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CONCEPT NOTE

Reproductive, Maternal, Newborn, and Child Health

In 2015, an estimated 303,000 women died during pregnancy and childbirth, 99% of them in developing countries.[1] In the same year, an estimated 5.9 million infants and children under age five died, including more than 2.6 million newborns.[2] Most of these maternal and neonatal (newborn) deaths occurred during pregnancy and could have been prevented with access to skilled routine and emergency care.[3]

Risk factors for maternal and neonatal mortality include living in low- and middle-income countries (LMICs), especially in rural areas; poverty; and pregnancy at either extreme of the reproductive age period. Similarly, risk factors for under-5 mortality include living in rural areas, poverty, and having a mother who did not receive basic education.[5]

In 2017, more than one in 10 married or in-union women globally had an unmet family planning need, and less than half of the total demand for family planning was being met with modern contraceptive methods in 45 countries.[6]

Reproductive, maternal, newborn, and child health (RMNCH) is the field within population health that encompasses the life stages and health events that take place from pre-pregnancy through the first five years of a child's life. **Reproductive health** pertains to reproductive processes and systems throughout all stages of life; **maternal health** refers to the health of mothers during pregnancy, childbirth, and the postpartum period; **newborn health** refers to the health of a baby during its first 28 days of life; and **child health** pertains to the health of children from birth through adolescence, with a focus on the first five years of life.[7–9]

Causes of Maternal, Neonatal, and Child Morbidity and Mortality

When designing interventions to improve RMNCH, programs must consider the causes of poor outcomes and how best to address them. The most common causes of maternal mortality worldwide include postpartum hemorrhage (contributing to 27% of deaths between 2003 and 2012);[4] infection; high blood pressure (including eclampsia and preeclampsia); childbirth (delivery) complications, such as

Claire Donovan, Julie Rosenberg, Rebecca Weintraub, and Ana Langer prepared this concept note for the purposes of classroom discussion rather than to illustrate either effective or ineffective health care delivery practice.

obstructed labor; and complications of unsafe abortion. Communicable diseases such as HIV and malaria, as well as non-communicable diseases such as diabetes and hypertension account for the remainder of maternal deaths.[1],[4]

As of 2015, the biggest contributor to under-5 mortality was premature birth (35%), followed by childbirth-related complications (24%), sepsis (15%), congenital abnormalities (11%), other causes of death (7%), pneumonia (6%), tetanus (1%), and diarrhea (1%).[5]

Factors that influence RMNCH outcomes include, but are not limited to, biological factors; the choices and behaviors of beneficiaries; the availability, accessibility, and quality of health services, personnel, facilities, and supplies; the policy environment; and local context (e.g., social mores, socioeconomic factors). High-value programs will account for these factors at each stage for each target population. This includes addressing risks and potential complications for women's reproductive health, pregnancy, delivery, and postpartum health, as well as risks for children's, from fetus to age five, and adolescents' health. In the section that follows, we consider the complications and conditions that need to be prevented or treated at each stage of the RMNCH care cycle.

Reproductive Health Complications

Adequate reproductive healthcare includes access to safe, affordable, and effective contraception; safe abortion services; and post-abortion care.[10] Multiple health issues can arise as a result of inadequate or unsafe reproductive healthcare. The absence or incorrect use of contraception increases the risk of contracting and passing on sexually transmitted diseases such as HIV/AIDS. Methods of contraception that require insertion or surgery carry the risk of infection or complications that can lead to illness or death.

Other common reproductive health concerns include sterility, infertility, unwanted pregnancy, and abortion complications. **Unsafe abortion**—any abortion performed by untrained personnel or in an environment that does not meet minimum medical standards, or both—increases the risk of potentially fatal hemorrhage, infection, and injury to the genital tract and/or internal organs.[11]

Reproductive health is, in many countries, a neglected area of focus and services are not offered by the public health system. Furthermore, various cultural practices and religious traditions oppose aspects of family planning and contraception, constraining access where services are available.

Pregnancy Complications

Pregnancy typically lasts around 40 weeks. RMNCH programs must consider the many complications that can occur during pregnancy that affect the well-being of both the mother and the fetus as well as perinatal complications, those occurring specifically between 22 weeks of gestation and 1 week after birth, when designing interventions and establishing goals.

Although the definition varies according to cultural context, a **miscarriage** is commonly defined as the loss of an embryo or fetus before the 20th week of pregnancy.[12] Most miscarriages are due to abnormal fetal development (e.g., chromosomal abnormalities). Other causes include maternal health conditions such as diabetes, infection, hormonal imbalance, thyroid disease, and uterine or cervical problems.[13] Miscarriages can lead to further health complications for the mother, most notably mental health issues and infection due to an incomplete expulsion of the fetus. Likelihood of a miscarriage increases with age, history of miscarriage, chronic conditions, unhealthy maternal weight, smoking and drug use, and uterine abnormalities.

A **stillbirth** occurs when a fetus dies in the womb after the 20th week of pregnancy or during labor or childbirth**.** Stillbirths can be caused by birth defects, problems with the placenta or umbilical cord, and

preexisting maternal health conditions or behaviors, such as smoking, uncontrolled diabetes, high blood pressure, or obesity.[12] Stillbirths are not included in neonatal mortality figures.

An **ectopic pregnancy**, another form of a nonviable pregnancy, occurs when a fertilized egg attaches somewhere other than the main cavity of the uterus, most commonly in the fallopian tubes. Left untreated, an ectopic pregnancy can result in destruction of the reproductive organs and fatal hemorrhage (bleeding).[14] If an ectopic pregnancy is caught at an early stage, only medication is needed to end the pregnancy; if not, surgery is required. Ectopic pregnancies are estimated to occur in less than 2% of pregnancies globally.[14]

Hypertensive disorders of pregnancy are one of the top five causes of maternal death. One is **preeclampsia**, a condition of poorly understood etiology characterized by elevated blood pressure (hypertension) and damage to an organ system—most often the kidneys—that appears in women around or after the 20th week of pregnancy. Common signs include headache, fluid retention, vision changes, and stomach pain. Although treatment is available, the only cure is delivery of the fetus, sometimes before it is mature enough to survive outside the womb.[15] Left untreated, preeclampsia can lead to **eclampsia**, which is characterized by seizures in the pregnant woman and necessitates immediate delivery of the fetus.

Childbirth Complications

A number of complications may occur during the birth process. Childbirth complications are one of the top five causes of maternal mortality and under-5 mortality.

When, despite strong uterine contractions, the fetus cannot progress through the pelvis due to an insurmountable barrier preventing its descent, labor is considered obstructed.[16] **Obstructed labor** (dystocia) often lasts over 12 hours and requires surgery (Cesarean section) or the use of forceps or a vacuum extractor. It threatens the fetus' oxygen supply, which can lead to fetal asphyxia, brain damage, and neonatal death.[17] It can also cause infection and organ damage in the mother and, in extreme cases, lead to obstetric fistula, severe hemorrhage, shock, and even death.

Obstructed labor, along with prolonged labor, absence of a skilled health worker, multiple vaginal births beginning at a young age, and a history of heavy lifting,[18] can lead to **pelvic organ prolapses**—the protrusion of pelvic organs through the vaginal opening following a vaginal birth. Pelvic organ prolapses occur in an estimated 9% of pregnancies worldwide and can result in incontinence, infection, and ulcers.[18,19] These conditions often carry a stigma and can result in ostracism from the community.

Obstructed labor can also lead to **obstetric fistula**, a hole between the vagina and either the bladder or rectum. Access to and use of contraceptive methods, postponing pregnancy until adulthood, and ensuring the presence of skilled health workers reduces the risk of developing an obstetric fistula. Without training and tools such as forceps and vacuum extractors, obstetric fistulas are preventable only through **Caesarean section** (C-section)—a surgical delivery procedure that requires incisions in the mother's abdomen and uterus—and treatable through reconstructive surgery. An estimated 2 million women in LMICs were living with an obstetric fistula in 2016, while there were no reports of untreated fistula in high-income countries.[20] Untreated, an obstetric fistula can lead to severe incontinence, vulnerability to infection, kidney disease, sores, and infertility—another source of stigma in many communities. Mental and psychosocial complications, such as isolation, depression, and self-harm, often accompany untreated fistulas.[20]

Tetanus is a toxic bacterial infection contracted through open wounds that causes central nervous system damage, painful muscle contractions, and, in some cases, death.[21] **Maternal tetanus** can occur any time during pregnancy or as the result of an unsafe abortion; however, the most prevalent cause is childbirth in unsterile conditions. It is most common in LMICs, where coverage of the tetanus toxoid

immunization is lowest. In some areas of Asia and Africa, 10% of all maternal deaths are attributed to tetanus.[21]

Birth asphyxia is the failure of the fetus or newborn to establish breathing before, during, or after childbirth.[22] It prevents sufficient oxygen from reaching internal organs and, if untreated, can lead to cell death, brain damage, and death.[23] Birth asphyxia is a leading cause of stillbirths and neonatal mortality, accounting for 23% of neonatal deaths globally.[5,22]

Complications Post-Childbirth

The six weeks following delivery are known as the **puerperium period**. A major cause of maternal death during this timeframe is **sepsis**, the body's inflammatory response to infection. C-sections are the biggest risk factor for infection.[24]

Although blood loss is natural during childbirth, abnormally high blood loss (greater than or equal to 500mL within 24 hours of a vaginal birth, or greater than or equal to 1,000mL within 24 hours of a C-section)[25] is known as **postpartum hemorrhage** (PPH). PPH and late PPH, which occurs 24 hours or more post-childbirth, pose a serious threat to the mother's health. The most common cause of PPH is uterine **atony**, the failure of the uterus to contract and retract following childbirth.[25] Other causes include retention of the placenta, failure to progress during the second stage of labor, **placenta accreta** (failure of all or part of the placenta to detach from the uterine wall), high newborn birth weight, anemia, hypertensive disorders (including preeclampsia), medical induction of labor, and maternal obesity.[25]

Anemia, which can result from a variety of causes, is a condition in which the body has lower-than-average hemoglobin, hematocrit, and red blood cell counts. Anemia can manifest as a chronic or acute condition, and its severity can vary.[26] Symptoms include fatigue, headache, dizziness, and pale or yellowing skin. **Iron deficiency anemia** accounts for up to 95% of anemia in pregnancy.[27] Severe anemia during pregnancy predisposes a woman to preterm birth, low birth weight, perinatal mortality, and postpartum depression.[27]

An often-underreported cause of maternal morbidity and mortality is **postpartum depression**, characterized by mood swings, insomnia, irritability, and anxiety. Postpartum depression is caused by a combination of dramatic hormone changes and emotional instability after giving birth. As many as one in seven new mothers experiences postpartum depression; however, only about 15% of women with postpartum depression receive treatment.[28,29]

Neonatal and Infant Health

For the purposes of assessing morbidity and mortality, the neonatal period is defined as days 1 to 28; and, the infant period, 28 days to one year old. Newborns are especially vulnerable in the first 48 hours after birth, when infection, illnesses, and complications from delivery can threaten their short- and long-term health. The most common causes of mortality in this period are infections including sepsis, pneumonia, tetanus, and diarrhea (36%); complications of pre-term birth (28%); and asphyxia (23%).[30]

A major cause of neonatal mortality is **preterm birth**, defined as birth before week 37 of pregnancy. Preterm birth is often associated with low birth weight. Preterm babies are prone to short-term issues such as breathing problems, heart problems, excessive bleeding and fluid retention in the brain, and issues in temperature regulation.[31] The World Health Organization (WHO) estimates that three-quarters of preterm birth fatalities are preventable.[32]

Congenital anomalies account for 11% of neonatal deaths and 5.8% of infant deaths.[33] Congenital anomalies, often called birth defects, are catchall terms for structural or functional anomalies in a fetus or newborn that hinder proper development and are often fatal within the first five years of life. The category includes congenital heart abnormalities, neural tube defects, chromosomal abnormalities, Down's syndrome, and others.[33] Birth defects occur in an estimated one in 33 births. They are poorly understood; only one in five birth defects has an identifiable cause.[34]

Neonatal tetanus, like maternal tetanus, usually is caused by unsterile practices, such as birth attendants not washing their hands, severing the umbilical cord with an unsterilized instrument, or cultural traditions involving the application of animal feces to the umbilical cord, circumcision scar, or body.[21] Untreated neonatal tetanus leads to septic shock. In 2013, the global mortality rate for untreated tetanus was 0.3 per 1,000 live births.[35]

The major causes of diseases in the infant period globally are lower respiratory infections (20.1%); diarrheal diseases (17.4%); and malaria (11.8%).[33]

Under-5 Morbidity and Mortality

While the risk goes down with time, the first 1,000 days following conception, or roughly the first two years of life, are considered crucial for childhood survival and long-term development.[36] The primary causes of under-5 mortality globally are pneumonia (13%) and diarrhea (8%).[37] According to WHO, more than half of under-5 deaths globally are preventable.[5] Just over 40% of under-5 mortality occurs in the neonatal period.[30]

Transmittable diseases and conditions can be passed to the fetus or baby from the mother at various points along the continuum of RMNCH care: during conception, in the uterus, during childbirth, and post-childbirth (see **Exhibit 1** for a list of diseases and conditions associated with vertical transmission). Most notably, **mother-to-child transmission** (MTCT) of HIV can occur during pregnancy, childbirth, and breastfeeding. Almost all of the 3.4 million children living with HIV in 2009 acquired the infection through MTCT.[38] Childhood HIV/AIDS is most common in sub-Saharan Africa and Southern Asia and, like adult HIV/AIDS, can be fatal if untreated.[5]

Acute respiratory infections, including pneumonia, are the primary cause of mortality among children under five. Children who are immunocompromised due to conditions such as HIV/AIDS have an increased risk of contracting acute respiratory infections.

Diarrhea is characterized by three or more loose or liquid stools within a 24-hour period.[39] It has many causes, including illnesses such as cholera, parasitic and bacterial infections, and environmental factors such as unclean drinking water and food, poor sanitation, and waste control.[39] Diarrhea causes rapid fluid loss, depriving the body of necessary salts, vitamins, and minerals. In severe cases, diarrhea can cause fatal dehydration. Diarrhea is the second leading cause of under-5 mortality and a leading cause of malnutrition.[39]

Malaria, a vector-borne parasitic infection, also disproportionally impacts children; 69% of malaria deaths globally in 2015 were in children under five.[40] Malaria is most prevalent in sub-Saharan Africa.[41]

Malnutrition was responsible for 45% of all under-5 deaths in 2015.[5] It encompasses three broad conditions: undernutrition, which includes stunting (low height for age), wasting (low weight for height), and underweight (low weight for age); overweight, obesity (defined by preset body mass measurements), and diet-related noncommunicable diseases (such as heart disease, stroke, diabetes, and cancer);[42] and vitamin and nutrient deficiencies. Malnutrition can be acute or chronic. Early malnutrition can lead to

delayed or impaired cognitive and physical development, which is largely irreversible and can impair school and work achievement and increase the risk of disease later in life (see **GHD-C08** Concept Note: Malnutrition).[36] Specifically, **vitamin A deficiency** can lead to blindness and increases the risk of death from certain childhood diseases, including diarrhea.[43]

While widespread immunization efforts have decreased vaccine-preventable diseases associated with childhood, including **tetanus**, **measles**, **poliomyelitis**, **diphtheria**, and **pertussis,** these diseases still contribute substantially to global child mortality.[44] Measles and poliomyelitis (polio) are viral infections, while diphtheria and pertussis are bacterial infections.

Building the Field

Historically, healthcare providers and communities focused most of their attention on the moment of childbirth. Many cultures have viewed the components of what is now known as RMNCH as "life events," not health events requiring medical guidance, active monitoring, or intervention.

RMNCH, therefore, is a relatively new field. Originally known as maternal, newborn, and child health, or MNCH, it recently incorporated "reproductive health" (a term coined by WHO in 1988) to acknowledge and prioritize women's health needs beyond pregnancy and childbirth.

In the mid-20th century, international efforts to treat and prevent child morbidity gradually expanded to include infant and neonatal health.[9] In 1964, research conducted by the US military, the US Agency for International Development (USAID), and the US National Institutes of Health (NIH) discovered a glucose-salt combination that reduced dehydration and diarrhea in soldiers and led to the development of oral rehydration therapy to treat childhood diarrhea. Further efforts to reduce childhood mortality included malaria control and prevention, and fortifying foods with vitamin A to reduce vitamin A deficiency.[9,45]

As global attention turned to the youngest victims of poverty and disease, UNICEF declared 1979 the Year of the Child. In 1982, UNICEF launched the "child survival revolution," an effort to bring awareness to child mortality and promote cost-effective solutions for common childhood illnesses. These solutions, known collectively as GOBI—growth monitoring; oral rehydration therapy; breastfeeding; and immunizations against tuberculosis, diphtheria, whooping cough, tetanus, polio, and measles—drew from emerging primary healthcare models.[46]

In 1985, the US Congress increased its budget allocation for global child health efforts.[9] The US focused on vaccination as a cost-effective, high-impact intervention for improving child health and well-being domestically and abroad.[47]

Slowly, and in conjunction with the women's movement, health policymakers and practitioners began to recognize maternal care as a value in itself and distinct from newborn and child healthcare. As new knowledge about the relationship between behavior, diet, and pregnancy risk factors became available in the 1980s, maternal health expanded to include the nine months of gestation and the months immediately following childbirth.[48] In 1989, USAID implemented its first international maternal health program.[9]

In 1990, at the World Summit for Children, international leaders signed a World Declaration and 10-point Plan of Action outlining target indicators for infant and maternal mortality, child malnutrition and illiteracy, family planning, education, water, and sanitation. By 1995, 179 countries had ratified the 1990 UN General Assembly's Convention of the Rights of the Child.[46]

An increasing number of studies showed that access to safe and effective family planning and contraception methods contributed to improved health and indirect financial benefits for women and

children.[49] The broadening of MNCH care in the early and mid-1990s to encompass **reproductive health** (a term coined by WHO in 1988) signaled a major shift in thinking.

Spurred by the achievement of universal childhood immunization coverage (80%) in 1990, the international community set malnutrition, clean water, and sanitation access targets for the year 2000.[46] The Global Vaccine Alliance (Gavi) launched in January 2000 and aimed to bring together the public and private sectors to expand vaccine access globally.

Over time, growing evidence demonstrated that institutional maternal care led to better health outcomes than home-based care. The first big push for skilled birth attendance occurred in 1997, at the Safe Motherhood Conference in Sri Lanka.

WHO and other international health leaders developed guidelines for pre-pregnancy, antenatal, childbirth, postnatal, and newborn and child healthcare. The concept of the continuum of RMNCH care including these five stages, along with lifelong reproductive healthcare, has been attributed to the Partnership for Maternal, Newborn & Child Health, an alliance of more than 1,000 organizations in 77 countries established in 2005. The grouping of these interventions, which has brought greater attention to their importance and facilitated integration with broader healthcare systems, has led to improved RMNCH outcomes and lower healthcare costs (see **Exhibit 2** for recommended interventions by facility level).[50]

The Millennium Summit in 2000 brought renewed attention to RMNCH with eight Millennium Development Goals (MDGs) aimed at addressing extreme poverty globally by 2015, including Goal 4 (to reduce under-5 mortality by two-thirds between 1990 and 2015) and Goal 5 (to reduce maternal mortality by three-quarters between 1990 and 2015) (see **Exhibit 3a-3f** for MDG goals and outcomes). Reproductive health was not explicitly mentioned as part of the original MDGs. In 2007, a second target was added under Goal 5: achieve universal access to reproductive health. Thirty-two percent of countries reached Goal 4, and very few countries reached Goal 5 targets.[51,52] The Sustainable Development Goals, covering 2015–2030, included targets meant to improve on progress made during the MDG period (see **Exhibit 4** for Sustainable Development Goals related to RMNCH).

In 2012, WHO published a checklist of guidelines for safe childbirth (see **Exhibit 5** for the Safe Childbirth Checklist). Its purpose was to increase compliance with and streamline delivery of proven interventions during labor, childbirth, and postpartum. The checklist reinforced clinician behaviors such as handwashing, recommended tools and supplies for each step of childbirth, and promoted communication and collaboration within care teams. A large-scale study of coaching-based implementation of the checklist in Uttar Pradesh, India, showed that while its use increased birth attendants' adherence to essential practices, it did not lead to lower maternal or perinatal mortality and morbidity.[53] Possible explanations include insufficient levels of adherence to the checklist to affect outcomes; women's underlying health status; the quality of the pre- and postnatal care women received; the quality of referral care for complex cases; and gaps in technical skills, access to supportive management, and high-quality supplies and medicines.[54]

Over the past two decades, despite rising rates of institutional delivery and the proportion of births attended by skilled personnel, preventable maternal and neonatal mortality persists.[55] In response, global stakeholders, led by WHO, began turning their attention towards and prioritizing quality of care. In 2016, WHO developed a maternal and newborn quality framework consisting of eight domains and output and outcome measurements associated with each, allowing stakeholders and practitioners to assess, monitor, and ultimately improve quality of care (see **Exhibit 6** for WHO Standards for Improving Quality of Care).[55]

In recent years, some countries and organizations have added adolescent health to the RMNCH continuum (RMNCH+A), recognizing that reproductive health begins early—with prevention of chronic

diseases and sexually transmitted infections (STIs), as well as unplanned pregnancies. In 2015, the United Nations (UN) expanded its Global Strategy for Women's and Children's Health to include adolescent health.[56] Some groups also include nutrition and NCDs. Reproductive health, particularly contraception and abortion, continues to be the most controversial component of RMNCH. Religious, cultural, and political attitudes toward reproductive health have exerted a strong influence on decision making at all levels, from governments and donors to providers and patients.

Major RMNCH donors include the Bill & Melinda Gates Foundation, USAID, the UN Population Fund, and the UK's Department for International Development. Their support has played a considerable role in shaping RMNCH research and programs.

Measuring Mortality, Morbidity, and Health Service Utilization

Underreporting and poor-quality data collection are common challenges in tracking RMNCH service delivery and outcomes. Monitoring and reporting may be further complicated with different stakeholders using different definitions for various time periods in the RMNCH cycle of care. Due to poor health management and information systems resulting in a dearth of reliable or complete data, countries often use modeling to estimate mortality.[57] Many women and children live with untreated health conditions and are overlooked as a result. Most country-level data comes from population based surveys, such as the Demographic Health Survey, Multiple Indicator Cluster Survey, and others. In 2016, official country records only captured approximately one-third of maternal deaths.[58]

In addition to mortality*, WHO identifies the following as key RMNCH measures: the number of antenatal care contacts a pregnant woman has and when the first visit occurs (ideally during the first trimester); completion of child immunizations; prevalence of malnutrition, anemia, and stunting in children under five; and use of contraceptive methods (see **Exhibit 7a** and **7b** for a complete list of indicators and key indicators by region). WHO selected these measures based on evidence of their validity and measurability, with input from global and country stakeholders.

Established in 2010, the UN Commission on Information and Accountability for Women's and Children's Health provides a framework for global reporting, oversight, and accountability in women's and children's health.[59]

Improving Outcomes

Nutrition

Nutrition underlies almost every health outcome; it is necessary for a healthy pregnancy, childbirth, postpartum recovery, and fetal and child development. Proper nutrition is important for all women of reproductive age, as many pregnancies are unplanned.

A mother's pre-pregnancy weight directly correlates to the weight of her baby and can result in underweight (mother's BMI <18.5 kg/m^2) or overweight (macrosomic) babies (mother's BMI >25 kg/m^2).[60] Underweight and macrosomic babies are more likely than other babies to experience health complications throughout their lives and pose a greater maternal health risks during and after childbirth.[61,62] Overweight babies are linked to higher rates of C-section and preeclampsia.[62]

* Maternal mortality rates are usually measured per 100,000 live births, while neonatal, infant, and child mortality are measured per 1,000 live births.

During pregnancy, the main nutritional goal for women is sufficient macronutrient and micronutrient intake (see **Exhibit 8** for a table of recommended nutrients during pregnancy). Macronutrients nourish the developing fetus, give the mother energy, and prepare the mother for labor, childbirth, and the postpartum period.[60] The Food and Agriculture Organization of the UN recommends increasing caloric intake by 85 kcal/day, 285 kcal/day, and 475 kcal/day during the first, second, and third trimesters, respectively, to meet the energy requirements of pregnancy.[63] It also suggests tailoring pregnancy diets to individual height, weight, and physical activity. This is not always possible in resource-limited settings, where the average daily per capita caloric intake is about 75% of what is recommended.[64] Weight gain during the second trimester is most closely associated with healthy infant birth weights.[60]

Micronutrient deficits can be addressed through increased consumption of nutrient-dense foods and/or supplements. Iron, for example, occurs naturally in foods such as legumes, leafy green vegetables, whole grains, nuts and seeds, and eggs. Iron-deficiency anemia may require more vitamins and minerals than diet alone can provide, however. **Supplementation** and **fortification** are nutritional interventions designed to ensure proper fetal development and lower the risk of maternal anemia and sepsis, low birth weight, neural tube defects, and other maternal and congenital health issues.[65] Daily oral iron and folic acid (IFA) supplementation is recommended for pregnant women; supplements are available as capsules or tablets, as well as in fortified foods (e.g., pastas, cereals).[66] Potential side effects of IFA include vomiting, diarrhea, constipation, or black stools. These contribute to low compliance with IFA consumption guidelines.[67]

Multiple micronutrient supplementation, primarily in the form of a prenatal vitamin, is common in many high-income countries; however, cost, quality control, and supply chain issues have prevented it from becoming the standard practice in most LMICs.[68] Furthermore, WHO's antenatal care (ANC) guidelines (2016) suggest further evidence is needed to determine which micronutrients improve outcomes and how they can be optimally combined into a single supplement.[67,69]

Newborns and children under five are most vulnerable to micronutrient deficiency. In places where nutrient-rich diets and mandatory fortification do not exist, multiple micronutrient supplementation is a relatively low-cost way to increase vital nutrient uptake without changing a child's diet. A common intervention in LMICs is a single-use powder package that caregivers sprinkle on semisolid food.[70] Vitamin A supplementation for postpartum women in areas where vitamin A deficiency is common can increase the vitamin's concentration in breast milk, which is passed on to the infant.[71] WHO recommends oral vitamin A supplementation for infants beginning at six months of age.[71]

Ready-to-use therapeutic foods (RUTF) are a popular and proven treatment for moderate and severe acute malnutrition. A common RUTF is a lipid-based nutrient- and energy-dense paste made from whole milk powder, sugar, roasted peanuts, oil, and vitamin and mineral powder.[72] RUTF can be given in clinical nutrition rehabilitation facilities or in the home setting. One advantage of RUTF is that it does not require preparation or the addition of water, which could introduce life-threatening contaminants (for more information, see **GHD-014** Treating Malnutrition in Haiti with Ready-to-Use Therapeutic Foods and **GHD-C08** Concept Note: Malnutrition).

Behavior change and communication interventions to reduce malnutrition include nutrition counseling and frequent monitoring of weight gain by nutritionists, community health workers, midwives, or clinicians. Blood tests can determine specific nutrient deficiencies, if needed, and help providers tailor interventions.

Reproductive Health and Family Planning

A second set of interventions that spans the RMNCH continuum is **reproductive healthcare**, including family planning and contraception. **Family planning**—the "information, means, and methods that allow individuals to decide if and when to have children"[73]—yields widespread benefits for mothers, families, and

society at large, and has been classified as one of the most cost-effective health interventions.[49] It reduces the incidence of unplanned pregnancies, which can take a physical, mental, and economic toll on mothers and families.[49] It also lowers the costs of delivering health, water, sanitation, and other public services.

The practice of **birth spacing**, or intentionally delaying a first or subsequent pregnancy, contributes directly to lower maternal and infant mortality and HIV/AIDS transmission, as well as indirectly to improved development outcomes, such as prolonging girls' education and increasing the likelihood that a woman will work for pay outside the home.[49,74]

Contraception is the practice of preventing conception by interfering with ovulation, fertilization, or fetal implantation.[75] In 2015, the most common forms of contraception globally were female sterilization (30%), intrauterine device (IUD; 21%), and hormonal (oral, implants, and injectables) contraception (14%; see **Exhibit 9** for a breakdown of contraceptive use by type and geography). The most effective forms were contraceptive implants (99.5%), IUDs (99.2% with copper; 99.8% with hormonal), and male and female sterilization (99.85% and 99.5%, respectively).[76] Other methods were less effective because they relied on consistent use. Long-acting contraception (sterilization, IUDs, implants, etc.), although more cost-effective, was more expensive than short-term contraception (male and female condoms, oral hormonal pills, injections, etc.).[77]

The contraceptives described above are known as modern methods. Traditional or natural methods such as the rhythm method (also known as periodic abstinence), withdrawal, and the lactational amenorrhoea method, temporary reduction of fertility due to breastfeeding, are less effective then modern methods, increasing the odds of an undesired pregnancy 2.7 times.[74] (Non-use of any contraceptive method increases the odds by 14.3 times.)[78]

In 2015, 57.4% of married and in-union women of reproductive age used one or more forms of modern contraception; 36.4% used no form of contraception, and 6.2% used a traditional method. Modern contraceptive use was highest in high- and middle-income countries and lowest in certain sub-Saharan African countries (5%).[74] An estimated one in 10 married or in-union women globally—and as many as one in five in Africa—had an unmet need[†] for family planning in 2017.[6] **Unmet need** measures the gap between women's reproductive health and their behavior; unmet need refers to women who are sexually active and fertile, but do not report using any contraceptive method and who report not wanting more children or who want to delay the next child.[79] These figures likely underestimate the need because they exclude sexually active unmarried women in regions where extramarital sex is taboo.

In many countries, trained community health workers distribute oral contraception and barrier methods (e.g., condoms); midwives, nurses, and/or physicians deliver these as well as injections, implants, and IUDs. Surgical methods of contraception, such as sterilization, require a surgeon and other clinical personnel.[10]

Sexually Transmitted Infections

Prevention and management of STIs, including HIV, should take place across the continuum of RMNCH care (see **GHD-C06** HIV Prevention Concept Note). This may include community outreach and education, communicating the importance of condom use, encouraging mutual monogamy, frequent testing, and treatment. HIV screening and treatment (antiretroviral prophylaxis) for women of childbearing age and pregnant women helps prevent MTCT. Pregnant women who test positive for HIV are often counseled to deliver through elective C-section and to avoid breastfeeding.[38]

[†] This includes women who are not using modern contraception, are at risk of becoming pregnant, and say that they do not want to have a child soon or that they do not want to have any more children.

Limited health infrastructure and financing in low-resource settings constrain implementation of these interventions. Nevertheless, global MTCT prevention efforts have led to a sharp decrease in incidence of pediatric HIV in recent decades.[38]

Antenatal Care

Antenatal care may be women's first point of contact with healthcare providers and should aim to instill health-seeking behaviors and trust in the healthcare system that last beyond a single pregnancy.[50,80] ANC aims to improve pregnancy outcomes through education about healthy practices (e.g., proper nutrition, the importance of having a skilled birth attendant, early and exclusive breastfeeding, family planning post-pregnancy); distribution of insecticide-treated bednets and nutrition supplements; counseling on birth preparedness. It also addresses clinical services, such as immunizations; ultrasound and physical examinations of the pregnant woman and fetus; and prevention, diagnosis, and treatment of diseases, risky behaviors (e.g., smoking, drug use), and pregnancy-related complications (see **Exhibit 10** for recommended ANC interventions). Trained physicians, nurses, and midwives can deliver ANC.

In late 2016, WHO published new ANC guidelines (see **Exhibit 2** for recommended interventions by facility level).[81] Their focus on maximizing patient and community health represented a departure from previous guidelines, which had focused more narrowly on reducing mortality. Other differences included a more comprehensive view of pregnancy and childbirth, including preventive and mental health needs, and an emphasis on "person-centered" care, including increasing the frequency of antenatal contacts, ensuring continuity of care during and following pregnancy, giving women physical ownership of their antenatal visit records, and providing psychosocial and emotional support.[82] The guidelines advocated ensuring a positive pregnancy experience to increase the likelihood of positive labor, delivery, and motherhood experiences.[69]

The new guidelines also raised the number of recommended ANC visits from four to eight to increase: comfort and trust between pregnant women and health systems; institutional deliveries;[81] the frequency of screening for complications and potential risks; and opportunities for counseling and reproductive health education. WHO changed the minimum in response to weak evidence that four visits contribute to lower maternal and neonatal mortality. One global study even showed a slight increase in perinatal mortality and lower patient satisfaction in women who received four ANC visits.[83]

WHO acknowledged the shift would take time; in 2016, only half of women worldwide attended four ANC visits.[84] Doubling the recommended ANC visits would require new investments in personnel, human resource training, infrastructure, and transportation.[81] Critics have noted that increasing the number of visits without addressing quality of care will do little to improve RMNCH outcomes.[81]

Childbirth and Postnatal Care

The key interventions associated with better labor and childbirth outcomes are giving birth in a facility and the presence of a skilled (trained) birth attendant.[85] These factors alone can reduce the risk of stillbirth or intrapartum-related complications by an estimated 20%.[85]

A common tool used during childbirth is a **partograph**, a paper-based graphic representation of labor progress that alerts the care team to any abnormalities in the mother or fetus. The partograph is often underused in LMICs; barriers include availability of partographs, equipment for assessing labor progress, and resources to deliver recommended interventions, as well as provider awareness, knowledge, and training.[86] However, evidence of the partograph's effectiveness in reducing mortality remains inconclusive.[87]

Throughout labor and delivery, the mother's temperature should be monitored and antibiotics administered if it indicates sepsis (see **Exhibit 5** for the WHO Safe Childbirth Checklist). Recommended

interventions to avoid septic infection include disinfection and sterilization of medical tools and surroundings, ensuring that healthcare workers have clean hands, and use of prophylactic antibiotics.[88]

During labor, women experience successively intense contractions and "push" the baby toward and through the birth canal. If labor fails to progress within a specified time period, **induction** is used to stimulate uterine contractions. In some circumstances, clinicians perform an **episiotomy**, a surgical incision to the perineum to enlarge the opening through which the baby will pass. This practice should not be used routinely, because it significantly increases the risk of infection, perineal lacerations, and other complications.[89]

Labor can be intensely painful, and many women, especially in high-resource settings, choose to receive an **epidural**—an injection of anesthesia directly into the spinal cord which eases the pain of childbirth. Limited supplies of anesthesia and medical equipment (e.g., mechanical ventilation) have made this practice much less common in LMICs. Despite general public health consensus that pain relief is a human right, financial and infrastructure constraints often hinder access to pain relief medication in LMICs.[90]

A C-section—surgical delivery—can be planned for many reasons, including in the case of multiple gestations, a pregnancy known to be complicated, the risk of transmitting a mother's infection through vaginal delivery, a history of previous C-sections, and in some cases, by maternal request.[91] Unplanned C-sections are often the result of stalled labor, fetal or maternal distress, abnormal placement of the fetus, or a medical emergency.[91] When necessary, C-sections can be life saving; however, due to their surgical nature, C-sections carry additional short- and long-term risks for the mother and a modest increase in risk for the newborn.[91] The primary risks associated with C-section for the mother include injury to abdominal organs, infection, increased susceptibility to uterine rupture, hemorrhage, and blood clots.[91] C-sections have become increasingly common globally, reaching a prevalence of over 40% in Latin America, 32% in North America, 31% in Oceania, 25% in Europe, and 19% in Asia.[92] Because there is no evidence that unnecessary C-sections are beneficial to the mother or the newborn, WHO recommends C-sections be performed only when medically necessary, a calculated population level rate of 10%.[93]

Immediately after vaginal delivery or a C-section, the baby should be dried with a clean cloth and its breathing examined. The baby is still connected to its mother via the umbilical cord, the portion of the placenta that transfers oxygen and nutrients from the mother to the fetus during pregnancy. If breathing is normal, WHO recommends delaying cutting the umbilical cord at least 60 seconds after childbirth to prolong blood flow between the mother and baby, which increases the baby's iron stores.[94] This is especially important in low-resource settings, where alimentary sources of iron are less available.[95] After waiting, the care team should use a sterile tie or clamps to cut off blood flow through the umbilical cord before severing the cord with a sterile instrument.[95] In high neonatal mortality settings, the daily application of chlorhexidine digluconate for the first week of life is also recommended to prevent cord infection.[3]

If the baby's breathing is abnormal, indicating respiratory distress syndrome, WHO recommends rubbing its back to stimulate breathing. If this is unsuccessful, the next step is clearing the baby's airways through positive-pressure ventilation using a sterile bag-and-mask tool, a technique known as continuous positive airway pressure (CPAP).

A key principle of PPH prevention after vaginal birth is **active management of the third stage of labor**, a combination of three interventions: (1) uteronic administration (oxytocin recommended), which encourages the uterus to expel the placenta; (2) controlled cord traction to deliver the placenta; and (3) gentle uterine massage after the placenta is delivered.[96] The goal of the uteronic and the massage is to prevent postpartum hemorrhage. A clinician should ensure that the entire placenta is delivered before

massaging the uterus until it fully contracts. Each of these interventions requires trained staff, sterile tools, and a functional medicine supply chain.

For light to moderate cases of PPH, the care team should continue to massage the uterus, consider administering more uteronic, start intravenous fluids, and keep the woman warm. The team should immediately identify and treat the cause of bleeding, which could be due to uterine atony, retention of all or part of the placenta, vaginal tear, or uterine rupture. In cases of severe PPH, the woman may go into shock, and blood transfusions may be necessary. Only in the most severe cases (or in the case of uterine rupture or genital tract trauma) is surgery necessary to treat PPH.[25]

Women who deliver via C-section face higher risk of blood loss, infection, blood clots, injury to abdominal organs, and uterine rupture in subsequent pregnancies.[91] An intermittent compression device, a band that wraps around the legs and applies gentle pressure during and after surgery, can help prevent blood clots. Women who are predisposed to blood clots may also take a prophylactic anticoagulant.[91]

In the 30 minutes following a vaginal childbirth or in the hour following a C-section, women should initiate breastfeeding, with guidance and instruction from a health professional. If the woman underwent an episiotomy, a clinician stitches the incision after childbirth.

Specific medications are essential for treating some of the major complications associated with labor and childbirth: low-dose aspirin (or another anti-platelet agent) for prevention of preeclampsia; and magnesium sulfate and antihypertensives for treating preeclampsia and hypertension. Treatment of complications such as obstetric fistulas and pelvic organ prolapses requires reconstructive surgery, often unattainable for women in LMICs.

The practice of **kangaroo mother care** (KMC), which promotes prolonged (at least one hour) skin-to-skin contact between the mother and her baby as well as exclusive and frequent breastfeeding, has been shown to reduce the risks of mortality, hypothermia, severe illness, and infections in clinically stable underweight infants. In addition to drying and covering the baby's head, KMC provides warmth and maintains optimal infant body temperature. This is especially important for preterm and underweight babies, who struggle to regulate their temperature and are more vulnerable to hypothermia.[3] KMC is especially well suited for LMICs, as it is cost-effective and does not rely directly on equipment or electricity.

About one hour after birth and breastfeeding, a complete clinical exam—including assessment of weight, eyes, cord, and danger signs—should be performed on the newborn. In addition, vitamin K prophylaxis can be administered.[3] Within the first 24 hours of life, the baby should receive its first Hepatitis B vaccination (see **Exhibit 11** for the recommended immunization schedule).

In addition to the early initiation of breastfeeding, new mothers should be counseled on the importance of exclusive breastfeeding for the first six months of life. WHO describes breast milk as "the perfect food for the newborn" because it contains all the nutrients and antibodies needed for early growth and development.[97] Exclusive breastfeeding also helps to prevent diarrhea. Providers should also advise new mothers how to keep the umbilical cord clean and dry and to delay bathing the baby until 24 hours after childbirth.

In its postnatal care guidelines, WHO recommends a 24-hour delay before discharge from the hospital or health facility.[3] During this window, the mother and newborn should be assessed three times: immediately after birth, one hour after birth, and before hospital discharge.[3] Following discharge, WHO recommends four postnatal visits for the mother and newborn at specific intervals within the 42-day puerperium period.

In addition to post-childbirth physical exams, clinicians should screen for postpartum depression in mothers. Key to recognizing and treating postpartum depression is access to trained psychologists and psychiatrists who can counsel women and prescribe appropriate medications, if necessary.[28]

Strong referral and transportation systems are key to attaining positive maternal and child outcomes. Primary care facilities are often unprepared to address complications that arise during early stages of labor and childbirth. In such cases, timely and safe transfer to a secondary or tertiary hospital is necessary; this requires clear communication and good relationships between facilities. In low-resource and rural settings, poor road networks and inadequate transportation options—including ambulances—are major obstacles to successful referral and transport. Distance to facilities is a key factor in referral making and completion.[98]

Infancy and Childhood

Prevention of neonatal and under-5 child mortality requires timely immunizations (see **Exhibit 10**); adequate nutrition, including exclusive breastfeeding for at least six months; and proper hygiene and sanitation.

The use of infant formula, an artificial breast milk substitute, has been a common practice globally since its invention in the late nineteenth century.[99] This is due in part to pervasive advertising by formula manufacturers in many countries, targeted at physicians and consumers, which created the perception that breastfeeding is inferior to formula.[99] The advertisements highlighted the convenience of formula, claiming it allowed mothers to return to work or otherwise liberate themselves from their infant's feeding cycle. Formula supporters argued that the nutritional content of infant formula is an acceptable substitute for breast milk and noted its benefit to women who physically struggled to breastfeed. Critics countered that although the formula itself is relatively nutritious, it increases the likelihood of underfeeding or even sickening a baby if prepared incorrectly or with contaminated water.[100] In the 1970s and 1980s, WHO and other authorities responded to high rates of formula use by restricting infant formula promotion.[100]

Children under five experiencing diarrhea and showing signs of dehydration, such as lethargy, sunken eyes, cramping in the extremities, headache, and irritability, should be given zinc and oral rehydration therapy made with clean water.[39] Children under five, including newborns, who show signs of infection should be administered oral antibiotics as soon as possible following the onset of symptoms.[101]

RMNCH in the Global Context

Despite global improvements in RMNCH care and outcomes—due in part to the ambitious goals set by the MDGs—inequalities in care and outcomes persist between and within countries. Within countries, access to care and outcomes can differ between ethnic groups, religious groups, rural and urban areas, and male and female children. In 2015, the proportion of births attended by a skilled birth attendant differed by 37 percentage points or more between the wealthiest and poorest subgroups in half of countries.[102] Higher-income groups also were more likely to attend ANC visits. People in urban settings were about 10% more likely to access RMNCH services than those in rural areas, who typically have more limited access to health facilities.[102] A study in Ghana showed that use of health services nearly doubled when the distance to health facilities was halved.[103]

Access to education is closely correlated with access to RMNCH care. In 2015, women who had received secondary schooling were twice as likely to use a modern form of contraception, and their children were 39% less likely to be stunted than children whose mothers had received no education.[102]

Challenges to Improving RMNCH

Improving RNMCH in resource-limited settings requires improving health care—including limited access and utilization of services, variations in quality of care, and varying policy and programmatic environments. Variable quality in human resource training and weak supply chains further constrain RMNCH service delivery in these settings. Health personnel shortages reduce the availability of skilled birth attendants and antenatal consultations.

Many obstacles to improving RMNCH also exist outside the health system. Individuals' risk perceptions and approaches to decision making play an important role in health choices and behaviors and may vary over time. Cultural practices, such as a preference for delivering at home and aversions to modern contraception methods or vaccinations, often hinder adequate and equitable provision of RMNCH services. Additionally, legal barriers, such as restrictive laws surrounding access to safe abortion services, complicate service delivery and can result in adverse outcomes.

Efforts to increase healthy RMNCH-related behaviors and access are under way across the globe. Several countries offer conditional cash transfers to encourage healthy maternal health practices such as antenatal care and institutional delivery. On the provider side, trained community health workers and midwives have shown promise addressing RMNCH education and service gaps in remote and underserved areas. The design and outcomes of community health worker–based programs vary considerably across settings. Programs in Nepal, Bangladesh, and other countries have had measurable impacts on maternal and child health outcomes and provide potential examples for replication.

Maternity waiting homes—temporary residences located near qualified health facilities—have become an increasingly popular strategy for improving access to obstetric care for rural and high-risk pregnant women by reducing the time, money, and transportation required to transport them to a facility for delivery.[104] Staff at the nearby health facility are better able to monitor these women for complications leading up to labor.[105] Research to demonstrate the effectiveness of maternity homes is ongoing.

Addressing the social determinants of RMNCH issues (e.g., education, women's rights) and scaling up cost-effective interventions will be essential to improving outcomes and reducing disparities. Understanding what hinders and drives demand for RMNCH behaviors and care are equally important to ensuring access to high-quality information, medicines and technologies, and services.

Conclusion

The field of RMNCH is broad and complex, spanning multiple life stages and health events. The impact of RMNCH outcomes is vast and extends well beyond the physical health and life expectancy of individuals and their families health and vitality of communities and countries. Maternal and child health outcomes, for example, affect an estimated 2.32% to 4.81% of a country's GDP per capita.[106]

The prioritization of RMNCH indicators in both the Millennium Development Goals and the Sustainable Development Goals signals the critical role they play in advancing or impeding development. Trends in global health spending reflect this as well; maternal, newborn, and child health received the largest percentage (29.4%) of development assistance for health in 2016.[107] Continued investments in and beyond health systems (e.g., in access to clean water, sanitation) are needed to achieve and sustain further reductions in RMNCH-related morbidity and mortality.

Glossary

Birth Spacing: the intentional prolonging of the interval between childbirth and a subsequent pregnancy

Caesarean Section (C-section): a surgical procedure used to deliver a baby through incisions in the mother's abdomen and uterus

Child Health: the health of children from birth through adolescence, with a focus on the health of children under the age of five

Child Morbidity: illness or injury of a child in the first five years of life

Child Mortality: the death of a child in the first five years of life

Contraception: deliberate use of natural or artificial methods or tools to prevent pregnancy

Direct Obstetric Death: death resulting from OB complications in pregnancy, labor, and puerperium period

Episiotomy: a surgical cut made at the opening of the vagina during childbirth to aid a difficult delivery and prevent rupture of tissues

Family Planning: the specific set of interventions and strategies that allow a woman and her partner to control the number of children she has and the spacing of those children

Fetal Macrosomia: describes a newborn that is significantly larger than average, weighing 4,000 grams or more, regardless of gestational age

Fortification: "the physical process of deliberately increasing the quantity of essential micronutrients into food products where they do not already exist, or exist in low quantities"[108]

Indirect Obstetric Death: death resulting from previous existing disease or disease that developed during pregnancy and was aggravated by the physiologic effects of pregnancy

Infant Mortality: death of a baby before its first birthday

Infant Mortality Ratio (IMR): the number of infant (under one year of age) deaths per 1,000 live births

Kangaroo Mother Care (KMC): "early continuous, and prolonged skin-to-skin contact between the mother and preterm babies; exclusive breastfeeding or breast milk feeding; early discharge after hospital—initiated KMC with continuation at home; and adequate support and follow-up for mothers at home"[109]

Live Birth: "the complete expulsion of the product of conception, irrespective of the duration of pregnancy, which after expulsion breathes or shows any signs of life"[57]

Maternal Health: the health of mothers during pregnancy, childbirth, and the postpartum period.

Maternal Morbidity: any health condition attributed to and/or worsened by pregnancy or childbirth that has a negative impact on the woman's health

Maternal Mortality: the death of a woman during the period from conception until 42 days after childbirth from a cause related to or aggravated by the pregnancy (not accidental or incidental causes)

Maternal Mortality Ratio (MMR): the number of maternal deaths per 100,000 live births (maternal deaths usually occur during or immediately following childbirth)

Miscarriage: the loss of a baby before the 20th week of pregnancy

Neonatal Morbidity: the development of a condition or disease in a neonate directly due to pregnancy and childbirth

Neonatal Mortality: the death of a child in the first 28 days of life

Neonatal Mortality Rate: the likelihood of dying in the first 28 days of life

Newborn Health: the health of babies from birth through the first 28 days of life

Postpartum Depression: depression and emotional instability due to hormonal changes related to pregnancy and childbirth

Postpartum Hemorrhage (PPH): loss of more than 500mL of blood within the 24 hours of delivery after a vaginal birth or more than 1,000mL within 24 hours after a C-section

Preterm Birth: any birth in which the baby is born alive before the 37th completed week of pregnancy

Puerperium Period: period of six weeks following birth in which the mother's organs return to original non-pregnant state

Reproductive Health: refers to the reproductive processes, functions, and systems at all stages of life

Skilled Healthcare Personnel: healthcare workers trained to provide supervision, care, and advice to women during pregnancy, labor, and the postpartum period; conduct deliveries; and care for newborns

Stillbirth: the loss of a baby after the 20th week of pregnancy and during delivery

- **Early stillbirth:** fetal death occurring between 20 and 27 completed weeks of pregnancy
- **Late stillbirth:** fetal death occurring between 28 and 36 completed pregnancy weeks
- **Term stillbirth:** fetal death occurring at 37 or more completed pregnancy weeks

Supplementation: the addition of non-alimentary sources of certain nutrients into the diet

Source: Compiled by case writers using data from UNICEF, WHO, the Mayo Clinic, and World Bank Data.

Exhibit 1 *Examples of Vertical Transmission Risks During Pregnancy, