whether the calculated method-specific unit costs from all shipments were within the plausible ranges. If outliers were found to be due to obvious recording errors in the data set (e.g., a shipment of nine contraceptive pill packs instead of 9,000), these mistakes were corrected. If no obvious error could be found, out-of-range unit costs were flagged as outliers.

Then, for each country for which we had commodity cost data, we calculated the average cost per method, weighted by the shipment volumes. This was done by dividing the total costs of all method-specific shipments by the total number of method units in the shipments. We performed this calculation twice: first including and then excluding all outliers. If including the shipments with outlier unit costs did not change the weighted average cost per commodity type in a particular country by more than 10% (higher or lower), then the outliers were maintained. However, if the weighted cost of a method was greater than 10% (higher or lower) when the outliers were included, we followed a set of pre-established rules for checking each outlier. If the outliers were the minority of shipments, we censored them one at a time until the weighted average cost per method with the remaining outliers was within 10% of the weighted average cost without outliers. For cases where outliers comprised the only or the majority of method shipments in a country, we checked whether the outlier was greater than two standard deviations away from the mean unit cost for the item—in the country and in the country's UN Population Division subregion—and if yes for both, we excluded the outlier.

After checking and censoring outliers, we recalculated the average unit costs per method for each country by dividing the total costs of all allowed (i.e., noncensored) shipments by the total number of method units in those shipments. We did not inflate the unit costs because of the relative stability of

contraceptive commodity prices over short to medium periods of time, as observed within a sample of RHI data covering 2013–2018.

Then, the contraceptive method unit costs were annualized to reflect couple-years of protection (CYP), or estimates of the number of commodity units, or method use required, to provide one year of contraceptive protection, i.e., with no unintended pregnancy. For AIU-2019, we based annualization on conversion factors estimated in 2011 by USAID.[242–244] Calculation of CYP conversion factors, which are used to convert individual method units to CYPs, generally includes assessment and adjustment for the following conditions:

- Use-failure rates for all methods
- Duration of use for long-acting reversible and permanent methods and FABMs, based on continuation rates and age at the time the method is received
- Coital frequency and consistency of use for such coitus-dependent methods as condoms and spermicides
- Wastage for user-controlled short-acting methods, such as the pill, condoms and spermicides

Since AIU-2019's analysis accounts for method use-failure in a separate step (see Section 7), we recalculated the conversion factors, removing the contribution of method use-failure. For methods with more than one type of product per category, we calculated weighted average method costs. Collapsing occurred in several categories of method types:

- The pill category includes combined and progestin-only formulations.
- The IUD category could have included copper and levonorgestrel IUDs; however, none of the latter were included in the priced shipments.
- The injectables category includes one-, two- and three-month injectables, including a self-injectable option.
- The implants category includes a single-rod etonogestrel implant and two-rod levonorgestrel implants.

Some regions lacked any contraceptive commodity cost data. For countries in those regions, we imputed average annualized costs from a proxy UN Population Division subregion.[43] These cases were as follows: Injectable and IUD costs for Eastern Europe were set to equal observed prices in Southern Europe. Internal (female) condom and implant prices for Eastern Europe and Southern Europe were set to equal prices observed for Central Asia and Western Asia. For emergency contraceptive pills, prices in Central Asia, Eastern Europe and Southern Europe were set to equal prices in Western Asia. For all methods in Micronesia and for internal (female) condoms and implants in Polynesia, we used the average price in the Oceania region. Finally, prices for FABMs (i.e., CycleBeads) were available only for two African countries. We used the average of the prices in these two countries as a proxy price for FABMs in other regions.

Annual commodity costs per user for each method and country are shown separately in Methodology Report Appendix Table MA8.3 and conversion factors for annualization of contraceptive commodity costs are shown in Methodology Report Appendix Table MA8.4.

Other drug and supply costs

Sources: Prices for drugs and supplies were drawn from UNICEF,[222] the IDA Foundation,[223] Management Sciences for Health International Medical Products Price Guide,[224] CHAI,[225] UNFPA,[226] the Global Fund,[227] IMRES,[228] and other online and single-country sources.[229–235]

Estimation approach: AIU-2019 includes prices for more than 140 drugs, supplies and diagnostics. Each item required one price, which we assumed to be applicable in all of the LMICs included.

We searched the sources in the order listed for the most recent price for each required drug and supply item. If we could not find a price in any of those internationally recognized catalogs or listings, we resorted to other sources. For supply items such as the hat and socks required for newborns, medical ID bracelets and women's printed ANC record, we used private sector bulk-purchasing quotations.[229] For blood products and oxygen, we performed special tabulations with data drawn from different sources and expert opinion[229–235], and for in-house diagnostics (such as hemoglobin and nitrite test strips) and laboratory testing (such as blood typing), we used information obtained from published individual sources.[229–232]

Most prices were reported for 2018; we only inflated prices if they were older than 2015, following the inflation methodology noted in Section 8.3.a. Finally, based on consultation with WHO colleagues, we increased all drug and supply prices by 45% to allow for shipping (15%) and wastage (30%) costs. Wastage is assumed to include expiry, damage and other losses prior to dispensing.

The types and quantities of drugs and supplies required per intervention are shown in the treatment assumptions list in Methodology Report Appendix Table MA1.3. The drug and supply costs and sources are shown in Methodology Report Appendix Table MA8.6.

Hospital food costs

Source: For interventions requiring inpatient care, our treatment assumptions included the daily cost of food. Other costs of hospitalization were assumed to be included in programs and systems costs.

Estimation approach: In prior iterations of Adding It Up, daily food costs were estimated at $0.50 per person per day. For AIU-2019, we stratified this initial point estimate using the proportional distribution of GDP per capita in each country. We first determined the mean GDP per capita among the LMICs in AIU-2019, and then computed the difference from each individual country's GDP per capita as a percentage (e.g., country A is X% higher than the mean; country B is Y% lower than the mean). We then used those percentages to inflate or deflate the $0.50 point estimate (e.g., country A's hospital costs would be X% higher than $0.50; country B's hospital costs would be Y% lower than $0.50).

The treatment assumptions (Methodology Report Appendix Table MA1.3) show the interventions assumed to require hospitalization. Food costs per day per country are listed in Methodology Report Appendix Table MA8.7.

8.4.b. Programs and systems costs

Source: We estimated programs and systems costs from work done by researchers at UNFPA in 2009.[35] The UNFPA approach provides cost estimates for the following categories of health programs and systems related to SRH care services:

- Program management—developing and assessing policies, regulations, and strategic and operations plans for programs
- Staff supervision
- Monitoring and evaluation—establishing or integrating services into monitoring and evaluation frameworks and designs, conducting household-based surveys (such as DHS) and conducting facility-based surveys
- Human resources development—increasing training capacity and number of trained staff to scale to target coverage levels, accounting for attrition; upgrading preservice 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—raising community 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 maintaining supply chains
- Health management information system improvements

Estimation approach: UNFPA produced region-specific indirect markup rates for calculating programs and systems costs assuming both a pre- and post-scale-up environment spanning the years 2008–2015. To calculate programs and systems costs, the indirect markup rates were multiplied by the total direct cost per intervention.

We assumed that UNFPA's estimated markup rates for 2008 (pre-scale-up) apply to the current levels for AIU-2019. Although UNFPA assumed that full scale-up of programs and systems to support health service provision would occur over a period spanning 2009–2015, for the all-needs-met scenario in AIU-2019, we used the rates presented for 2009. The 2009 markup rates reflected the large, immediate investments thought to be needed for health systems to initiate expansion of capacity and improve service quality to meet international standards. The UNFPA markup rates presented for subsequent years (2010–2015) represented required marginal increases or sustained investments.

To illustrate how the markup rates were applied for AIU-2019, for the current levels of care, programs and systems costs were estimated to be equivalent to 53.5% of direct costs in Sub-Saharan Africa (Table 8.2). For the all-needs-met scenario with improved and increased service coverage, the programs and systems costs increased in this region to an equivalent of 382.6% of total direct costs. The larger increase in Sub-Saharan Africa between 2008 and 2009, compared with other regions, reflects the resource requirements for expanding capacity, such as capital investments in the health care system, and improving quality to meet international standards. In Eastern Europe and Southern Europe, programs and systems costs were assumed to be sufficiently high in 2008, and thus remained relatively stable over time, so the difference between 2008 and 2009 is relatively small.

Table 8.2. Indirect markup rates for calculating programs and systems costs

Region	Current level of care/2008	All needs met/2009
Sub-Saharan Africa	0.535	3.826
Asia and the Pacific	0.942	1.139
Latin America and the Caribbean	1.321	1.470
Western Asia and Northern Africa	1.249	1.370
Eastern Europe and Southern Europe	1.298	1.245

Note that the markup rates were originally meant to capture programs and systems costs for SRH care, not including STI management and care related to HIV/AIDS. However, because of the lack of additional data sources on appropriate markup rates for these health services, we used the rates for all interventions in AIU-2019.

8.4.c. Estimation approach: abortion care, PAC and miscarriage care

For induced abortion care, PAC and miscarriage care, the services were broken down into smaller components, or subinterventions, to account for the fact that multiple methods are available to provide the specific service. Average direct costs were produced for each of these subinterventions, then combined using weights reflecting the proportional representation of the methods in different settings to produce weighted average intervention costs.

Abortion care

As noted in Section 3, abortions were classified as safe, less safe and least safe.[59] Using the best available data, we established a country-specific proportional distribution of methods among women receiving safe or less safe abortions. We assumed that safe methods included a mix of all WHO-recommended options: manual or electric vacuum aspiration (MVA/EVA), dilation and evacuation (D&E), and medication abortion with and without mifepristone. Less safe methods included dilation and curettage (D&C), which is not recommended by WHO as a safe abortion method, plus MVA/EVA and medication abortion with and without mifepristone. We did not include methods for least safe abortions because we assumed that least safe procedures did not incur direct health systems costs. See Methodology Report Appendix Tables MA5.8a and MA5.8b for the percentage distribution of induced abortion methods for safe and less safe abortions, respectively.

We estimated health systems costs separately for each service type in each safety category. For the recommended procedures in the safe category, we assumed use of drugs and supplies in accordance with WHO guidance. In the less safe abortion category, for D&C we also assumed use of health systems supplies and personnel. However, for other methods in the less safe category, we either assumed lower levels of staffing than are recommended or that certain health systems supplies, such as painkillers and sterile gloves, are not used (see Methodology Report Appendix Table MA1.3). Finally, we used the country-level safety distribution of abortions to estimate an overall weighted average cost for abortion services in a country.

PAC and miscarriage care

Weighted average intervention costs for these two services were estimated using an approach similar to that used for abortion care costs. Each service was separated into the possible clinical approaches and populations affected, then weighted average costs were computed. The weighted PAC costs take into consideration that women can have more than one complication. The types of postabortion complications and subsequent clinical treatments are detailed in Section 5.4.

8.4.d. Estimation approach: special cases

Intervention 400—Basic ANC: For this intervention, we costed out the number of ANC visits reported by women in DHS and other national surveys. In the all-needs-met scenario, we assumed that all women giving birth would have at least eight visits, per WHO recommendations. Therefore, the costs for this intervention were divided into three intervention unit costs: 1) first visit only, 2) each subsequent visit and 3) all eight visits. The first visit includes a number of different diagnostics and time spent with a health care worker to provide counseling and other services; subsequent visits require fewer resources.

STI-related interventions: STI treatment interventions were calculated in two different ways. Need and coverage for syphilis, gonorrhea and chlamydia treatment were estimated for pregnant women (as explained in Section 5), and need and coverage for chlamydia, gonorrhea, trichomoniasis and syphilis treatment were estimated among all women aged 15–49 (as described in Section 6). To avoid double counting, when presenting the total costs of offering contraceptive services, pregnancy-related and newborn care, and STI treatment, we subtracted the costs of treating STIs in pregnant women from the costs of treating STIs in all women of reproductive age.

Methodology Report Appendix Table MA1.2 provides a list of pregnancy-related and newborn care interventions where one unit cost was applied to more than one intervention.

8.5. Tables

The costing components were compiled in Microsoft Excel, so there are no Stata do-files for this section. However, the list below provides the tables of data inputs and treatment assumptions used in estimating costs for AIU-2019.

- **Methodology Report Appendix Table MA8.1a:** Annual and per-minute salary for health care personnel, by LMIC, 2019
- **Methodology Report Appendix Table MA8.1b:** Mapping of 2010 WHO-CHOICE health care personnel salary categories to AIU-2019 personnel salaries
- **Methodology Report Appendix Table MA8.2:** Average annualized contraceptive commodity cost by method in U.S. dollars, according to selected grouping of LMICs, 2015–2018
- **Methodology Report Appendix Table MA8.3:** Average annualized contraceptive commodity cost by method in U.S. dollars, according to LMIC, 2015–2018
- **Methodology Report Appendix Table MA8.4:** Conversion factors for annualization of contraceptive commodity costs, according to short- and long-acting methods
- **Methodology Report Appendix Table MA8.5:** Average annual direct costs per user in U.S. dollars, by contraceptive method for each direct cost category, according to selected grouping of LMICs, 2019

- **Methodology Report Appendix Table MA8.6:** Unit costs of drugs and supplies needed for provision of SRH care, and sources for pricing
- **Methodology Report Appendix Table MA8.7:** Hospital food cost per day, in U.S. dollars, by LMIC, 2019

References

1. Sully EA et al., *Adding It Up: Investing in Sexual and Reproductive Health 2019*, New York: Guttmacher Institute, 2020, https://www.guttmacher.org/report/adding-it-up-investing-in-sexual-reproductive-health-2019.

2. Singh S et al., *Adding It Up: The Benefits of Investing in Sexual and Reproductive Health Care*, New York: The Alan Guttmacher Institute and United Nations Population Fund (UNFPA), 2003, https://www.guttmacher.org/report/adding-it-benefits-investing-sexual-and-reproductive-health-care-2003.

3. Singh S et al., *Adding It Up: The Costs and Benefits of Investing in Family Planning and Maternal and Newborn Health*, New York: Guttmacher Institute and UNFPA, 2009, https://www.guttmacher.org/report/adding-it-costs-and-benefits-investing-family-planning-and-maternal-and-newborn-health.

4. Singh S and Darroch JE, *Adding It Up: Costs and Benefits of Contraceptive Services—Estimates for 2012*, New York: Guttmacher Institute, 2012, https://www.guttmacher.org/report/adding-it-costs-and-benefits-contraceptive-services-estimates-2012.

5. Singh S, Darroch JE and Ashford L, *Adding It Up: The Need for and Cost of Maternal and Newborn Care—Estimates for 2012*, New York: Guttmacher Institute, 2013, https://www.guttmacher.org/report/adding-it-need-and-cost-maternal-and-newborn-care-estimates-2012.

6. Singh S, Darroch JE and Ashford L, *Adding It Up: The Costs and Benefits of Investing in Sexual and Reproductive Health 2014*, New York: Guttmacher Institute and UNFPA, 2014, https://www.guttmacher.org/report/adding-it-costs-and-benefits-investing-sexual-and-reproductive-health-2014.

7. Guttmacher Institute, Adding It Up: Investing in contraception and maternal and newborn health, 2017, *Fact Sheet*, New York: Guttmacher Institute, 2017, https://www.guttmacher.org/fact-sheet/adding-it-up-contraception-mnh-2017.

8. Darroch JE et al., *Adding It Up: Costs and Benefits of Meeting the Contraceptive Needs of Adolescents*, New York: Guttmacher Institute, 2016, https://www.guttmacher.org/report/adding-it-meeting-contraceptive-needs-of-adolescents.

9. Statistics Division, United Nations (UN) Department of Economic and Social Affairs, M49 Standard, Developing Regions, https://unstats.un.org/unsd/methodology/m49/.

10. World Bank, World Bank Country and Lending Groups, 2020 fiscal year, https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

11. Population Division, UN Department of Economic and Social Affairs, Estimates and Projections of Family Planning Indicators 2020, New York: United Nations, 2020, https://www.un.org/en/development/desa/population/theme/family-planning/cp_model.asp.

12. Bearak J et al., Unintended pregnancy and abortion by income, region, and the legal status of abortion: estimates from a comprehensive model for 1990–2019, *Lancet Global Health*, 2020.

13. Bradley S et al., Revising unmet need for family planning, *DHS Analytical Studies*, Calverton, MD, USA: ICF International, 2012, No. 28, https://dhsprogram.com/publications/publication-as25-analytical-studies.cfm.

14. Vlassoff M et al., Assessing costs and benefits of sexual and reproductive health interventions, *Occasional Report*, New York: The Alan Guttmacher Institute, 2004, No. 11.

15. Darroch JE and Singh S, *Adding It Up: The Costs and Benefits of Investing in Family Planning and Maternal and Newborn Health—Estimation Methodology*, New York: Guttmacher Institute, 2011, https://www.guttmacher.org/sites/default/files/pdfs/pubs/AIU-methodology.pdf.

