Adding It Up:
Costs and Benefits of Meeting the Contraceptive and Maternal and Newborn Health Needs of Women in Pakistan

Methodology Appendix

Acknowledgments

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Methodology Appendix

Introduction

This document provides the methodology used to estimate the values presented in the report *Adding It Up: Costs and Benefits of Meeting the Contraceptive and Maternal and Newborn Health Needs of Women in Pakistan,* 2019.[1] The report adds to the ongoing Guttmacher Institute effort to estimate the costs and benefits of expanding contraceptive use in specific developing countries. Similar reports have been produced for the Philippines, Uganda, Ethiopia, Burkina Faso, Malawi, Cameroon and Nepal.[1–7]

Country-level Adding It Up reports have estimated the costs of meeting all women's needs for modern contraceptives, and they have estimated the benefits of expanded contraceptive services in terms of the number of pregnancies, births, abortions, and maternal and infant deaths averted and disability-adjusted life years (DALYs) saved.

The country-level reports have drawn heavily on the methods and approaches used in the global Adding It Up series of reports, which have estimated the need for and the use, costs and impacts of various sexual and reproductive health services for the major regions and subregions of the developing world. While the basic approach for the Adding It Up analysis has remained unchanged over the years, some country-specific changes to the methodology have been made based on data availability in each country.

This document describes the analytic framework, sources and calculations underlying the Adding It Up estimates for Pakistan. Our objective is to enable users to better understand the results and limitations of the estimates.

We estimated the **health impacts** for three scenarios:

1) *Zero modern contraceptive use*. This scenario assumes that none of the women wanting to avoid pregnancy* use a modern contraceptive method. In other words, all current modern method users become nonusers, and the only users of contraception are the current traditional method users. In this scenario, all nonusers and current modern method users are

*We consider the terms "wanting to avoid pregnancy" and "at risk of unintended pregnancy" to be equivalent and use them interchangeably; we abbreviate this term to "@risk" and "not@risk" in our equations.

assumed to have an unmet need, meaning they want to avoid becoming pregnant for at least two years but are not using a modern contraceptive method.

2) *Current contraceptive use*. This scenario represents actual levels of contraceptive use in Pakistan as obtained from the 2017–2018 Pakistan Demographic and Health Survey (PDHS).[8]

3) *All unmet need for modern methods met*. In this scenario, all women wanting to avoid pregnancy—including current nonusers and those who currently use traditional methods—become users of modern methods. The proportions of women using each type of modern method are based on the mix of modern methods used currently. Unmet need for modern contraception is reduced to zero in this scenario.

In all three scenarios, we assumed that the level of use of maternal and newborn health (MNH) care would remain constant at current levels.

In addition, in this report, we estimated the **financial costs and savings** for three scenarios, where we assumed that MNH coverage would be extended to all women in need:

1) Coverage of MNH care and of modern contraception is at current levels (this is the baseline scenario).
2) MNH care is provided to all women who need it, while current levels of modern contraceptive services are maintained.
3) Both MNH care and modern contraceptive services are provided to all women who need them (that is, all unmet need for modern contraception is met).

We recognize that the necessary increases in coverage cannot be achieved immediately, especially because many of them depend on improvements in health service infrastructure. However, we use the same year for all scenarios to demonstrate the changes needed, compared with the current situation.

We conducted all analyses on the costs of care in the public sector under the assumption that it is the government's mandate to provide these services. In reality, the costs could be higher if a large proportion of women sought these services in the private sector, where costs are quite variable. The costs presented in this report could therefore be considered to be at the lower end or a minimum; they represent what it would cost the government to provide the additional services.

Data Sources

The estimates of the costs and benefits of contraceptive use in Pakistan draw from multiple data sources. Numbers of women in each region in 2017 by marital status, desire to avoid pregnancy and contraceptive use were calculated using data from the 2017–2018 PDHS.[†8] The estimates of women aged 15–49 in 2017 were obtained from the 2017 Pakistan National Population and Housing Census.[9]

We calculated numbers of unintended pregnancies at current levels of contraceptive use, as well as for the other scenarios, using contraceptive use failure rates and pregnancy rates for nonusers from the 2017–2018 PDHS and other sources,[8,10–14] adjusted to the estimated number of unintended pregnancies in each region in 2017. Pregnancy intendedness and pregnancy outcomes were estimated from regional data on the planning status of recent births from the 2017–2018 PDHS, estimates of unsafe induced abortion rates in 2012[8,15] and estimates of the number of miscarriages. We calculated the number of pregnancy-related deaths using a projected estimate of the maternal mortality ratio (MMR) estimated in the 2006–2007 PDHS using a World Health Organization (WHO) regression model.[16,17]

Estimates of unsafe abortions are based on regional estimates of the abortion rate published jointly by researchers at the Pakistan Population Council and the Guttmacher Institute.[15]

National-level estimates of 2017 pregnancy-related deaths and DALYs among women were obtained from the Institute for Health Metrics and Evaluation.[18]

We estimated the costs of contraceptive and maternal and newborn care using an ingredients-based costing method as follows: For each contraceptive method or health care intervention, we combined the direct costs (in 2017 U.S. dollars) of drugs, supplies, materials, labor and hospitalization with the indirect costs associated with programs and systems to arrive at an annual cost of protection against unintended pregnancy for each woman receiving pregnancy-related medical care. Indirect costs (e.g., overhead and capital expenditure) were based on estimates provided by the United Nations Population Fund (UNFPA).[19] Indirect costs of contraceptives came from UNFPA's Reproductive Health Interchange database.[20]

We obtained the direct costs of drugs, supplies, materials and labor used for family planning and MNH care interventions from the following sources:

- Drugs and supplies: United Nations Children's Fund (UNICEF) Supply Catalogue[21]
- Cost of labor (salaries for different categories of medical professionals): Based on derivations from the estimates used in the Essential Package of Health Services for

[†]Information on sexual activity, contraceptive use and pregnancy desires among unmarried women in Pakistan is not available; our analyses of contraceptive use and needs were based on the behaviors of married women as measured in the PDHS, and all married women were assumed to be sexually active.

Primary Health Care accepted by most of the regions. [22-26]

We used the most recently available data, either for 2017, which is the reference year for the analysis, or from the most recently available year projected to 2017. Cost figures are expressed in 2017 U.S. dollars, and all scenarios are calculated as of 2017.

All data used in this project came from publicly available sources and did not contain any individual's identifying information. Consent was therefore not required for these analyses.

Demographic Estimates

1. Population Size and Composition

a. Total population for Pakistan and for each region, 2017

The total population numbers for each region were obtained from the 2017 Pakistan Population and Housing Census.[9]

All provinces (Balochistan, Khyber Pakhtunkwha, Punjab and Sindh) and four other regions and administrative areas (Azad Jammu and Kashmir, Federally Administrated Tribal Areas, Gilgit-Baltistan and Islamabad Capital Territory) were included in the analysis. For the purpose of this report, the areas described above will be referred to as regions. In this and subsequent calculations, when regional data or estimates were available, we computed the national number as the sum of the regional numbers.

b. Women aged 15–49 by region, 2017

1b1. The proportions aged 15–49 among all women were applied to the total female population by region.[8,9]

$$\#\ ♀(15-49)^{2017}_{region(i)} = \#\ \text{women (total)}_{2017\ \text{region(i)}} * \%\ \text{women}\ (15-49)_{2017\ region(i)}$$

1b2. National numbers were computed as the sum of regional numbers.

$$\#♀(15-49)^{2017}_{Pakistan} = \sum \#♀(15-49)^{2017}_{region(i)}$$

c. Women aged 15–49 in each region, by marital and household wealth status, 2017

1c1. We obtained the numbers of women of reproductive age by marital status in each region using the following calculation:

$$\#\ \text{women}\ (15\text{–}49)_{\text{marital status, region(i)}} = \#\ \text{women}\ (15\text{–}49)_{\text{region (i)}} * \%\ \text{women}_{\text{marital status, region(i)}}$$

Data:

1. The percentages married and unmarried among all women for each region were obtained from the 2017–2018 PDHS.[8]
2. The number of women of reproductive age in each region for 2017 was obtained from the 2017–2018 PDHS and the Pakistan Population and Housing Census, as described in **1b1**.[9]

1c2. The sum of the region numbers was the total number of women for the country:

$$\#\ ♀(15\text{–}49)_{\text{marital status, Pakistan}} = \sum (\#\ ♀(15\text{–}49)_{\text{region (i)}} * \%\ ♀_{\text{marital status, region(i)}})$$

1c3. In the PDHS, women are categorized according to the wealth of their household relative to other households in the country. Wealth quintiles divide the total household population into fifths (Table 1).

Table 1. Distribution of women in Pakistan aged 15–49 by wealth status

Wealth status (quintile)	% of women aged 15–49
First (poorest)	18.9
Second	21.8
Third	20.6
Fourth	19.7
Fifth (wealthiest)	19.0

Source: 2017–2018 PDHS, Reference 8.

We obtained the numbers of women by wealth status, using the following calculation:

$$\#♀(15\text{-}49)_{\text{wealth status(i)}} = \#♀(15\text{-}49)_{\text{Pakistan}} * \%♀_{\text{wealth status(i)}}$$

Data:

1. We obtained the percentages of women by wealth status from the 2017–2018 PDHS.[8]
2. The number of women for all of Pakistan was obtained from the calculations outlined in **1c2**.
3. Formulas were applied for each region to obtain the distribution of women by wealth status in each region.

2. Risk for unintended pregnancy and contraceptive use status

a. Definition of key concepts

Risk for unintended pregnancy was defined as follows:

1) Women not at risk for unintended pregnancy: Those who were not sexually active (or unmarried, for Pakistan), who were infecund or who wanted a child within the next two years.
2) Women at risk for unintended pregnancy and seeking to *space* future births: Those who were fecund and married, and who did not want a child or another child within the next two years. For the purposes of this analysis, we call these women **spacers**.
3) Women at risk for unintended pregnancy and seeking to *limit* future births: Those who were married, who were fecund and who did not want another child. For the purposes of this analysis, we call these women **limiters**.
4) Risk status of women who were pregnant or amenorrheic[‡]: Women were considered to be **at risk** for unintended pregnancy if their current pregnancy or most recent birth was mistimed (i.e., women seeking to **space** births) or unwanted (i.e., women seeking to **limit** births).

The concepts used to determine risk for unintended pregnancy were defined as follows:

1) Sexual activity: All currently married women were assumed to be or potentially to be sexually active. Women who were not married were classified as not sexually active per the information available in the PDHS.[8] Because of stigma attached to nonmarital sex, the level of sexual activity—and therefore risk for unintended pregnancy—is likely to be underestimated among unmarried women.
2) Fecundity: Married women were classified as infecund if they reported being so at the time of the survey, had had a hysterectomy or were menopausal. We also considered to be infecund those women who were neither pregnant nor in postpartum amenorrhea but who had not had a menstrual period for six or more months, as well as those who were married and not using a contraceptive method during the past five years, but had not had a birth and were not currently pregnant.
3) Childbearing intentions: Intention for future childbearing was defined according to women's desire for a child (or another child). Among pregnant women, intention was based on whether their current pregnancy was wanted at that time or earlier, mistimed or unwanted.
4) Amenorrhea: Women who were amenorrheic were classified according to the intention status of their last birth.

Contraceptive use status for women at risk was defined as follows:

[‡]This refers to the number of months after childbirth in which women are protected against pregnancy. In Pakistan, the median number of months for postpartum amenorrhea is 3.3 months.[8]

1) Modern method users: This included women who reported using tubal ligation, vasectomy, IUD, injectable, implant, pill, condom, standard days methods and other supply methods. Modern method users could be **spacers** or **limiters**. If they were using tubal ligation or vasectomy, they were always considered limiters.
2) Traditional method users: This included women who reported using periodic abstinence, withdrawal and other non-supply methods. Traditional method users could be **spacers** or **limiters**.
3) Nonusers: Those women who were at risk but using no contraceptive method. Such women were considered to have an unmet need for **spacing** or for **limiting**, depending on their childbearing intentions.

b. Risk for unintended pregnancy and contraceptive use status by scenario:

1. Current (2017) scenario (scenario 2):
We grouped married women of reproductive age by risk of unintended pregnancy and contraceptive use. Each subgroup was further categorized according to region and household wealth quintiles.

The calculations to compute the numbers of women by each of these subgroups were set up as follows:

2b1a. Married women **not at risk** by region:

$$\#\text{♀}^{\text{not@risk}}_{\text{region (i)}} = \#\text{♀}_{\text{region (i)}} * \%\text{♀}^{\text{not@risk}}_{\text{region (i)}}$$

Data:

1. The number of married women by region was obtained from the calculations outlined in **1c1**.
2. The percentages in each subgroup were obtained from the 2017–2018 PDHS.[8]

2b1b. For married women **at risk** by region, we grouped them by whether they were spacers or limiters:

$$\#\text{♀}^{\text{@risk, spacers}}_{\text{region (i)}} = \#\text{♀}_{\text{region (i)}} * \%\text{♀}^{\text{@risk, spacers}}_{\text{region (i)}}$$

$$\#\text{♀}^{\text{@risk, limiters}}_{\text{region (i)}} = \#\text{♀}_{\text{region (i)}} * \%\text{♀}^{\text{@risk, limiters}}_{\text{region (i)}}$$

Data:

1. The number of women by region was obtained from the calculations outlined in **1c1**.

2. The percentages in each subgroup were obtained from the 2017–2018 PDHS.[8]

2b1b1. We further grouped women **at risk** as those who have an unmet need for modern contraception, and those who were at risk, but were using modern contraception.

$$\#\text{♀ met need for modern contraception}^{\text{sp/lt}}_{\text{region (i)}} = \#\text{♀}_{\text{region (i)}} * \%\text{♀modern method users}^{\text{sp/lt}}_{\text{region (i)}}$$

$$\#\text{♀ unmet need for modern contraception}^{\text{sp/lt}}_{\text{region (i)}} = \#\text{♀}_{\text{region (i)}} * \%\text{♀ non-user/trad. users}^{\text{sp/lt}}_{\text{region (i)}}$$

Data:

1. The number of women by region was obtained from the calculations outlined above in **1c1**.
2. The percentages in each subgroup were obtained from the 2017–2018 PDHS.[8]

<u>2b1c</u>. Women **not at risk** by wealth status

$$\#\text{♀}^{\text{not@risk}}_{\text{wealth status (i)}} = \#\text{♀}_{\text{wealth status (i)}} * \%\text{♀}^{\text{not@risk}}_{\text{wealth status (i)}}$$

Data:

1. The number of women by wealth status was obtained from the calculations outlined in **1c3**.
2. The percentages in each subgroup were obtained from the 2017–2018 PDHS.[8]

<u>2b1d</u>. For women **at risk** by wealth status, we grouped them by whether they were spacers or limiters:

$$\#\text{♀}^{\text{@risk, spacers}}_{\text{wealth status (i)}} = \#\text{♀}_{\text{wealth status (i)}} * \%\text{♀}^{\text{@risk, spacers}}_{\text{wealth status (i)}}$$

$$\#\text{♀}^{\text{@risk, limiters}}_{\text{wealth status (i)}} = \#\text{♀}_{\text{wealth status (i)}} * \%\text{♀}^{\text{@risk, limiters}}_{\text{wealth status (i)}}$$

Data:

1. The number of women by wealth status was obtained from the calculations outlined in **1c3**.
2. The percentages in each subgroup were obtained from the 2017–2018 PDHS.[8]

2b1d1. We further grouped women **at risk** as those who have an unmet need for modern contraception, and those who were at risk, but were using modern contraception.

$$\#\text{♀ met need for modern contraception}^{\text{sp/lt}}_{\text{WQ (i)}} = \#\text{♀}_{\text{WQ (i)}} * \%\text{♀modern method users}^{\text{sp/lt}}_{\text{WQ (i)}}$$

$$\#\text{♀ unmet need for modern contraception}^{\text{sp/lt}}_{\text{WQ (i)}} = \#\text{♀}_{\text{WQ (i)}} * \%\text{♀ non-user/trad. users}^{\text{sp/lt}}_{\text{WQ (i)}}$$

Data:

1. The number of women by wealth status was obtained from the calculations outlined in **1c3**.
2. The percentages in each subgroup were obtained from the 2017–2018 PDHS.[8]

Adjustments to values:

The wealth quintiles totals by risk did not match the totals by risk for the regions, due to differences in data. The differences were less than 0.2%. Therefore, we adjusted the values in the final tables for wealth status to align them with the region totals. In order to do this, we first divided region totals (by risk status) by the wealth quintile totals (also by risk status). The result of this division was multiplied by the result obtained above (**2b1c** and **2b1d**) in each category.

$$\text{final } \#\,♀^{\text{risk,space/limit}}_{\text{wealth status (i)}} = \text{Result of 2b1c \& 2b1d} * \frac{\text{total } \#\,♀^{\text{region}}_{\text{Pakistan}}}{\text{total } \#\,♀^{\text{wealth status}}_{\text{Pakistan}}}$$

<u>2b1e</u>. Contraceptive use status among all women at risk for unintended pregnancy by region:

$$\#\ ♀\ \text{with met need}^{\text{spacers, method type}}_{\text{region (i)}} = \#\ \text{all}\ ♀^{\text{@risk}}_{\text{region (i)}} * \%\ \text{all}\ ♀^{\text{spacers, method type}}_{\text{region (i)}}$$

$$\#\ ♀\text{with met need}^{\text{limiters, method type}}_{\text{region (i)}} = \#\ \text{all}\ ♀^{\text{@risk}}_{\text{region (i)}} * \%\ \text{all}\ ♀^{\text{limiters, method type}}_{\text{region (i)}}$$

<u>2b1f</u>. Contraceptive use status among women at risk for unintended pregnancy by wealth quintile:

$$\#\ ♀\ \text{with met need}^{\text{spacers, method type}}_{\text{wealth status }(i)} = \#\ \text{all}\ ♀^{\text{@risk}}_{\text{wealth status }(i)} * \%\ \text{all}\ ♀^{\text{spacers, method type}}_{\text{wealth status }(i)}$$

$$\#\ ♀\ \text{with met need}^{\text{limiters, method category}}_{\text{wealth status (i)}} = \#\ \text{all}\ ♀^{\text{@risk}}_{\text{wealth status (i)}} * \%\ \text{all}\ ♀^{\text{limiters, method category}}_{\text{wealth status (i)}}$$

Data:

1. The number of women at risk by region was obtained from the calculations outlined in **2b1b**.
2. The number of women at risk by region was obtained from the calculations outlined in **2b1d**.
3. The percent of women by region and method category who were spacers/limiters was obtained from the 2017–2018 PDHS.[8]
4. The method types for spacers were pill, IUD, injectable, implant, condom, other modern methods, periodic abstinence, withdrawal and other traditional methods.

5. The method types for limiters included all the methods listed for spacers, plus male and female sterilization.

Adjustments to values for wealth quintiles:
The wealth quintile totals of women at risk by method categories did not match the totals for the regions. Therefore, we adjusted the values in the final tables for wealth status. In order to do this, we first divided region totals for women at risk (by each method category) by the wealth quintile totals for women at risk (also by method categories). The result of this division was multiplied by the result obtained above in **2b1f** in each category.

$$\text{final } \#\text{♀@risk}^{\text{space/limit,method}}_{\text{wealth status (i)}} = \text{Result of 2b1f} * \frac{\text{total } \#\text{♀@risk}^{\text{region,method}}_{\text{Pakistan}}}{\text{total } \#\text{♀@risk}^{\text{wealth status,method}}_{\text{Pakistan}}}$$

2. Risk for unintended pregnancy in alternative contraceptive-use scenarios

The introduction of this report outlined the alternative hypothetical use scenarios. All of them assume that other variables are unchanged, including the number of women aged 15–49 and their distribution by region, household wealth, fecundity and intention to space or limit births.

We computed the contraceptive use status among all women at risk for unintended pregnancy for each of the hypothetical use scenarios. These are discussed below.

Zero modern contraceptive use (scenario 1):

In this scenario, all women at risk for unintended pregnancy either have an unmet need for modern methods or are traditional method users. To calculate the number of women at risk for unintended pregnancy who had an unmet need for modern methods, we added the number of women in the current scenario who were at risk and had an unmet need for a modern method to the number of women in the current scenario who were using modern methods. The number of women using traditional methods was equal to the number of women using traditional methods in the current scenario.

<u>2b2a</u>. By region:

$$\#\text{♀ unmet need}^{\text{spacers}}_{\text{region(i),scen 1}} = \#\text{♀ unmet need}^{\text{spacers}}_{\text{region(i), scen2}} + \#\text{♀ mod. methods}^{\text{spacers}}_{\text{region (i),scen 2}}$$

$$\#\text{♀ unmet need}^{\text{limiters}}_{\text{region(i),scen 1}} = \#\text{♀ unmet need}^{\text{limiters}}_{\text{region(i), scen2}} + \#\text{♀ mod. methods}^{\text{limiters}}_{\text{region (i),scen 2}}$$

$$\#\text{♀ unmet need}^{\text{spacers+limiters}}_{\text{region(i),scen 1}} = \#\text{♀ unmet need}^{\text{spacers}}_{\text{region(i), scen1}} + \#\text{♀ mod. methods}^{\text{limiters}}_{\text{region (i),scen 1}}$$

<u>2b2b</u>. By wealth status:

$$\#\text{♀ unmet need}^{\text{spacers}}_{\text{WQ(i),scen 1}} = \#\text{♀ unmet need}^{\text{spacers}}_{\text{WQ(i), scen2}} + \#\text{♀ mod. methods}^{\text{spacers}}_{\text{WQ (i),scen 2}}$$

$$\#\text{♀ unmet need}^{\text{limiters}}_{\text{WQ(i),scen 1}} = \#\text{♀ unmet need}^{\text{limiters}}_{\text{WQ(i), scen2}} + \#\text{♀ mod. methods}^{\text{limiters}}_{\text{WQ (i),scen 2}}$$

$$\#\text{♀ unmet need}^{\text{spacers+limiters}}_{\text{WQ(i),scen 1}} = \#\text{♀ unmet need}^{\text{spacers}}_{\text{WQ(i), scen1}} + \#\text{♀ mod. methods}^{\text{limiters}}_{\text{WQ (i),scen 1}}$$

Data:

1. The data for the region-level calculations come from **2b1b1**.
2. The data for the wealth status calculations come from **2b1d1**. Additional adjustments to the wealth status estimates were not required for this scenario.

All unmet need met scenario (scenario 3):

In this scenario, all women at risk for an unintended pregnancy are using a modern method, including women who were traditional method users in the current scenario. To calculate the number of women who were modern method users, we summed the total number of method users (modern and traditional) in the current scenario with the total number of women with an unmet need for a modern method in the current scenario.

<u>2b2c</u>. By region:

$$\#\text{♀ modern method users}_{\text{scen3, region(i)}} = \#\text{all ♀ method users(trad+modern)}_{\text{scen2, region(i)}} + \text{all♀ non-users}_{\text{scen2, region(i)}}$$

$$\#\text{♀modern method users}^{\text{method type}}_{\text{scen3,region(i)}} = \#\text{♀modern method users}_{scen3,prov(i)} * \frac{\%\text{users among all ♀}^{\text{method type}}_{\text{scen2,region(i)}}}{\Sigma\%\text{♀ mod meth users of all ♀}^{\text{all mod meth types}}_{\text{scen2, region(i)}}}$$

<u>2b2d</u>. By wealth status:

$$\#\text{♀ modern method users}_{scen3,WQ(i)} = \#\text{all ♀ method users(trad+modern)}_{\text{scen2, WQ(i)}} + \text{all♀ with unmet need}_{\text{scen2, WQ(i)}}$$

$$\#\text{♀modern method users}^{\text{method type}}_{\text{scen3,WQ(i)}} = \#\text{♀modern method users}_{\text{scen3, WQ(i)}} * \left(\frac{\#\text{♀modern method user}^{\text{method type}}_{\text{scen2 WQ(i)}}}{\#\text{♀modern method users}_{\text{scen2, WQ(i)}}}\right)$$

Adjustments to values for wealth quintiles:

The wealth quintile totals of women at risk by method categories did not match the totals for the regions. Therefore, we adjusted the values in the final tables for wealth status. In order to do this, we first divided region totals for women at risk (by each method category) by the wealth quintile totals for women at risk (also by method categories). The result of this division was multiplied by the result obtained in **2b2d** in each category. The calculation followed the same template as laid out in **2b1f**.

3. Current numbers of births, intention status of births and pregnancy outcomes

a. Total pregnancies

This is the sum of conceptions ending in birth, induced abortion and miscarriage. The calculations for obtaining the numbers of each are provided below.

Scenario 2. Current contraceptive use

b. Numbers of births, by region and wealth, 2017

We applied regional general fertility rates from the 2017–2018 PDHS to the 2017 numbers of women aged 15–44 in each region to estimate the number of births, by region, in 2017. The general fertility rate (GFR) is the number of births in each region in the three years preceding the 2017–2018 PDHS per 1,000 women aged 15–44.

<u>3b1</u>. By region:

$$\#\text{Births}^{\text{all ♀}}_{\text{region(i)}} = \#♀^{15-44}_{\text{region(i)}} * \frac{GFR^{15-44}_{\text{region(i)}}}{1000}$$

Data:

1. The data on the number of women aged 15–44 by region was obtained from the Pakistan Population and Housing Census and the 2017–2018 PDHS.[8,9]
2. The general fertility rate was obtained from the 2017–2018 PDHS.

<u>3b2</u>. By wealth status:

$$\#\text{Births}^{\text{all ♀}}_{\text{WQ(i)}} = \#♀^{15-49}_{\text{WQ(i)}} * \frac{GFR^{15-44}_{\text{region(i)}}}{1000} * \frac{\#\text{all}♀^{15-44}_{Pakistan}}{\#\text{all }♀^{15-49}_{Pakistan}}$$

Adjustments to values for wealth quintiles:

The wealth quintile totals of births by wealth quintile categories did not match the birth totals for the regions. Therefore, we adjusted the values in the final tables for wealth status. In order to do this, we first divided region totals by the wealth quintile totals. The result of this division was multiplied by the result obtained in **3b2** in each category. The calculation followed the same template as laid out in **2b1f**.

c. Planning status of births by region and wealth

We distributed the estimated numbers of births in each region in 2017 according to the planning-status distribution of births reported in the 2017–2018 PDHS.[8] To construct this variable, we considered all births in the last three years. This is unlike the PDHS, which considers all births in the last five years.

The planning status of births variable categorizes births according to whether women reported wanting a pregnancy then, wanting a pregnancy later, or not wanting any (additional) births. Births among women who had wanted the pregnancy later are called "mistimed." Births that resulted from pregnancies that were not wanted at all are called "unwanted." All other births are called "planned" or "wanted."

This variable does not include current pregnancies and pregnancies where there is missing data on intention status. This is a departure from the manner in which the PDHS constructs this variable.

We calculated the number of births by intention status as follows:

<u>3c1</u>. By region:

$$\#\text{Wanted births}^{\text{all ♀}}_{\text{region(i)}} = \#\text{Births}^{\text{all ♀}}_{\text{region(i)}} * \%\text{Wanted births}^{\text{all ♀}}_{\text{region(i)}}$$

$$\#\text{Births mistimed}^{\text{all ♀}}_{\text{region(i)}} = \#\text{Births}^{\text{all ♀}}_{\text{region(i)}} * \%\text{Births mistimed}^{\text{all ♀}}_{\text{region (i)}}$$

$$\#\text{Births unwanted}^{\text{all ♀}}_{\text{region(i)}} = \#\text{Births}^{\text{all ♀}}_{\text{region(i)}} * \%\text{Births unwanted}^{\text{all ♀}}_{\text{region (i)}}$$

Data:

1. The data on the number of births to all women by region was obtained from **3b1**.
2. The percentage of births by intention status was obtained from the 2017–2018 PDHS.[8]

d. Number of induced abortions, 2014

We obtained the annual national and regional rate of induced abortions from Sathar et al. (2014).[15] The rate of abortions was assumed to be constant for all categories of household wealth status. The number of abortions was obtained by multiplying the abortion rate by the number of women of reproductive age obtained from the census projections.

<u>3d1</u>. Scenario 2 by region:

$$\#\text{induced abortions}^{\text{all ♀}}_{\text{region(i)}} = \frac{\text{induced abortion rate}^{\text{all ♀}}_{\text{region(i)}}}{1000} * \#♀^{\text{15-49}}_{\text{region(i)}}$$

Data:

1. We obtained the induced abortion rate from Sathar et al. (2014).[15]

2. We obtained the number of women of reproductive age from the Pakistan Population and Housing Census and the 2017–2018 PDHS (specified in **1b1**).[8,9]

<u>3d2</u>. Scenario 2 by wealth quintile:

$$\#\text{induced abortions}_{\text{WQ(i)}}^{\text{all }\♀} = \frac{\text{induced abortion rate}_{\text{Pakistan}}^{\text{all }\♀}}{1000} * \ \#\♀_{\text{WQ(i)}}^{\text{15-49}}$$

Data:

1. We obtained the induced abortion rate for all women in Pakistan from Sathar et al. (2014).[15]
2. The number of women of reproductive age by wealth quintile was obtained from calculations shown in **1c3** above.

Adjustments to values for wealth quintiles:

The wealth quintile totals of induced abortion by wealth quintile categories did not match the induced abortion totals for the regions. Therefore, we adjusted the values in the final tables for wealth status. In order to do this, we first divided region totals by the wealth quintile totals. The result of this division was multiplied by the result obtained in **3d2** in each category. The calculation followed the same template as laid out in **2b1f**.

e. Number of miscarriages

Miscarriages resulting from unintended pregnancies are estimated to be equivalent to 20% of pregnancies ending in unintended birth plus 10% of pregnancies ending in induced abortion (all of which are assumed to be unintended).[27] These proportions attempt to account for pregnancies that end in miscarriage late enough to be noted by the woman (6–7 weeks after the last menstrual period).

<u>3e1</u>. Miscarriages resulting from unintended pregnancies by region:

$$\#\text{miscarriages}_{\text{reg(i)}}^{\text{unwanted conceptions}} = \#\text{induced abortions}_{\text{reg(i)}}^{\text{all }\♀} * 0.1 + (\#\text{births mistimed}_{\text{reg (i)}}^{\text{all }\♀} + \#\text{births unwanted}_{\text{reg (i)}}^{\text{all }\♀}) * 0.2$$

Data:

1. The numbers of induced abortions are obtained from calculations shown in **3d1**.
2. The numbers of births wanted later and never wanted are obtained from calculations shown in **3c1**.

<u>3e2</u>. Miscarriages resulting from intended pregnancies by region:

$$\#\text{miscarriage}_{\text{region(i)}}^{\text{wanted conceptions}} = \#\text{wanted births}_{\text{region(i)}}^{\text{all }\♀} * 0.2$$

Data:

1. The numbers of wanted births were obtained from calculations shown in **3c1**.

<u>3e3</u>. Miscarriages resulting from unintended pregnancies by wealth quintiles:

$$\#\text{miscarriage}_{\text{WQ(i)}}^{\text{unwanted conceptions}} =$$
$$\#\text{induced abortions}_{\text{WQ(i)}}^{\text{all ♀}} * 0.1 + (\#\text{births wanted later}_{\text{WQ (i)}}^{\text{all ♀}} + \#\text{births never wanted}_{\text{WQ (i)}}^{\text{all ♀}}) * 0.2$$

Data:

1. The number of induced abortions by wealth quintile was obtained from calculations shown in **3d2**.
2. The number of births wanted later or never was obtained from calculations shown in **3c3**.

<u>3e4</u>. Miscarriages resulting from intended pregnancies by wealth quintile:

$$\#\text{miscarriages}_{\text{WQ(i)}}^{\text{wanted conceptions}} = \#\text{wanted births}_{\text{WQ(i)}}^{\text{all ♀}} * 0.2$$

Data:

1. The number of wanted births were obtained from calculations shown in **3c3**.

Adjustments to values for wealth quintiles:

The wealth quintile totals of miscarriages by wealth quintile categories did not match the miscarriage totals for the regions. Therefore, we adjusted the values in the final tables for wealth status. In order to do this, we first divided the region totals by the wealth quintile totals. The result of this division was multiplied by the result obtained in **3e4** in each category. The calculation followed the same template as laid out in **2b1f**.

f. Intended pregnancies

Intended pregnancies are the sum of intended births and estimated miscarriages of intended conceptions.

<u>3f1</u>: By region:

$$\#\text{intended pregnancies}_{\text{region(i)}}^{\text{all ♀}} = \#\text{wanted births}_{\text{region(i)}}^{\text{all ♀}} + \text{miscarriages}_{\text{region(i)}}^{\text{wanted conceptions}}$$

Data:

1. All components on the right-hand side of the equation were obtained from **3c1** and **3e2**.

3f2: By wealth quintile:

$$\#\text{intended pregnancies}_{\text{WQ(i)}}^{\text{all ♀}} = \#\text{wanted births}_{\text{WQ(i)}}^{\text{all ♀}} + \text{miscarriages}_{\text{WQ(i)}}^{\text{wanted conceptions}}$$

Data:

1. All components on the right-hand side of the equation were obtained from **3c3** and **3e4**.

g. Unintended pregnancies

Unintended pregnancies are the sum of unplanned births, induced abortions and estimated miscarriages following unintended conceptions. The calculation is set up as follows:

<u>3g1</u>. By region:

$$\#\text{unintended pregnancies}^{\text{all }♀}_{\text{reg (i)}} = \#\text{induced abortions}^{\text{all }♀}_{\text{reg(i)}} + \text{miscarriages}^{\text{all }♀}_{\text{reg(i)}} + \text{births wanted later}^{\text{all }♀}_{\text{reg(i)}} + \text{births never wanted}^{\text{all }♀}_{\text{reg(i)}}$$

Data:

1. The components for the right-hand side of the equation were obtained from **3c1**, **3d1** and **3e1**.

<u>3g2</u>. By wealth quintile:

$$\#\text{unintended pregnancies}^{\text{all }♀}_{\text{WQ (i)}} = \#\text{induced abortions}^{\text{all }♀}_{\text{WQ(i)}} + \text{miscarriages}^{\text{all }♀}_{\text{WQ(i)}} + \text{births wanted later}^{\text{all }♀}_{\text{WQ(i)}} + \text{births never wanted}^{\text{all }♀}_{\text{WQ(i)}}$$

Data:

1. The components for the right-hand side of the equation were obtained from **3c3**, **3d2** and **3e3**.

h. Outcomes of unintended pregnancies

Unintended pregnancies were distributed according to outcome (birth, induced abortion or miscarriage), based on the regional distributions estimated from the 2017–2018 PDHS birth rates and intention status information, 2012 induced abortion rates and model-based miscarriage rates.[8,15,27,28] The calculations are as described above.

i. Pregnancy intentions and outcomes for alternate scenarios of modern contraceptive use

The estimates of pregnancy intentions and outcomes for scenarios 1 and 3 were calculated using formulas provided in the next section.

4. Unintended pregnancies among women at risk by method and unmet need (using contraceptive failure rates)

In addition to computing the number of unintended pregnancies among women at risk, using a combination of PDHS and census data (see section 3 above), we also computed the numbers of unintended pregnancies among women at risk, using contraceptive failure rates data. The reason for making this alternative estimate is to develop adjusted failure rates (see below),

which are needed to estimate unintended pregnancies in the scenario in which all of current unmet need is met.

We multiplied the annual pregnancy rates among a) women using contraceptive methods, and b) among women at risk for unintended pregnancy who were using no method, by the estimated numbers of women in Pakistan in 2017–2018, to estimate the current number of unintended pregnancies. The calculations used the current contraceptive mix.

a. Initial/unadjusted failure rates

Table 2 shows the initial or unadjusted failure rates used in the study. These were obtained from special tabulations of data from Darroch (2018).[29]

Table 2. Unadjusted contraceptive failure rates, Pakistan, 2017

Contraceptive method	Failure rate
Female sterilization	0.5
Male sterilization	0.2
Pill	5.2
IUD	0.8
Injectable	1.8
Implant	0.6
Condom	6.1
Other supply	6.6
Periodic abstinence	14.6
Withdrawal	12.9
Other non-supply methods	18.2
No protection/nonuse of method	40.0

Note: These are typical use failure rates and refer to the percentage of women experiencing an unintended pregnancy during the first year of typical use of contraception.
Source: Reference 29.

For women at risk for unintended pregnancy using no method, we assumed an annual pregnancy rate of 40%.[29] The 40% estimate is much lower than the 85% annual pregnancy rate that Trussell et al. (2018) estimate for couples who are continually sexually active.[12] Some studies have suggested, however, that couples at risk for unintended pregnancy who are using no contraceptive method are not continually sexually active.[30]

4a1. The unadjusted unintended pregnancy numbers from the contraceptive failure rates data were obtained as follows:

$$\#\text{UIP due to cp failure}_{\text{reg(i)}}^{\text{spacer,limiters.nonuse}} = \sum (\#\text{♀}_{\text{reg(i)}}^{\text{method type, sp/lt,nonuse}} * \text{unadj. cp failure rate}_{\text{reg(i)}}^{\text{method type}})$$

Data:

1. The number of women at risk who are using specific methods/not using any method by region was obtained from calculations shown in **2b1c** and **2b1d**.
2. The unadjusted contraceptive failure rate for each method was obtained from the values shown in **table 2**.

b. Failure rate adjustment

The number of pregnancies, based on current contraceptive use among women at risk for unintended pregnancy and the initial failure rates for each method, differed in all regions from the number of unintended pregnancies estimated using the PDHS intention status variable (discussed in section 3 above). This is likely due, in part, to the fact that many unintended pregnancies that end in induced abortion are not reported in the PDHS or other surveys of women. Therefore, the initial failure rates for each method were adjusted so that the number of unintended pregnancies calculated in each region equaled the number estimated from intention status.

The same regional adjustments were applied to the initial typical use failure rates for all methods and the nonuse pregnancy rate used for all women in the same region, regardless of household wealth.

4b1. The adjustment factor was calculated as follows:

$$\text{Adjustment factor}_{\text{reg(i)}} = \frac{\#\text{UIP (abortions + miscarriages from UIP + mistimed+unwanted births)}_{\text{reg(i)}}}{\#\text{UIP due to method failure}_{\text{reg (i)}}^{\text{sp,lt,non use}}}$$

Data:

1. The number of unintended pregnancies from summing the abortions, unwanted births and miscarriages from unintended pregnancy was obtained from **3g1**.
2. The number of unintended pregnancies from failure rates was obtained from **4a1**.

4b2. The adjusted contraceptive failure rates were computed as follows:

$$\text{Adjusted failure rate}_{\text{reg(i)}}^{\text{method type}} = \text{Unadjusted cp failure rate}_{\text{reg(i)}}^{\text{method type}} * \text{Adjustment factor}$$

Data:

1. The unadjusted contraceptive failure rate was obtained from **table 2**.
2. The adjustment factor was obtained from calculations shown in **4b1**.

4b3. Revised unintended pregnancy numbers using adjusted failure rates:

$$\#\text{UIP due to cp failure}_{\text{reg(i)}}^{\text{method type}} = \#\text{♀ at risk}_{\text{reg(i)}}^{\text{method type, sp,lt,nonuse}} * \text{adjusted failure rates}$$

Data:

1. The number of women at risk using contraceptives or those not using, by method type, and by spacing and limiting was obtained from the calculations shown in **2b1e**.
2. The adjusted failure rates for each method were obtained from **4b2**.

c. Unintended pregnancies by wealth quintile:

4c1. Unintended pregnancies from unadjusted failure rates by wealth quintile:

$$\#\text{unadj. UIP from method failure}_{\text{WQ(i)}}^{\text{method type or unmet need}} = \Sigma\#\text{♀}_{\text{WQ(i)}}^{\text{method type, sp, lt, unmet need}} * \text{unadj. failure rate}$$

Data:

1. The number of women by method type in each wealth quintile was obtained from calculations shown in **2b1f**.
2. The unadjusted failure rate for each method was obtained from **table 2**.

4c2. Adjustment factor:

$$\text{Adjustment factor}_{\text{WQ(i)}} = \frac{\#\text{unadj.UIP (abortions+miscarriages from UIP+mistimed+unwanted births)}_{\text{WQ(i)}}}{\Sigma\#\text{unadj.UIP from method failure}_{\text{WQ(i)}}^{\text{method type or unmet need}}}$$

Data:

1. The unadjusted unintended pregnancy numbers computed as a sum of abortions, unintended births and unintended miscarriages was obtained from **3g2**.
2. The denominator was obtained from **4c1**.

4c3. Adjusted failure rate:

$$\text{Adjusted failure rate}_{\text{WQ(i)}}^{\text{method type or unmet need}} = \text{Unadjusted failure rate}_{\text{WQ(i)}}^{\text{method type or unmet need}} * \text{Adjustment rate}$$

Data:

1. The unadjusted failure rate by wealth quintile was obtained from **4c1**.
2. The adjustment rate was obtained from **4c2**.

4c4. Adjusted number of unintended pregnancies by wealth quintile using adjusted failure rates:

$$\#\text{UIP from method failure}_{\text{WQ(i)}}^{\text{method type or nonuse}} = \#\text{♀ at risk}_{\text{WQ(i)}}^{\text{method type or nonuse}} * \text{adj. failure rate}$$

Data:

1. The number of women at risk using contraceptives or those not using, by method type, and by spacing and limiting was obtained from the calculations shown in **2b1f**.
2. The adjusted failure rates for each method were obtained from **4c3**.

d. Pregnancy outcomes by type of method use

1. Scenario 2: Current contraceptive use

4d1a. Unintended pregnancies:

$$\#\ \text{UIP}^{\text{nonuse/method use by type}}_{\text{reg(i), scen2}} = \#\text{♀}^{\text{nonuse/meth users by type}}_{\text{reg(i), scen 2}} * \text{adjusted cp failure rate}^{\text{nonuse/method type}}_{\text{reg (i)}}$$

Data:

1. The number of women modern/traditional method users by type and nonusers was obtained from calculations shown in **2b1c** and **2b1d**.
2. The adjusted contraceptive failure rate was obtained from calculations shown in **4b2**.

2. Scenario 1. Zero contraceptive use

4d2a. For scenario 1, all users of modern methods in scenario 2 and those with unmet need in scenario 2 are considered as having an unmet need.

$$\#\ \text{♀}^{\text{unmet need}}_{\text{scen 1, region(i)}} = \#\ \text{♀}^{\text{unmet need}}_{\text{region(i), scen2}} + \#\text{♀}^{\text{modern method users}}_{\text{region(i), scen 2}}$$

Data:

1. The data for numbers of women with unmet need by region was obtained from the calculations shown in **2b1b1**.

4d2. Number of unintended pregnancies in scenario 1:

$$\#\ \text{UIP}^{\text{nonuse of mod cp}}_{\text{region(i), scen1}} = \#\text{♀}^{\text{unmet need}}_{\text{region(i), scen 1}} * \text{adjusted contraceptive failure for ♀ with unmet need}$$

Data:

1. The number of women with unmet need by region in scenario was obtained from **4d1**.
2. The adjusted contraceptive failure rate for women with unmet need was obtained from **4b2**.

4d3. Number of induced abortions in scenario 1:

$$\#\ \text{induced abortions}^{\text{nonuse of mod cp}}_{\text{region (i), scen1}} = \#\ \text{UIP}^{\text{non use of mod cp}}_{\text{region (i), scen1}} * \frac{\#\ \text{induced abortions}^{\text{scen 2}}_{\text{reg (i)}}}{\#\ \text{UIP}^{\text{scen 2}}_{\text{reg (i)}}}$$

Data:

1. The numbers of unintended pregnancies for nonuse of contraception by region for scenario 1 was obtained from **4d2**.
2. The number of induced abortions and unintended pregnancies in scenario 2 was obtained from **3d1** and **3g1**.

4d4. Number of unplanned births in scenario 1:

$$\#\ \text{unplanned births}^{\text{nonuse of mod cp}}_{\text{reg (i), scen (1)}} =$$
$$\#\ \text{UIP}^{\text{nonuse of mod cp}}_{\text{reg (i), scen1}} - \#\ \text{induced abortions}^{\text{nonuse of cp}}_{\text{reg(i), scen1}} * \frac{1+\text{ratio of miscarriages to induced abortions}}{1+\text{ratio of miscarriages to births}}$$

Data:

1. The number of unintended pregnancies for nonuse of contraception by region in scenario 1 was obtained from **4d2**.
2. The number of induced abortions by region in scenario 1 was obtained from **4d3**.
3. The ratio of miscarriages to induced abortions is a model-based estimate, computed to be 0.1, while the ratio of miscarriages to births is also a model-based estimate, computed to be 0.2.[27]

Scenario 3. Full unmet need for modern contraception is met

4d4. Number of women who are modern method users in scenario 3:

$$\#♀\text{all modern method users}_{\text{scen3, reg(i)}} =$$
$$\#♀\ \text{with unmet need}_{\text{scen 2, reg(i)}} + \#♀\text{modern method users}_{\text{scen 2, reg(i)}}$$

Data:

1. The components on the right-hand side of the equation were obtained from calculations shown in **2b1e**.

4d5. Number of women users by modern method type in scenario 3:

$$\#♀\ \text{mod meth users}^{\text{method type, sp or lt.}}_{\text{scen 3, reg(i)}} = \#♀\text{all users of mod meth}_{\text{scen 3, reg(i)}} * \frac{\%♀\text{users}^{\text{method type}}_{\text{scen 2, reg(i)}}}{\%♀\text{all modern meth users}_{\text{scen 2, reg(i)}}}$$

Data:

1. The total number of women who used modern methods in scenario 3 by region was obtained from **4d4**.
2. The percentage of women who used each method in scenario 2 and the total percentage of all modern method users in scenario 2 was obtained from the 2017–2018 PDHS.[8]

4d6. Number of unintended pregnancies in scenario 3:

$$\#\text{UIP}^{\text{modern use failures}}_{\text{reg(i), scen3}} = \#♀\text{mod meth users}^{\text{method type, sp or lt.}}_{\text{scen 3, reg (i)}} * \text{contraceptive failure}^{\text{method type}}_{\text{reg(i)}}$$

Data:

1. The number of women who were modern method users by method type and region was obtained from **4d5**.
2. The contraceptive failure rate by method type was obtained from **4b2**.

4d7. Number of induced abortions in scenario 3:

$$\#\text{induced abortions}^{\text{modern use failures}}_{\text{scen3,reg(i)}} = \#\text{UIP}^{\text{modern use failures}}_{\text{scen 3, reg(i)}} * \frac{\#\text{induced abortions}_{\text{scen 2, reg(i)}}}{\#\text{UIP}_{\text{scen 2, reg(i)}}}$$

Data:

1. The number of unintended pregnancies in scenario 3 for each region was obtained from **4d6**.
2. The numbers of induced abortions and the numbers of unintended pregnancies by region were obtained from **3d1** and **3g1**.

4d8. Number of unplanned births in scenario 3:

$$\#\text{ unint. births}^{\text{modern use failures}}_{\text{reg (i), scen (3)}} =$$
$$\#\text{ UIP}^{\text{modern use failures}}_{\text{reg (i), scen3}} - \#\text{ induced abortions}^{\text{modern use failures}}_{\text{reg(i), scen3}} * \frac{1+\text{ratio of miscarriages to induced abortions}}{1+\text{ratio of miscarriages to births}}$$

5. Pregnancy-related mortality and morbidity

a. Pregnancy-related deaths among women, by outcome

The number of pregnancy-related deaths was projected to 2017 using the region-level estimates of maternal deaths in the 2006–2007 PDHS, sociodemographic and maternal and newborn health indicators from the 2017–2018 PDHS and the maternal mortality regression model used to estimate maternal mortality by the World Health Organization, UNICEF and UNFPA.[8,16,17,31] For regions included in this report with no MMR or abortion estimates, we used the national estimates. Because we did not have information to estimate MMR by wealth status, each wealth quintile was assumed to have the national MMR estimate, a limitation in the methodology.

The calculations were set up as follows:

Scenario 2 by region

5a1. Number of maternal deaths among wanted births:

$$\#\text{Maternal deaths}^{\text{wanted births}}_{\text{region(i)}} = \frac{\text{Maternal mortality ratio}_{\text{DHS}} * \#\text{ wanted births}_{\text{region (i)}}}{100{,}000}$$

Data:

1. The maternal mortality ratio was projected using information from the 2006–2007 PHDS, 2017–2018 PDHS and WHO, UNICEF and UNFPA.[8,16,31]
2. The number of unwanted births was obtained from calculations shown in **3c1**.

5a2. Number of maternal deaths among unwanted births:

$$\#\text{Maternal deaths}_{\text{region(i)}}^{\text{unwanted births}} = \frac{\text{Maternal mortality ratio}_{\text{DHS}} * \ \#\text{ unwanted births}_{\text{region (i)}}}{100{,}000}$$

Data:

1. The maternal mortality ratio was projected using information from the 2006–2007 PHDS, 2017–2018 PDHS and WHO, UNICEF and UNFPA.
2. The number of unwanted births was obtained from calculations shown in **3c1**.

5a3. Total number of maternal deaths among all births:

$$\#\text{Maternal deaths}_{\text{region(i)}}^{\text{all births}} = \ \#\text{Maternal deaths}_{\text{region(i)}}^{\text{wanted births}} + \#\text{Maternal deaths}_{\text{region(i)}}^{\text{unwanted births}}$$

Data:

1. The right-hand side of the equation is obtained from **5a1** and **5a2**.

5a4. Total number of maternal deaths across all regions:

$$\#\ \text{Maternal deaths}\ {}_{\text{Pakistan}}^{\text{all births}} = \sum \#\text{maternal deaths}_{\text{region(i)}}^{\text{all births}}$$

5a5. Maternal deaths by alternate use scenarios:

We made similar calculations for alternative scenarios of modern contraceptive use. The calculations for wanted and unwanted births by scenario are shown above in section **3c1**.

b. Disability-adjusted life years (DALYs) incurred by pregnant women, 2017

We obtained the number of DALYs related to maternal conditions from the Institute for Health Metrics and Evaluation Global Burden of Disease Tool, 2017.[18] We assumed that rates of maternal DALYs for Pakistan as a whole applied across all regions of the country and wealth quintiles. Again, this is a weak assumption because rates of DALYs most likely vary by rural-urban residence and by income group, but it is unavoidable, since the DALYs by subgroups are not available.

5b1. The DALYs for all scenarios were computed as follows:

$$\text{DALYS}_{\text{region (i)}}^{\text{scenario (j)}} = \frac{\#\text{Pregnancies}_{\text{region(i)}}^{\text{intention status, scenario (j)}}}{\#\text{ All pregnancies}_{\text{region (i)}}^{\text{scenario (j)}}} * \text{Total DALYS from maternal conditions}$$

Data:

1. The total numbers of pregnancies and pregnancies by intention status and scenario were obtained from calculations shown in sections **3f1** and **3g1**.

6. Maternal and newborn health care interventions

We obtained the list of interventions, the percentage of women in need of the interventions and the percentage of women currently covered by each intervention from Darroch (2018), with the exception of the interventions listed below.[29] Not all pregnant women need each intervention. For those interventions not required by all pregnant women, the value for the percentage covered was divided by the percentage of women who require such care, in order to estimate the percentage covered only among those who need the care.

The percentage in need of post-abortion care (PAC) by region was obtained from the Sathar et.al. study on abortion and PAC in Pakistan.[15] We used national proportions in need of PAC for Gilgit-Baltistan, Islamabad Capital Territory, Federally Administrated Tribal Areas, and Azad Jammu and Kashmir because information was not available for these regions. Because this study did not include information on the PAC need for specific interventions, we used proxy values calculated from a recent abortion and PAC study in Bangladesh to estimate these specific interventions.[32]

a. PAC: Incomplete abortion/hemorrhage
b. PAC: Shock
c. PAC: Uterine perforation/cervical laceration
d. PAC: Sepsis

We used the 2017–2018 PHDS to obtain the coverage of the following interventions:

a. Basic antenatal care (4+ visits)
b. Tetanus toxoid
c. Hookworm treatment
d. Daily iron supplementation
e. Essential care for all women with routine vaginal delivery: delivery by a skilled birth attendant
f. Essential care for all newborns: delivery by a skilled birth attendant
g. Cesarean section
h. Preventive postpartum care

For the interventions listed above, the 2017–2018 PDHS also provides coverage percentages by each region of Pakistan. For the interventions not covered by the PDHS, we used national coverage proportions estimated in *Adding It Up: Investing in Contraception and Maternal and Newborn Health, 2017—Estimation Methodology.*[29] To obtain region-level coverage percentages, we used the distribution proportions of other key inventions such as “Basic

antenatal care," "Emergency obstetric Care (EmOC)" and "Delivery in a health facility" that are linked to the interventions not covered by the DHS to adjust the national coverage proportions across regions. For example, to get coverage percentages at the subnational level for hypertensive disease care management, we used the estimated national proportion of coverage estimated in Darroch 2018 (23%) and adjusted the regional proportions of women receiving basic antenatal care to estimate coverage across regions (10–36%). For interventions such as pre-eclampsia case management, antenatal hemorrhage management and prolonged labor, we used the regional proportions of EmOC (50% of women who receive cesarean sections) to adjust and estimate subnational estimates. For interventions such as active management of third-stage labor, pre-referral management of labor complications and induction of labor, we used the regional values for delivery in a health facility as a proxy to adjust and estimate subnational coverage proportions (for a full list of interventions, see **table 3**).

6a. The percentage of women in each region covered by each intervention not included in the 2017–2018 PDHS was estimated as follows:

$$\%\text{♀covered}_{\text{region(i)}}^{\text{scen 2, intervention type}} = \%\text{♀covered for intervention}_{\text{Pakistan, Darroch}}^{\text{scenario 2, intervention type}} * \frac{\%\text{♀covered for intervention}_{\text{region (i), PDHS}}^{\text{scenario 2, intervention type}}}{\%\text{♀covered for intervention}_{\text{Pakistan, Darroch}}^{\text{scenario 2, intervention type}}}$$

Data:

1. The percentage of women at the country level who were covered for an intervention not included in the DHS was obtained from Darroch (2018).[29]
2. The percentage of women covered at the region level, for an intervention included in the PDHS, was obtained from the 2017–2018 PDHS.[8]

6b. The number of women and newborns requiring MNH care by intervention type and scenario and by region was calculated as follows:

$$\#\,\text{♀ and newborns requiring MNH care}_{\text{region(i),intervention type}}^{\text{scen(j)}} = (\#\,\text{births}_{\text{region(i), scen (j)}}^{\text{intention status}} + 50\%\big(\#\,\text{abortions}_{\text{region(i), scen (j)}}\big))r\%\text{requiring intervention}_{\text{intervention type}}$$

Data:

3. Number of births by region, intention status and scenario was computed using the calculations shown in **3c1**.
4. Number of abortions by scenario and region was computed using calculations shown in **3c3**.
5. Percentage requiring the intervention was obtained from calculations shown in **6a**.

6c. The number of women and newborns requiring MNH care by intervention type, scenario and wealth status was calculated as follows:

$$\#\,\text{♀ and newborns requiring MNH care}^{\text{scen (j)}}_{\text{WQ(i),intervention}} = (\#\,\text{births}_{\text{WQ (i), scen (j)}}\,\text{intention status} + 50\%\,\#\,\textit{abortions}_{\text{WQ(i), scen (j)}})\,Q\%_{\text{requiring intervention}}\,\text{intervention type}$$

Data:

1. Number of births by region, intention status and scenario was computed using the calculations shown in **3c1**.
2. Number of abortions by scenario and region was computed using calculations shown in **3c3**.
3. Percentage requiring the intervention was obtained from calculations shown in **6a**.

7. Cost of providing contraceptive care and maternal and newborn health care

For this analysis, we estimated costs separately for each contraceptive commodity and for each maternal and newborn health intervention. For each, we estimated total direct costs as well as indirect costs. Direct costs include the cost of contraceptive commodities, drugs and supplies, and labor (see **tables 4 and 5** for full list of ingredients that were included in direct costs); indirect costs include management, infrastructure, transport and other overheads. Both categories were computed using the methods outlined in Darroch (2018).[29] All costs were estimated in 2017 U.S. dollars.

The costs of the various ingredients needed to compute regional and national costs were obtained from two main sources in Pakistan (see **table 5** for the ingredients):

- We obtained average unit costs for contraceptives, as well as all drugs and supplies needed for contraceptive care and maternal and newborn health care, from the UNICEF Supply Catalogue.[21]
- The 2017 average salary data for medical personnel were obtained from the Ministry of Finance.[23]

7a. The total cost of a contraceptive commodity by each scenario and by region was estimated as follows:

$$\$\,\text{cost for all users}^{\text{method type}}_{\text{scenario (j), region(i)}} = \#\,\text{♀ method users}^{\text{method type}}_{\text{scenario (j), region (i)}} * \text{total unit \$ cost}^{\text{method type}}_{\text{scenario (j), region (i)}}$$

Data:

1. The number of women using each method by scenario and region was obtained from calculations shown in **2b1e**.

2. The total unit cost per contraceptive commodity was obtained using methods shown in Darroch (2018).[29]

7b. The total cost of an MNH intervention by each scenario and by region was estimated as follows:

$$\$\ \text{cost for all users}^{\text{intervention type}}_{\text{scenario (i), region(i)}} = \#\text{♀ and newborns requiring care}^{\text{intervention type}}_{\text{scenario (i), region (i)}} * \text{total unit } \$\ \text{cost}^{\text{intervention type}}_{\text{scenario (i), region (i)}}$$

Data:

1. The number of women requiring each intervention by scenario and region was obtained from calculations shown in **6b**.
2. The total unit cost per MNH intervention was obtained using methods shown in Darroch (2018).[29]

Table 3. List of MNH interventions and the DHS interventions used as proxies for estimating distribution of women covered by region

MNH Intervention	DHS/other source intervention
Antenatal care	
1. Basic antenatal care	from DHS data
2. Tetanus toxoid	from DHS data
3. Syphilis screening	Basic antenatal care
4. Syphilis treatment for seropositive women	Basic antenatal care
5. Hypertensive disease care management	Basic antenatal care
6. Pre-Eclampsia case management - Mild cases < 37 weeks	EmOC (50% of C-section)
7. Pre-Eclampsia case management - Mild cases > 37 weeks	EmOC (50% of C-section)
8. Pre-Eclampsia case management - Severe Cases	EmOC (50% of C-section)
9. Hookworm treatment	from DHS data
10. Malaria prevention—Insecticide-treated bed nets	Basic antenatal care
11. Malaria prevention—Intermittant preventive treatment in pregnancy (IPT)	Basic antenatal care
12. Malaria screening and treatment	Basic antenatal care
13. Anemia Screening	Basic antenatal care

14. Daily Iron and Folic Acid Supplementation (anemic pregnant women)	from DHS data
15. Intermittent Iron and Folic Acid Supplementation (Nonanemic pregnant women - 1 month care)	Basic antenatal care
16. Urinary Tract Infection	Basic antenatal care
17. Ectopic pregnancy case management	EmOC (50% of C-section)
Labor, delivery and postpartum care	
18. Antenatal Corticosteroids for Preterm Labor	Institutional delivery
19. Antibiotics for Premature Rupture of Membranes (pPROM)	Institutional delivery
20. Induction of Labor (>41 weeks)	Institutional delivery
21. Essential care for all women with routine vaginal delivery	from DHS data
22. Essential care for all newborns	from DHS data
23. Active Management of Third Stage of Labor	Institutional delivery
24. Prereferral Management of Labor Complications	Institutional delivery
25. Antepartum Hemorrhage Management	EmOC (50% of C-section)
26. Prolonged Labor	EmOC (50% of C-section)
27. Cesarean section	from DHS data
28. Assisted Vaginal Delivery	EmOC (50% of C-section)
29. Management of Eclampsia	EmOC (50% of C-section)
30. Maternal Sepsis case management	EmOC (50% of C-section)
31. Postpartum Hemorrhage	EmOC (50% of C-section)
32. Preventive postnatal care	from DHS data
33. Mastitis Care	EmOC (50% of C-section)
34. Obstetric Fistula	EmOC (50% of C-section)
35. Counseling and Support for Breast-Feeding	Institutional delivery
Newborn care	
36. Newborn Resuscitation (Institutional Deliveries)	Institutional delivery
37. Newborn Local Infections	Institutional delivery
38. Management of Newborn Syphilis	Institutional delivery
39. Kangaroo Mother Care	Institutional delivery
40. Treatment of Low Birth Weight	Institutional delivery
41. Management of Severe Infection for Neonates—Injectable Antibiotics	Institutional delivery
42. Management of Severe Infection for Neonates—Full Supportive Care	Institutional delivery
43. Newborn Vaccines—BCG Vaccine	Institutional delivery

44. Newborn Vaccines—Hepatitis B Vaccine	Institutional delivery
45. Newborn Vaccines—Polio Vaccine	Institutional delivery
Postabortion care (PAC)	
46. PAC - Incomplete abortion	Sathar et al. (2014)
47. PAC – Shock	Sathar et al. (2014)
48. PAC - Uterine perforation/cervical laceration	Sathar et al. (2014)
49. PAC – Sepsis	Sathar et al. (2014)

Table 4. List of personnel used for calculating direct costs

Personnel	Source
Obstetrician	Technical Resource Facility (TRF)
General physician/Medical officer	Technical Resource Facility (TRF)
Nurse/Midwife	Technical Resource Facility (TRF)
Lady Health Visitor (LHV)	Technical Resource Facility (TRF)
Lady Health Worker (LHW)	Technical Resource Facility (TRF)

Source: References 24-26

Table 5. List of drugs and supplies included in cost estimates

Drug /Supply Name	Source
Acetylsalicylic acid, tab, 75mg	UNICEF Supply Catalogue
Albendazole, tablet, 400mg	UNICEF Supply Catalogue
Amoxicillin, caplet, 250 mg	UNICEF Supply Catalogue
Amoxicillin, powder/oral suspension, 125mg/5ml	UNICEF Supply Catalogue
Ampicillin, powder for injection, 500mg, vial	UNICEF Supply Catalogue
Antenatal care record	UNICEF Supply Catalogue
Artemether + Lumefantrine, tablets, 20+120mg, 6x1 blister	UNICEF Supply Catalogue
Artesunate + Amodiaquine, tablets, 50mg+135mg, 3+3 blister	UNICEF Supply Catalogue
Artesunate + SP, tablets, 50mg+500mg+25mg, 3+1 blister	UNICEF Supply Catalogue
Artesunate, vial, 60mg	UNICEF Supply Catalogue
Atropine sulphate, injection, 1 mg in 1-ml ampoule	UNICEF Supply Catalogue
AZT solution 10mg/ml	UNICEF Supply Catalogue
Bag, urine, collecting, 2000ml	UNICEF Supply Catalogue

BCG vaccine	UNICEF Supply Catalogue
Benzathine benzylpenicillin, powder for injection, 2.4 million IU	UNICEF Supply Catalogue
Betamethasone, 12mg injection	UNICEF Supply Catalogue
Blade, surgical, no. 22, sterile, disposable	UNICEF Supply Catalogue
Blood collecting tube, 5ml	UNICEF Supply Catalogue
Blood culture	UNICEF Supply Catalogue
Blood type and cross-match	UNICEF Supply Catalogue
Calcium carbonate, tablet, 600mg	UNICEF Supply Catalogue
Cannula, IV, 18G, sterile, disposable	UNICEF Supply Catalogue
Cefazolin, ampoule, 500 mg	UNICEF Supply Catalogue
Ceftriaxone, powder for injection, 250 mg vial	UNICEF Supply Catalogue
Chest X-ray	UNICEF Supply Catalogue
Chlorhexidine surgical scrub, 5ml	UNICEF Supply Catalogue
Ciprofloxacin, tablet, 250mg	UNICEF Supply Catalogue
Clean delivery kit	UNICEF Supply Catalogue
Clindamycin, tab, 300mg	UNICEF Supply Catalogue
Complete blood count	UNICEF Supply Catalogue
Condom, male	UNICEF Supply Catalogue
Cotton swab	UNICEF Supply Catalogue
Delivery record	UNICEF Supply Catalogue
Diazepam, injection, 5mg/ml in 2-ml ampoule	UNICEF Supply Catalogue
Doxycycline, tablet, 100mg	UNICEF Supply Catalogue
Drawsheet, plastic, 90x180cm	UNICEF Supply Catalogue
Epinephrine, ampoule, 1mg/ml	UNICEF Supply Catalogue
Erythromycin, tablet, 250 mg	UNICEF Supply Catalogue
Erythromycin estolate 125 mg base/5 ml oral suspension, 100 ml	UNICEF Supply Catalogue
Ferrous Salt + Folic Acid, tablet, 200+0.4mg (60mg iron)	UNICEF Supply Catalogue
Foley catheter	UNICEF Supply Catalogue
Folic acid, tablet, 5mg	UNICEF Supply Catalogue
Gauze pad, 10 x 10cm, sterile	UNICEF Supply Catalogue
Gentamicin, injection, 40 mg/ml in 2ml vial	UNICEF Supply Catalogue
Gentian violet, powder 25mg	UNICEF Supply Catalogue
Gloves, exam, latex, disposable, pair	UNICEF Supply Catalogue
Gloves, surgeon's, latex, disposable, sterile, pair	UNICEF Supply Catalogue

Glucose injection 5%, 500ml with giving set	UNICEF Supply Catalogue
Hemoglobin test strip	UNICEF Supply Catalogue
Hep B vaccine	UNICEF Supply Catalogue
Hib vaccine	UNICEF Supply Catalogue
HIV EID (Early Infant Diagnosis Test) Assay Renewables	UNICEF Supply Catalogue
HIV EID Dry Blood Spot (DBS) Collection kit	UNICEF Supply Catalogue
HIV Rapid Detection Test (STAT-PAK HIV1/2,dipstick)	UNICEF Supply Catalogue
HIV Confirmatory test (MP Biomedical HIV BLOT 2.2)	UNICEF Supply Catalogue
HPV vaccine	UNICEF Supply Catalogue
Hydralazine, powder for injection, 20mg ampoule	UNICEF Supply Catalogue
Insecticide-Treated Net	UNICEF Supply Catalogue
IV giving/infusion set, with needle	UNICEF Supply Catalogue
Ketamine, 10ml vial, 50mg/ml	UNICEF Supply Catalogue
Lancet, blood, disposable	UNICEF Supply Catalogue
Lidocaine HCl (in dextrose 7.5%), ampoule 2ml	UNICEF Supply Catalogue
Lidocaine, injection, 1% in 20 ml vial	UNICEF Supply Catalogue
Magnesium sulfate, injection, 500 mg/ml in 10-ml ampoule	UNICEF Supply Catalogue
Malaria test kit (RDT)	UNICEF Supply Catalogue
Mebendazole, chewable tablet, 500 mg	UNICEF Supply Catalogue
Metronidazole, injection, 500 mg in 100 ml vial	UNICEF Supply Catalogue
Metronidazole, tablet, 500mg	UNICEF Supply Catalogue
Mifepristine, tablet, 200mg	UNICEF Supply Catalogue
Misoprostol, tablet, 200mcg	UNICEF Supply Catalogue
Nevirapine, oral solution, 10mg/ml	UNICEF Supply Catalogue
Nifedipine, tab-cap, 10mg	UNICEF Supply Catalogue
Oxygen, 1000 liters, primarily with oxygen cylinders	UNICEF Supply Catalogue
Oxytocin, injection, 10 IU in 1 ml ampoule	UNICEF Supply Catalogue
Paracetamol, tablet, 500 mg	UNICEF Supply Catalogue
Partograph	UNICEF Supply Catalogue
Pethidine, 50 mg/ml, 2ml ampoule	UNICEF Supply Catalogue

Polio vaccine	UNICEF Supply Catalogue
Pregnancy test	UNICEF Supply Catalogue
Procaine benzylpenicillin, powder for injection, 1 g (= 1 million IU) in vial	UNICEF Supply Catalogue
Quinine, injection, 300mg/ml, 2ml ampoule	UNICEF Supply Catalogue
Quinine sulphate, tab, 300 mg	UNICEF Supply Catalogue
Razor blade, stainless steel	UNICEF Supply Catalogue
Resuscitator,hand-operated,infant/child,set	UNICEF Supply Catalogue
Safety box for used syringes/needles, 5 liter	UNICEF Supply Catalogue
Sodium chloride, injectable solution, 0,9%, 500ml	UNICEF Supply Catalogue
Sodium lactate injection (Ringer's), 500ml, with giving set	UNICEF Supply Catalogue
Sulfadoxine + pyrimethamine, tablet 500mg + 25mg	UNICEF Supply Catalogue
Suture, absorbable, synthetic, 2/0, curved needle	UNICEF Supply Catalogue
Suture, catgut, chromic, 0, needle	UNICEF Supply Catalogue
Suture, non-absorbable, synthetic, 2/0, needle	UNICEF Supply Catalogue
Suture, non-absorbable, synthetic, 3/0, curved needle	UNICEF Supply Catalogue
Syringe, auto-disable, 0.5ml, with needle	UNICEF Supply Catalogue
Syringe, auto-disable, BCG, 0.1ml, with needle	UNICEF Supply Catalogue
Syringe, needle+ swab	UNICEF Supply Catalogue
TDF + 3TC + EFV	UNICEF Supply Catalogue
TDF + FTC + EFV	UNICEF Supply Catalogue
Test strips, urine analysis	UNICEF Supply Catalogue
Test, blood glucose	UNICEF Supply Catalogue
Test, blood group, anti A + B, 10 ml	UNICEF Supply Catalogue
Test, hemoglobin	UNICEF Supply Catalogue
Test, Rapid plasma reagin (RPR)	UNICEF Supply Catalogue
Tetanus toxoid, injection	UNICEF Supply Catalogue
Tetracycline eye ointment, 1%, tube 5mg	UNICEF Supply Catalogue
Tetracycline, tablet, 250mg	UNICEF Supply Catalogue
Umbilical cord clamp, sterile	UNICEF Supply Catalogue

Water for injection, 10 ml ampoule	UNICEF Supply Catalogue
Water for injection, 5 ml ampoule	UNICEF Supply Catalogue
Contraceptives	**Source**
Condom, Male	UNICEF Supply Catalogue
Implant – Jadelle	UNICEF Supply Catalogue
Injectable, 3-monthly	UNICEF Supply Catalogue
IUD – Copper	UNICEF Supply Catalogue
Pill – Combined	UNICEF Supply Catalogue

Source: Reference 21

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