16. Darroch JE, Singh S and Weissman E, *Adding It Up: The Costs and Benefits of Investing in Sexual and Reproductive Health 2014—Estimation Methodology*, New York: Guttmacher Institute, 2016, https://www.guttmacher.org/report/adding-it-costs-and-benefits-investing-sexual-and-reproductive-health-2014-methodology.

17. Darroch JE, *Adding It Up: Investing in Contraception and Maternal and Newborn Health, 2017—Estimation Methodology*, New York: Guttmacher Institute, 2018, https://www.guttmacher.org/report/adding-it-up-investing-in-contraception-maternal-newborn-health-2017-methodology.

18. Stenberg K et al., Returns on investment in the continuum of care for reproductive, maternal, newborn, and child health, in: Black R et al., eds., *Reproductive, Maternal, Newborn, and Child Health: Disease Control Priorities*, third ed., Vol. 2, Washington, DC: World Bank, 2016, pp. 299–317, https://doi.org/10.1596/978-1-4648-0348-2.

19. Reproductive Health Supplies Coalition, *Commodity Gap Analysis 2019*, 2019, https://www.rhsupplies.org/cga/.

20. Stenberg K et al., Financing transformative health systems towards achievement of the health Sustainable Development Goals: a model for projected resource needs in 67 low-income and middle-income countries, *Lancet Global Health*, 2017, 5(9):e875–e887, https://doi.org/10.1016/S2214-109X(17)30263-2.

21. Sheehan P et al., Building the foundations for sustainable development: a case for global investment in the capabilities of adolescents, *Lancet*, 2017, 390(10104):1792–1806, https://doi.org/10.1016/S0140-6736(17)30872-3.

22. Every Woman Every Child, *Global Strategy for Women's, Children's and Adolescents' Health 2016–2030*, New York: UN, 2015, https://www.who.int/life-course/publications/global-strategy-2016-2030/en/.

23. UN Secretary General, *Global Strategy for Women's and Children's Health*, New York: Partnership for Maternal, Newborn and Child Health, 2010, https://www.who.int/woman_child_accountability/about/un_gs/en/.

24. Global Financing Facility, *Global Financing Facility in Support of Every Woman Every Child: Business Plan*, Washington, DC: World Bank, 2015, https://www.worldbank.org/en/topic/health/brief/global-financing-facility-business-plan.

25. Family Planning 2020, *Family Planning's Return on Investment*, Washington, DC: Family Planning 2020, no date, http://www.familyplanning2020.org/sites/default/files/Data-Hub/ROI/FP2020_ROI_OnePager_FINAL.pdf.

26. Family Planning 2020, FP2020: Women at the Center 2018–2019, 2019, http://progress.familyplanning2020.org/.

27. UN Economic and Social Council, Report on the flow of financial resources for assisting in the implementation of the Programme of Action of the International Conference on Population and Development, paper presented at the Commission on Population and Development 50th session, New York, Apr. 3–7, 2017, https://undocs.org/E/CN.9/2017/4.

28. UNFPA and Netherlands Interdisciplinary Demographic Institute, Resource Flows Open Database, 2014, http://resourceflowsdata.org/.

29. Deutsche Stiftung Weltbevolkerung and European Parliamentary Forum on Population and Development, *Accountability Guide for Reproductive, Maternal, Newborn and Child Health, and Family Planning: Euromapping 2018*, Brussels: Deutsche Stiftung Weltbevolkerung and European Parliamentary Forum on Population and Development, 2018, https://euromapping.org/.

30. Partnership for Maternal, Newborn & Child Health, *2015 Accountability Report, Strengthening Accountability: Achievements and Perspectives for Women's, Children's, and Adolescents' Health*, Geneva: World Health Organization (WHO), 2015, https://www.who.int/pmnch/knowledge/publications/2015_pmnch_report/en/.

31. Couture T and Dennis S, *Towards a Common Framework for Measuring Government Spending on Family Planning*, Washington, DC: Population Action International, 2016, https://pai.org/resources/towards-common-framework-measuring-government-spending-family-planning.

32. Countdown 2030 Europe, Factsheet: European donor support to sexual & reproductive health & family planning, Countdown 2030 Europe, 2017, https://countdown2030europe.org/resources/european-donor-support-sexual-reproductive-health-family-planning.

33. Kates J, Wexler A and Lief E, *Donor Government Funding for Family Planning in 2018*, San Francisco: Kaiser Family Foundation, 2019, https://www.kff.org/report-section/donor-government-funding-for-family-planning-in-2018-report/.

34. Institute for Health Metrics and Evaluation (IHME), *Financing Global Health 2018: Countries and Programs in Transition*, Seattle: IHME, 2019, http://www.healthdata.org/policy-report/financing-global-health-2018-countries-and-programs-transition.

35. Technical Division, UNFPA, *Revised Cost Estimates for the Implementation of the Programme of Action for the International Conference on Population and Development: A Methodological Report*, New York: UNFPA, 2009, https://www.unfpa.org/resources/revised-cost-estimates-implementation-programme-action-icpd.

36. Grepin KA and Klugman J, *Closing the Deadly Gap Between What We Know and What We Do*, Washington, DC: World Bank Group, 2013, No. 78114, http://documents.worldbank.org/curated/en/217631468333060680/Closing-the-deadly-gap-between-what-we-know-and-what-we-do.

37. Taskforce on Innovative International Financing for Health Systems, *More Money for Health, and More Health for the Money*, Taskforce on Innovative International Financing for Health Systems, 2009, https://www.uhc2030.org/fileadmin/uploads/ihp/Documents/Results___Evidence/HAE__results___lessons/Taskforce_report_EN.2009.pdf.

38. Johns B et al., Estimated global resources needed to attain universal coverage of maternal and newborn health services, *Bulletin of the World Health Organization*, 2007, Vol. 85, No. 4, pp. 256–263, http://doi.org/10.2471/BLT.06.032037.

39. Ross J, Weissman E and Stover J, *Contraceptive Projections and the Donor Gap*, Brussels: Reproductive Health Supplies Coalition, 2009, https://www.rhsupplies.org/uploads/tx_rhscpublications/RHSC-FundingGap-Final.pdf.

40. UNICEF and WHO, *Tracking Progress Towards Universal Coverage for Reproductive, Newborn and Child Health: The 2017 Report*, Washington, DC: UNICEF and WHO, 2017, https://data.unicef.org/resources/countdown-2030-tracking-progress-towards-universal-coverage-womens-childrens-adolescents-health-2019/.

41. STEP UP Research Programme Consortium, Measuring the impact of contraceptive use on unintended pregnancy and other health outcomes, New York: Population Council, 2014, http://doi.org/10.31899/rh4.1023.

42. Askew I et al., Harmonizing methods for estimating the impact of contraceptive use on unintended pregnancy, abortion, and maternal health, *Global Health: Science and Practice*, 2017, 5(4):658–667, https://doi.org/10.9745/GHSP-D-17-00121.

43. Population Division, UN Department of Economic and Social Affairs, World Population Prospects 2019, Online Edition, Rev. 1, August 2019, https://population.un.org/wpp/Download/Standard/.

44. StataCorp, Stata Statistical Software: Release 16.0, College Station, TX, USA: StataCorp, 2019.

45. Population Division, UN Department of Economic and Social Affairs, Estimates and Projections of Women of Reproductive Age Who Are Married or in a Union: 2020 Revision, 2020, https://www.un.org/en/development/desa/population/theme/marriage-unions/marriage_estimates.asp.

46. Population Division, UN Department of Economic and Social Affairs, World Marriage Data 2017, 2017, https://www.un.org/en/development/desa/population/theme/marriage-unions/WMD2017.asp.

47. Statistics Division, UN Department of Economic and Social Affairs, Population by marital status, age, sex and urban/rural residence, UNData, Demographic Statistics Database, downloaded Sept. 5, 2019, http://data.un.org/Data.aspx?d=POP&f=tableCode%3A23.

48. WHO, *The WHO Application of ICD-10 to Deaths During the Perinatal Period: ICD-PM*, Geneva: WHO, 2016, https://apps.who.int/iris/bitstream/handle/10665/249515/9789241549752-eng.pdf?sequence=1.

49. Bearak JM et al., Pregnancies, abortions, and pregnancy intentions: a protocol for modeling and reporting global, regional and country estimates, *Reproductive Health*, 2019, 16(36), https://doi.org/10.1186/s12978-019-0682-0.

50. Chae S et al., Characteristics of women obtaining induced abortions in selected low- and middle-income countries, *PLOS ONE*, 2017, 12(3):e0172976, https://doi.org/10.1371/journal.pone.0172976.

51. Mohamed SF et al., The estimated incidence of induced abortion in Kenya: a cross-sectional study, *BMC Pregnancy and Childbirth*, 2015, 15(185), https://doi.org/10.1186/s12884-015-0621-1.

52. Sully E et al., Playing it safe: legal and clandestine abortions among adolescents in Ethiopia, *Journal of Adolescent Health*, 2018, 62(6):729–736, https://doi.org/10.1016/j.jadohealth.2017.12.015.

53. Statistics Division, UN Department of Economic and Social Affairs, *Demographic Yearbook 2017*, 68th ed., New York: UN, 2018, https://unstats.un.org/unsd/demographic-social/products/dyb/dyb_2017/.

54. Juarez F et al., *Unintended Pregnancy and Induced Abortion in Mexico: Causes and Consequences*, New York: Guttmacher Institute, 2013, https://www.guttmacher.org/report/unintended-pregnancy-and-induced-abortion-mexico-causes-and-consequences.

55. Sully EA et al., Estimating abortion incidence among adolescents and differences in postabortion care by age: a cross-sectional study of postabortion care patients in Uganda, *Contraception*, 2018, 98(6):510–516, https://doi.org/10.1016/j.contraception.2018.07.135.

56. Leridon H, *Human Fertility: The Basic Components*, Chicago: University of Chicago Press, 1977, Table 4.20.

57. Bongaarts J and Potter RG, *Fertility, Biology, and Behavior: An Analysis of the Proximate Determinants*, New York: Academic Press, 1983.

58. Blencowe H et al., National, regional, and worldwide estimates of stillbirth rates in 2015, with trends from 2000: a systematic analysis, *Lancet Global Health*, 2016, 4(2):e98–e108, https://doi.org/10.1016/S2214-109X(15)00275-2.

59. Ganatra B et al., Global, regional, and subregional classification of abortions by safety, 2010–14: estimates from a Bayesian hierarchical model, *Lancet*, 2017, 390(10110):2372–2381, https://doi.org/10.1016/S0140-6736(17)31794-4.

60. Singh S et al., The incidence of menstrual regulation procedures and abortion in Bangladesh, 2014, *International Perspectives on Sexual and Reproductive Health*, 2017, 43(1):1–11, https://www.jstor.org/stable/10.1363/43e2417.

61. Moore AM et al., The estimated incidence of induced abortion in Ethiopia, 2014: changes in the provision of services since 2008, *International Perspectives on Sexual and Reproductive Health*, 2016, 42(3):111–120, https://www.jstor.org/stable/10.1363/42e1816.

62. Singh S et al., The incidence of abortion and unintended pregnancy in India, 2015, *Lancet Global Health*, 2018, 6(1):e111–e120, https://doi.org/10.1016/S2214-109X(17)30453-9.

63. Puri M et al., Abortion incidence and unintended pregnancy in Nepal, *International Perspectives on Sexual and Reproductive Health*, 2016, 42(4):197–209, https://www.jstor.org/stable/10.1363/42e2116.

64. WHO et al., *Trends in Maternal Mortality 2000 to 2017: Estimates by WHO, UNICEF, UNFPA, World*

Bank Group and the United Nations Population Division, Geneva: WHO, 2019, http://www.who.int/reproductivehealth/publications/maternal-mortality-2000-2017/en/.

65. WHO et al., specialized tabulation of unrounded data from the UN Maternal Mortality Estimation Inter-Agency Group database: Maternal Mortality, Levels and Trends, 2000 to 2017, 2019.

66. IHME, Global Health Data Exchange, GBD Results Tool, Global Burden of Disease (GBD) 2017 study results, no date, http://ghdx.healthdata.org/gbd-results-tool.

67. Say L et al., Global causes of maternal death: a WHO systematic analysis, *Lancet Global Health*, 2014, 2(6):e323–e333, https://doi.org/10.1016/S2214-109X(14)70227-X.

68. Åhman E and Shah IH, New estimates and trends regarding unsafe abortion mortality, *International Journal of Gynecology & Obstetrics*, 2011, 115(2):121–126, https://doi.org/10.1016/j.ijgo.2011.05.027.

69. Henshaw S, Unintended pregnancy and abortion: a public health perspective, in: Paul M, ed., *A Clinician's Guide to Medical and Surgical Abortion*, New York: Churchill Livingstone, 1999, pp. 11–12.

70. UN Inter-agency Group for Child Mortality Estimation, child mortality estimates by country, neonatal mortality rate and number of neonatal deaths, 2019, https://childmortality.org/data.

71. Department of Evidence, Information and Research, WHO, and Maternal Child Epidemiology Estimation (MCEE), *MCEE-WHO Methods and Data Sources for Child Causes of Death 2000–2017*, 2018, https://www.who.int/healthinfo/global_burden_disease/estimates/en/index2.html.

72. Bradley SEK and Casterline JB, Understanding unmet need: history, theory, and measurement, *Studies in Family Planning*, 2014, 45(2):123–150, https://doi.org/10.1111/j.1728-4465.2014.00381.x.

73. Ueffing P, Dasgupta ANZ and Kantorová V, Sexual activity by marital status and age: a comparative perspective, *Journal of Biosocial Science*, 2019:1–25, https://doi.org/10.1017/S002193201900083X.

74. Fabic MS and Jadhav A, Standardizing measurement of contraceptive use among unmarried women, *Global Health: Science and Practice*, 2019, 7(4):564–575, https://doi.org/10.9745/GHSP-D-19-00298.

75. Festin MPR et al., Moving towards the goals of FP2020—classifying contraceptives, *Contraception*, 2016, 94(4):289–294, https://doi.org/10.1016/j.contraception.2016.05.015.

76. Hubacher D and Trussell J, A definition of modern contraceptive methods, *Contraception*, 2015, 92(5):420–421, https://doi.org/10.1016/j.contraception.2015.08.008.

77. Fabic MS et al., Meeting demand for family planning within a generation: the post-2015 agenda, *Lancet*, 2015, 385(9981):1928–1931, https://doi.org/10.1016/S0140-6736(14)61055-2.

78. Population Division, UN Department of Economic and Social Affairs, World Contraceptive Use 2020, 2020, https://www.un.org/en/development/desa/population/publications/dataset/contraception/wcu2020.asp.

79. Bradley SEK et al., Global contraceptive failure rates: Who is most at risk?, *Studies in Family Planning*, 2019, 50(1):3–24, https://doi.org/10.1111/sifp.12085.

80. Cleland J and Ali MM, Reproductive consequences of contraceptive failure in 19 developing countries, *Obstetrics & Gynecology*, 2004, 104(2):314–320, https://doi.org/10.1097/01.AOG.0000134789.73663.fd.

81. Cleland J, Ali MM and Shah IH, *Levels and Trends of Contraceptive Use as Assessed in 2002*, New York: UN Department of Economic and Social Affairs, Population Division, 2004, https://www.un.org/en/development/desa/population/publications/pdf/family/worldContraceptiveUseReport2002.pdf.

82. Ali MM, Cleland J and Shah IH, *Causes and Consequences of Contraceptive Discontinuation: Evidence from 60 Demographic and Health Surveys*, Geneva: WHO, 2012, https://www.who.int/reproductive health/publications/family_planning/9789241504058/en/.

83. Polis CB et al., *Contraceptive Failure Rates in the Developing World: An Analysis of Demographic and Health Survey Data in 43 Countries*, New York: Guttmacher Institute, 2016, https://www.guttmacher.org/report/contraceptive-failure-rates-in-developing-world.

84. Polis CB et al., Typical-use contraceptive failure rates in 43 countries with Demographic and Health Survey data: summary of a detailed report, *Contraception*, 2016, 94(1):11–17, https://doi.org/10.1016/j.contraception.2016.03.011.

85. Trussell J and Aiken A, Contraceptive efficacy, in: Hatcher R et al., eds., *Contraceptive Technology*, 21st ed., New York: Ayer Company Publishers, 2018, pp. 829–839.

86. Wheldon M et al., Methods for estimating and projecting key family planning indicators among all women of reproductive age, New York: UN, 2018, Technical Paper No. 2, https://www.un.org/en/development/desa/population/publications/pdf/technical/TP2018-2.pdf.

87. International Institute for Population Sciences (IIPS) and Population Council, *Youth in India: Situation and Needs 2006–2007*, Mumbai: IIPS, 2010, https://www.popcouncil.org/research/youth-in-india-situation-and-needs-study.

88. Guo W et al., The timing of sexual debut among Chinese youth, *International Perspectives on Sexual and Reproductive Health*, 2012, 38(4):196–204, https://www.guttmacher.org/journals/ipsrh/2012/12/timing-sexual-debut-among-chinese-youth.

89. WHO, UNFPA and UNICEF, *Managing Complications in Pregnancy and Childbirth: A Guide for Midwives and Doctors*, second ed. Geneva: WHO, 2017, https://www.who.int/maternal_child_adolescent/documents/managing-complications-pregnancy-childbirth/en/.

90. WHO, *WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience*, Geneva: WHO, 2016, https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/anc-positive-pregnancy-experience/en/.

91. WHO, *Safe Abortion: Technical and Policy Guidance for Health Systems,* second ed., Geneva: WHO, 2012, http://www.who.int/reproductivehealth/publications/unsafe_abortion/9789241548434/en/.

92. WHO, *Medical Management of Abortion*, Geneva: WHO, 2018, https://www.who.int/reproductive health/publications/medical-management-abortion/en/.

93. WHO, *Standards for Maternal and Neonatal Care*, Geneva: WHO, 2007, https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/a91272/en/.

94. Institute for International Programs, Johns Hopkins Bloomberg School of Public Health, Johns Hopkins University, Lives Saved Tool, Spectrum Version 5.73, no date, https://www.livessavedtool.org/listspectrum.

95. UN InterAgency Working Group on Costing, OneHealth Tool: Intervention Assumptions, 2016, https://www.avenirhealth.org/software-onehealth.php.

96. Avenir Health, AIDS Impact Model 2018 Version 5.63, Spectrum Version 7.753, no date, https://www.avenirhealth.org/software-spectrum.php.

97. WHO et al., *Monitoring Emergency Obstetric Care: A Handbook*, Geneva: WHO, 2009, https://www.who.int/reproductivehealth/publications/monitoring/9789241547734/en/.

98. Stegmuller A, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA, personal communication, Apr. 2, 2019.

99. Singh S et al., *Abortion Worldwide 2017: Uneven Progress and Unequal Access*, New York: Guttmacher Institute, 2018, https://www.guttmacher.org/report/abortion-worldwide-2017.

100. Warriner IK et al., Can midlevel health-care providers administer early medical abortion as safely and effectively as doctors? A randomised controlled equivalence trial in Nepal, *Lancet*, 2011, 377(9772):1155–1161, https://doi.org/10.1016/S0140-6736(10)62229-5.

101. Calvert C et al., The magnitude and severity of abortion-related morbidity in settings with limited access to abortion services: a systematic review and meta-regression, *BMJ Global Health*, 2018, 3:e000692, http://doi.org/10.1136/bmjgh-2017-000692.

102. Bello FA et al., Trends in misoprostol use and abortion complications: a cross-sectional study from nine referral hospitals in Nigeria, *PLOS ONE*, 2018, 13(12):e0209415, https://doi.org/10.1371/journal.pone.0209415.

103. Hossain A et al., *Access to and Quality of Menstrual Regulation and Postabortion Care in Bangladesh: Evidence from a Survey of Health Facilities, 2014*, New York: Guttmacher Institute, 2017, https://www.guttmacher.org/report/menstrual-regulation-postabortion-care-bangladesh.

104. Singh S et al., *Abortion and Unintended Pregnancy in Six Indian States: Findings and Implications for Policies and Programs*, New York: Guttmacher Institute, 2018, https://www.guttmacher.org/report/abortion-unintended-pregnancy-six-states-india.

105. Singh S, Guttmacher Institute, New York, personal communication, Apr. 17, 2019.

106. Nanda K et al., Expectant care versus surgical treatment for miscarriage, *Cochrane Database of Systematic Reviews*, 2012, Issue 3, No. CD003518, https://doi.org/10.1002/14651858.CD003518.pub3.

107. Kim C et al., Medical treatments for incomplete miscarriage, *Cochrane Database of Systematic Reviews*, 2017, Issue 1, No. CD007223, https://doi.org/10.1002/14651858.CD007223.pub4.

108. Centers for Disease Control and Prevention (CDC), Current Trends Ectopic Pregnancy—United States, 1990–1992, *Morbidity and Mortality Weekly Report*, 1995, Vol. 44, No. 3, pp. 46–48, https://www.cdc.gov/mmwr/preview/mmwrhtml/00035709.htm.

109. Department of Making Pregnancy Safer, WHO, Prevention of mother-to-child transmission of syphilis: standards for maternal and neonatal care, Geneva: WHO, 2007, http://www.who.int /reproductivehealth/publications/rtis/mtct/en/.

110. WHO, *WHO Guideline on Syphilis Screening and Treatment for Pregnant Women*, Geneva: WHO, 2017, http://www.who.int/reproductivehealth/publications/rtis/syphilis-ANC-screenandtreat -guidelines/en/.

111. WHO, *WHO Guidelines for the Treatment of* Chlamydia trachomatis, Geneva: WHO, 2016, https://www.who.int/reproductivehealth/publications/rtis/chlamydia-treatment-guidelines/en/.

112. WHO, *WHO Recommendation: Calcium Supplementation During Pregnancy for Prevention of Pre-Eclampsia and Its Complications*, Geneva: WHO, 2018, https://www.who.int/nutrition/publications /guidelines/calcium-supplementation-recommendation-2018/en/.

113. WHO Reproductive Health Library, WHO recommendation on magnesium sulfate regimen to prevent and treat eclampsia, Geneva: WHO, 2017, https://extranet.who.int/rhl/topics/preconception -pregnancy-childbirth-and-postpartum-care/medical-problems-during-pregnancy/who-recommendation -magnesium-sulfate-regimen-prevent-and-treat-eclampsia.

114. WHO, *Preventive Chemotherapy in Human Helminthiasis: Coordinated Use of Antihelminthic Drugs in Control Interventions: A Manual for Health Professionals and Programme Managers*, Geneva: WHO, 2006, http://www.who.int/neglected_diseases/preventive_chemotherapy/pct_manual/en/.

115. WHO and Global Malaria Programme, Updated WHO policy recommendation: intermittent preventive treatment of malaria in pregnancy using sulfadoxine-pyrimethamine (IPTp-SP), Geneva: WHO, 2012, https://www.who.int/malaria/publications/atoz/who_iptp_sp_policy _recommendation/en/.

116. WHO, UNFPA and UNICEF, *Pregnancy, Childbirth, Postpartum and Newborn Care: A Guide for Essential Practice*, third ed., Geneva: WHO, 2015, http://www.who.int/maternal_child_adolescent /documents/imca-essential-practice-guide/en/.

117. WHO, *Guideline: Daily Iron and Folic Acid Supplementation in Pregnant Women*, Geneva: WHO, 2012, https://www.who.int/nutrition/publications/micronutrients/guidelines/daily_ifa_supp_pregnant _women/en/.

118. WHO, USAID and Maternal and Child Survival Program, WHO recommendations on antenatal care for a positive pregnancy experience: ultrasound examination, Geneva: WHO, 2018, https://www.mcsprogram.org/resource/recommendations-antenatal-care-positive-pregnancy -experience-ultrasound-examination/.

119. WHO, Tetanus vaccine, *Weekly Epidemiological Record*, 2006, Vol. 81, No. 20, pp. 198–208, https://www.who.int/wer/2006/wer8120.pdf.

120. Audam S, Guttmacher Institute, special tabulations of data from Demographic and Health Surveys (DHS), 2019.

121. WHO, *WHO Guidelines for the Treatment of* Treponema pallidum *(Syphilis)*, Geneva: WHO, 2016, http://www.who.int/reproductivehealth/publications/rtis/syphilis-treatment-guidelines/en/.

122. Korenromp EL et al., Global burden of maternal and congenital syphilis and associated adverse birth outcomes—estimates for 2016 and progress since 2012, *PLOS ONE*, 2019, 14(2):e0211720, https://doi.org/10.1371/journal.pone.0211720.

123. WHO, *WHO Recommendations on Newborn Health: Guidelines Approved by the WHO Guidelines Review Committee*, Geneva: WHO, 2017, https://www.who.int/publications/i/item/WHO-MCA-17.07.

124. WHO, *Global Health Sector Strategy on Sexually Transmitted Infections 2016–2021: Towards Ending STIs*, Geneva: WHO, 2016, https://www.who.int/publications/i/item/WHO-RHR-16.09.

125. Rowley J et al., Chlamydia, gonorrhoea, trichomoniasis and syphilis: global prevalence and incidence estimates, 2016, *Bulletin of the World Health Organization*, 2019, Vol. 97, No. 8, pp. 513–580, http://dx.doi.org/10.2471/BLT.18.228486.

126. Newman L et al., Global estimates of the prevalence and incidence of four curable sexually transmitted infections in 2012 based on systematic review and global reporting, *PLOS ONE*, 2015, 10(12):e0143304, https://doi.org/10.1371/journal.pone.0143304.

127. Cormick G et al., Global inequities in dietary calcium intake during pregnancy: a systematic review and meta-analysis, *BJOG*, 2019, 126(4):444–456, https://doi.org/10.1111/1471-0528.15512.

128. Balk EM et al., Global dietary calcium intake among adults: a systematic review, *Osteoporosis International*, 2017, 28:3315–3324, https://doi.org/10.1007/s00198-017-4230-x.

129. Abalos E et al., Global and regional estimates of preeclampsia and eclampsia: a systematic review, *European Journal of Obstetrics & Gynecology and Reproductive Biology*, 2013, 170(1):1–7, https://doi.org/10.1016/j.ejogrb.2013.05.005.

130. Zhang J, Meikle S and Trumble A, Severe maternal morbidity associated with hypertensive disorders in pregnancy in the United States, *Hypertension in Pregnancy*, 2003, 22(2):203–212, https://doi.org /10.1081/PRG-120021066.

131. Hotez PJ, Empowering women and improving female reproductive health through control of neglected tropical diseases, *PLOS Neglected Tropical Diseases*, 2009, 3(11):e559, https://doi.org /10.1371/journal.pntd.0000559.

132. Hotez PJ et al., Hookworm: "the great infection of mankind," *PLOS Medicine*, 2005, 2(3):e67, https://doi.org/10.1371/journal.pmed.0020067.

133. Roll Back Malaria Partnership, The contribution of malaria control to maternal and newborn health, *Progress & Impact Series*, Geneva: WHO, 2014, No. 10, http://apps.who.int/iris/handle/10665/126340.

134. WHO and Global Partnership to Roll Back Malaria, Malaria vector control and personal protection:

report of a WHO study group, *WHO Technical Report Series*, Geneva: WHO, 2006, No. 936, http://apps.who.int/iris/handle/10665/43425.

135. WHO, *World Malaria Report 2018*, Geneva: WHO, 2018, http://www.who.int/malaria/publications/world-malaria-report-2018/report/en/.

136. DHS Program, STATcompiler, no date, https://www.statcompiler.com/en/.

137. WHO, Global Health Observatory data repository, Estimated number of malaria cases by country, 2000–2017, 2019, http://apps.who.int/gho/data/node.main.A1372?lang=en.

138. Owolabi O, Guttmacher Institute, New York, personal communication, Apr. 12, 2019.

139. WHO, Global Health Observatory Data Repository, Prevalence of anaemia in pregnant women by country, 1990–2016, 2017, http://apps.who.int/gho/data/node.main.ANEMIA1?lang=en.

140. Vazquez JC and Abalos E, Treatments for symptomatic urinary tract infections during pregnancy, *Cochrane Database of Systematic Reviews*, 2011, Issue 1, No. CD002256, https://doi.org/10.1002/14651858.CD002256.pub2.

141. WHO, *Systematic Screening for Active Tuberculosis: Principles and Recommendations*, Geneva: WHO, 2013, https://www.who.int/tb/tbscreening/en/.

142. WHO, *Global Tuberculosis Report 2018*, Geneva: WHO, 2018, https://apps.who.int/iris/bitstream/handle/10665/274453/9789241565646-eng.pdf

143. WHO, *Care of Girls & Women Living with Female Genital Mutilation: A Clinical Handbook*, Geneva: WHO, 2018, https://www.who.int/reproductivehealth/publications/health-care-girls-women-living-with-FGM/en/.

144. WHO, *WHO Recommendations on Interventions to Improve Preterm Birth Outcomes*, Geneva: WHO, 2015, https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/preterm-birth-guideline/en/.

145. WHO Reproductive Health Library, WHO recommendation on antenatal corticosteroid therapy for women at risk of preterm birth from 24 weeks to 34 weeks of gestation, Geneva: WHO, 2015, https://extranet.who.int/rhl/topics/preconception-pregnancy-childbirth-and-postpartum-care/pregnancy-complications/preterm-birth/who-recommendation-antenatal-corticosteroid-therapy-women-risk-preterm-birth-24-weeks-34-weeks.

146. Vogel JP et al., Use of antenatal corticosteroids and tocolytic drugs in preterm births in 29 countries: an analysis of the WHO Multicountry Survey on Maternal and Newborn Health, *Lancet*, 2014, 384(9957):1869–1877, https://doi.org/10.1016/S0140-6736(14)60580-8.

147. Chawanpaiboon S et al., Global, regional, and national estimates of levels of preterm birth in 2014: a systematic review and modelling analysis, *Lancet Global Health*, 2019, 7(1):e37–e46, https://doi.org/10.1016/S2214-109X(18)30451-0.

148. Yudin MH et al., Antibiotic therapy in preterm premature rupture of the membranes, *Journal of*

Obstetrics and Gynaecology Canada, 2009, 31(9):863–867, https://doi.org/10.1016/S1701-2163(16)34305-5.

149. Ananth CV and Vintzileos AM, Epidemiology of preterm birth and its clinical subtypes, *Journal of Maternal-Fetal & Neonatal Medicine*, 2006, 19(12):773–782, https://doi.org/10.1080/14767050600965882.

150. WHO Reproductive Health Library, WHO recommendation on induction of labour for women beyond 41 weeks of gestation, Geneva: WHO, 2011, https://extranet.who.int/rhl/topics/preconception-pregnancy-childbirth-and-postpartum-care/induction-labour/who-recommendation-induction-labour-women-beyond-41-weeks-gestation.

151. Mya KS et al., Management of pregnancy at and beyond 41 completed weeks of gestation in low-risk women: a secondary analysis of two WHO multi-country surveys on maternal and newborn health, *Reproductive Health*, 2017, 14:141, https://doi.org/10.1186/s12978-017-0394-2.

152. Guerra GV et al., Factors and outcomes associated with the induction of labour in Latin America, *BJOG*, 2009, 116(13):1762–1772, https://doi.org/10.1111/j.1471-0528.2009.02348.x.

153. WHO Reproductive Health Library, WHO recommendation on the use of magnesium sulfate for fetal protection from neurological complications, Geneva: WHO, 2015, https://extranet.who.int/rhl/topics/newborn-health/who-recommendation-use-magnesium-sulfate-fetal-protection-neurological-complications.

154. McCormack RA et al., Antepartum bleeding of unknown origin in the second half of pregnancy and pregnancy outcomes, *BJOG*, 2008, 115(11):1451–1457, https://doi.org/10.1111/j.1471-0528.2008.01856.x.

155. Giordano R et al., Antepartum haemorrhage, *Journal of Prenatal Medicine*, 2010, 4(1):12–16, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3263934/.

156. Mukherjee S and Bhide A, Antepartum haemorrhage, *Obstetrics, Gynaecology and Reproductive Medicine*, 2008, 18(12):335–339, https://doi.org/10.1016/j.ogrm.2008.09.005.

157. WHO, *WHO Recommendations for Augmentation of Labour*, Geneva: WHO, 2014, https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/augmentation-labour/en/.

158. Weissman E, Saltner J and Friedman H, Reproductive Health Costing Model User Guide, Version 3.0, New York: UNFPA, 2008.

159. Dolea C and AbouZahr C, *Global Burden of Obstructed Labour in the Year 2000*, Geneva: WHO, 2003, https://www.who.int/healthinfo/statistics/bod_obstructedlabour.pdf.

160. Maternal Health and Safe Motherhood Programme, WHO, *Education Material for Teachers of Midwifery: Midwifery Education Modules*, second ed., Geneva: WHO, 2008, http://www.who.int/iris/handle/10665/44145.

161. Sibai BM, Diagnosis, prevention, and management of eclampsia, *Obstetrics & Gynecology*, 2005,

105(2):402–410, http://doi.org/10.1097/01.AOG.0000152351.13671.99.

162. Uzan J et al., Pre-eclampsia: pathophysiology, diagnosis, and management, *Vascular Health and Risk Management*, 2011, 7:467–474, https://doi.org/10.2147/VHRM.S20181.

163. Saeed G, Wajid R and Dar AY, Maternal mortality in eclampsia after cesarean section versus vaginal delivery, *Annals of King Edward Medical University*, 2018, 23(4):446–450, https://doi.org/10.21649/akemu.v23i4.2188.

164. WHO, Global Health Observatory data repository, Births by caesarean section, data by country, 2018, http://apps.who.int/gho/data/node.main.BIRTHSBYCAESAREAN?lang=en.

165. WHO, WHO statement on caesarean section rates, Geneva: WHO, 2015, http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/cs-statement/en/.

166. Brown MA et al., Hypertensive disorders of pregnancy: ISSHP classification, diagnosis, and management recommendations for international practice, *Pregnancy Hypertension*, 2018, 72(1):24–43, https://doi.org/10.1161/HYPERTENSIONAHA.117.10803.

167. Dolea C and Stein C, *Global Burden of Maternal Sepsis in the Year 2000*, Geneva: WHO, 2003, http://www.who.int/healthinfo/statistics/bod_maternalsepsis.pdf.

168. WHO, *WHO Recommendations for the Prevention and Treatment of Postpartum Haemorrhage*, Geneva: WHO, 2012, http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/9789241548502/en/.

169. Calvert C et al., Identifying regional variation in the prevalence of postpartum haemorrhage: a systematic review and meta-analysis, *PLOS ONE*, 2012, 7(7):e41114, https://doi.org/10.1371/journal.pone.0041114.

170. Li B et al., Tranexamic acid for treatment of women with post-partum haemorrhage in Nigeria and Pakistan: a cost-effectiveness analysis of data from the WOMAN trial, *Lancet Global Health*, 2018, 6(2):e222–e228, https://doi.org/10.1016/S2214-109X(17)30467-9.

171. WHO, *WHO Recommendation on Tranexamic Acid for the Treatment of Postpartum Haemorrhage*, Geneva: WHO, 2017, http://www.who.int/reproductivehealth/publications/tranexamic-acid-pph-treatment/en/.

172. Murray SF and Pearson SC, Maternity referral systems in developing countries: current knowledge and future research needs, *Social Science & Medicine*, 2006, 62(9):2205–2215, https://doi.org/10.1016/j.socscimed.2005.10.025.

173. Prevention of Postpartum Hemorrhage Initiative, *Prevention of Postpartum Hemorrhage: Implementing Active Management of the Third Stage of Labor (AMTSL): A Reference Manual for Health Care Providers*, Seattle: Program for Appropriate Technology in Health, 2007, http://www.path.org/publications/files/MCHN_popphi_amtsl_ref_man.pdf.

174. WHO, *WHO Recommendations on Postnatal Care of the Mother and Newborn*, Geneva: WHO, 2013, http://www.who.int/maternal_child_adolescent/documents/postnatal-care-recommendations

/en/.

175. WHO, *Mastitis: Causes and Management*, Geneva: WHO, 2000, http://www.who.int/maternal_child_adolescent/documents/fch_cah_00_13/en/.

176. Semba RD, Mastitis and transmission of human immunodeficiency virus through breast milk, *Annals of the New York Academy of Sciences*, 2006, 918(1):156–162, https://doi.org/10.1111/j.1749-6632.2000.tb05484.x.

177. Lewis G, De Bernis L, eds., *Obstetric Fistula : Guiding Principles for Clinical Management and Programme Development*, Geneva: WHO, 2006, http://apps.who.int/iris/handle/10665/43343.

178. WHO, *Guideline: Protecting, Promoting and Supporting Breastfeeding in Facilities Providing Maternity and Newborn Services*, Geneva: WHO, 2017, https://www.who.int/publications-detail/9789241550086.

179. Azra Haider B and Bhutta ZA, Birth asphyxia in developing countries: current status and public health implications, *Current Problems in Pediatric and Adolescent Health Care*, 2006, 36(5):178–188, https://doi.org/10.1016/j.cppeds.2005.11.002.

180. Wall SN et al., Neonatal resuscitation in low-resource settings: What, who, and how to overcome challenges to scale up?, *International Journal of Gynecology & Obstetrics*, 2009, 107(Suppl. 1):S47–S64, https://doi.org/10.1016/j.ijgo.2009.07.013.

181. Mazumder S et al., Effect of community-initiated kangaroo mother care on survival of infants with low birthweight: a randomised controlled trial, *Lancet*, 2019, 394(10210):1724–1736, https://doi.org/10.1016/S0140-6736(19)32223-8.

182. Lawn JE et al., "Kangaroo mother care" to prevent neonatal deaths due to preterm birth complications, *International Journal of Epidemiology*, 2010, 39(Suppl. 1):i144–i154, https://doi.org/10.1093/ije/dyq031.

183. Healthy Newborn Network, *Kangaroo Mother Care*, no date, https://www.healthynewbornnetwork.org/issue/kangaroo-mother-care/.

184. Blencowe H et al., National, regional, and worldwide estimates of low birthweight in 2015, with trends from 2000: a systematic analysis, *Lancet Global Health*, 2019, 7(7):e849–e860, https://doi.org/10.1016/S2214-109X(18)30565-5.

185. Lee ACC et al., National and regional estimates of term and preterm babies born small for gestational age in 138 low-income and middle-income countries in 2010, *Lancet Global Health*, 2013, 1(1):e26–e36, https://doi.org/10.1016/S2214-109X(13)70006-8.

186. Thaver D and Zaidi AKM, Burden of neonatal infections in developing countries: a review of evidence from community-based studies, *Pediatric Infectious Disease Journal*, 2009, 28(Suppl. 1):S3–S9, http://doi.org/10.1097/INF.0b013e3181958755.

187. Lawn J, Child Health Epidemiology Reference Group, London School of Hygiene & Tropical Medicine, personal communication, Aug. 28, 2010.

188. WHO, BCG vaccines: WHO position paper—February 2018, *Weekly Epidemiological Record*, 2018, Vol. 93, No. 8, pp. 73–96, https://www.who.int/wer/2018/wer9308/en/.

189. WHO, *Guidelines for the Prevention, Care and Treatment of Persons with Chronic Hepatitis B Infection*, Geneva: WHO, 2015, http://www.who.int/hepatitis/publications/hepatitis-b-guidelines/en/.

190. WHO, Immunization, Vaccines and Biologicals: WHO recommendations for routine immunization—summary tables, Table 2: Summary of WHO position papers—recommended routine immunizations for children, April 2019, https://www.who.int/immunization/policy/immunization_tables/en/.

191. WHO and UNICEF Data, Estimates of national routine immunization coverage, 2017 revision, 2018, https://data.unicef.org/topic/child-health/immunization/.

192. Gomez GB et al., Untreated maternal syphilis and adverse outcomes of pregnancy: a systematic review and meta-analysis, *Bulletin of the World Health Organization*, 2013, Vol. 91, No. 3, pp. 217–226, http://doi.org/10.2471/BLT.12.107623.

193. Patterson R and Stankewicz H, *Penicillin Allergy*, Treasure Island, FL, USA: StatPearls Publishing, 2019, https://www.ncbi.nlm.nih.gov/books/NBK459320/?report=classic.

194. Albin S and Agarwal S, Prevalence and characteristics of reported penicillin allergy in an urban outpatient adult population, *Allergy and Asthma Proceedings*, 2014, 35(6):489–494, https://doi.org/10.2500/aap.2014.35.3791.

195. Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases, CDC, Evaluation and diagnosis of penicillin allergy for healthcare professionals: Is it really a penicillin allergy?, Atlanta: CDC, 2017, https://www.cdc.gov/antibiotic-use/community/for-hcp/Penicillin-Allergy.html.

196. WHO, *WHO Guidelines for the Treatment of* Neisseria gonorrhoeae, Geneva: WHO, 2016, https://www.who.int/reproductivehealth/publications/rtis/gonorrhoea-treatment-guidelines/en/.

197. Zuppa AA et al., Ophthalmia neonatorum: What kind of prophylaxis?, *Journal of Maternal-Fetal & Neonatal Medicine*, 2011, 24(6):769–773, https://doi.org/10.3109/14767058.2010.531326.

198. Moore DL, MacDonald NE and Canadian Paediatric Society, Position statement: preventing ophthalmia neonatorum, *Paediatrics & Child Health*, 2015, 20(2):93–96, https://www.cps.ca/en/documents/position/ophthalmia-neonatorum.

199. Hammerschlag MR, Chlamydial and gonococcal infections in infants and children, *Clinical Infectious Diseases*, 2011, 53(Suppl. 3):S99–S102, https://doi.org/10.1093/cid/cir699.

200. Hammerschlag MR, Chlamydial infections, *Journal of Pediatrics*, 1989, 114(5):727–734, https://doi.org/10.1016/S0022-3476(89)80128-3.

201. WHO, *Consolidated Guidelines on the Use of Antiretroviral Drugs for Treating and Preventing HIV Infection: Recommendations for a Public Health Approach*, second ed., Geneva: WHO, 2016, https://www.who.int/hiv/pub/arv/arv-2016/en/.

202. UNAIDS, National HIV estimates file, data inputs up to 2018, https://www.unaids.org/en /dataanalysis/datatools/spectrum-epp.

203. Guttmacher estimates based on special tabulations of data using the AIDS Impact Model 2018 Version 5.63, Spectrum Version 7.753, provided by John Stover, Avenir Health.

204. UNAIDS, *UNAIDS Terminology Guidelines*, Geneva: UNAIDS, 2011, https://www.unaids.org/sites /default/files/media_asset/JC2118_terminology-guidelines_en_1.pdf.

205. AIDSinfo, Epidemiological estimates, treatment and PMTCT: epidemiological estimates database, early infant diagnosis for all countries, http://www.aidsinfoonline.org/epi/libraries/aspx/Home.aspx.

206. WHO, Cost effectiveness and strategic planning (WHO-CHOICE): alphabetical list of WHO member states, no date, https://www.who.int/choice/demography/by_country/en/.

207. Cotch MF et al., *Trichomonas vaginalis* associated with low birth weight and preterm delivery, *Sexually Transmitted Diseases*, 1997, 24(6):353–360, http://doi.org/10.1097/00007435-199707000 -00008.

208. WHO, *Global Strategy for the Prevention and Control of Sexually Transmitted Infections: 2006–2015, Breaking the Chain of Transmission*, Geneva: WHO, 2007, https://www.who.int/reproductive health/publications/rtis/9789241563475/en/.

209. WHO, Sexually transmitted infections (STIs), 2019, https://www.who.int/news-room/fact-sheets /detail/sexually-transmitted-infections-(stis).

210. Special Programme of Research, Development and Research Training in Human Reproduction and WHO, Sexually transmitted infections (STIs): the importance of a renewed commitment to STI prevention and control in achieving global sexual and reproductive health, Geneva: WHO, 2012, https://apps.who.int/iris/handle/10665/75838.

211. Arévalo M, Jennings V and Sinai I, Efficacy of a new method of family planning: the Standard Days Method, *Contraception*, 2002, 65(5):333–338, https://doi.org/10.1016/S0010-7824(02)00288-3.

212. Trussell J, Contraceptive failure in the United States, *Contraception*, 2011, 83(5):397–404, https://doi.org/10.1016/j.contraception.2011.01.021.

213. Van der Wijden C and Manion C, Lactational amenorrhoea method for family planning, *Cochrane Database of Systematic Reviews*, 2015, Issue 10, No. CD001329, https://doi.org/10.1002/14651858 .CD001329.pub2.

214. Grady WR, Hayward MD and Yagi J, Contraceptive failure in the United States: estimates from the 1982 National Survey of Family Growth, *Family Planning Perspectives*, 1986, 18(5):200–209.

215. Trussell J and Kost K, Contraceptive failure in the United States: a critical review of the literature, *Studies in Family Planning*, 1987, 18(5):237–283.

216. Blanc AK and Grey S, Greater than expected fertility decline in Ghana: untangling a puzzle, *Journal of Biosocial Science*, 2002, 34(4):475–495, https://doi.org/10.1017/S0021932002004753.

217. Vaughan B et al., Discontinuation and resumption of contraceptive use: results from the 2002 National Survey of Family Growth, *Contraception*, 2008, 78(4):271–283, https://doi.org/10.1016/j.contraception.2008.05.007.

218. International Monetary Fund, World Economic Outlook database, Oct. 2018 edition release, https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/index.aspx.

219. World Bank, Indicators: GDP deflator (base year varies by country), 2019, https://data.worldbank.org/indicator/NY.GDP.DEFL.ZS.

220. Serje J et al., Global health worker salary estimates: an econometric analysis of global earnings data, *Cost Effectiveness and Resource Allocation*, 2018, 16(10), https://doi.org/10.1186/s12962-018-0093-z.

221. UNFPA Procurement Services, Reproductive Health Interchange, 2015–2018, https://www.unfpaprocurement.org/rhi-home.

222. Supply Division, UNICEF, UNICEF Supply Catalogue, no date, https://supply.unicef.org/.

223. IDA Foundation, *Product Indicator 2019*, Amsterdam: IDA Foundation, 2019, https://www.idafoundation.org/media/wysiwyg/products/IDA_Product_Indicator_2019.pdf.

224. Management Sciences for Health, International medical products price guide, no date, http://mshpriceguide.org/en/home/.

225. Clinton Health Access Initiative (CHAI), 2016 Antiretroviral (ARV) CHAI reference price list, Boston: CHAI, 2016, https://www.clintonhealthaccess.org/2016-chai-arv-reference-price-list/.

226. UNFPA Procurement Services, UNFPA Product catalog, no date, https://www.unfpaprocurement.org/products.

227. Global Fund, Pooled procurement mechanism reference pricing: ARVs (version: quarter 1 2020), January 2020, https://www.theglobalfund.org/en/sourcing-management/health-products/antiretrovirals/.

228. IMRES, IMRES product guide, IMRES, downloaded April 2019, https://www.imres.nl/en/page/products.

229. Alibaba, Health and beauty: health and medical, Alibaba.com, downloaded April 2019, https://www.alibaba.com/Health-Medical_p16?spm=a2700.8293689.scGlobalHomeHeader.502.2ce267af9cpuPK.

230. South African National Department of Health (SANDOH), S4-RT21-2013 Contract Circular 01 April 2014, Pretoria, South Africa: SANDOH, 2014.

231. South African National Health Laboratory Service (NHLS), *State Price List 2017*, Johannesburg, South Africa: NHLS, 2017.

232. Medindia, Drug information on Betnesol (4mg/mL) (Betamethasone) from Glaxo SmithKline

Pharmaceuticals Ltd., no date, https://www.medindia.net/drug-price/betamethasone/betnesol-4mg-ml.htm6#.

233. Inogen, The cost of a day's breath, no date, https://www.inogen.com/resources/health/cost-days-breath/.

234. Discovery Health, How much oxygen does a person consume in a day?, Sharecare, no date, https://www.sharecare.com/health/air-quality/oxygen-person-consume-a-day.

235. Mulligan J et al., Unit costs of health care inputs in low and middle income regions: Working Paper No. 9, Disease Control Priorities Project, Bethesda, MD, USA: Fogarty International Centre, National Institutes of Health, 2003, https://researchonline.lshtm.ac.uk/id/eprint/12952.

236. WHO, *WHO Recommendations: Optimizing Health Worker Roles to Improve Access to Key Maternal and Newborn Health Interventions Through Task Shifting (Optimize MNH)*, Geneva: WHO, 2012, https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/978924504843/en/.

237. WHO, *Task Shifting to Improve Access to Contraceptive Methods*, Geneva: WHO, 2013, http://www.who.int/reproductivehealth/publications/family_planning/task_shifting_access_contraceptives/en/.

238. UNFPA, UNFPA Contraceptives Price Indicator Year 2015, 2016, https://www.unfpa.org/resources/contraceptive-price-indicator-2015.

239. UNFPA, UNFPA Contraceptives Price Indicator Year 2016, 2017, https://www.unfpa.org/resources/contraceptive-price-indicator-2016.

240. UNFPA, UNFPA Contraceptives Price Indicator Year 2017, 2018, https://www.unfpa.org/resources/contraceptive-price-indicator-year-2017.

241. UNFPA, UNFPA Contraceptives Price Indicator Year 2018, 2019, https://www.unfpa.org/resources/contraceptive-price-indicator-year-2018.

242. Stover J, Bertrand JT and Shelton JD, Empirically based conversion factors for calculating couple-years of protection, *Evaluation Review*, 2000, 24(1):3–46, https://doi.org/10.1177%2F0193841X0002400101.

243. Sonneveldt E, CYP update: newly calculated factors—process, calculation, justification, implications, PowerPoint presentation, New Developments in the Calculation and Use of Couple-Years of Protection (CYP) and Their Implications for the Evaluation of Family Planning Programs, Washington DC, Sep. 8, 2011, http://www.respond-project.org/archive/files/2/Report-2011-LAPM-CoP-CYP.pdf.

244. USAID, Couple years of protection (CYP): What We Do: Family Planning, June 2019, https://www.usaid.gov/global-health/health-areas/family-planning/couple-years-protection-cyp.

Good reproductive health policy starts with credible research

125 Maiden Lane
New York, NY 10038
(212) 248-1111; fax (212) 248-1951
info@guttmacher.org

www.guttmacher.org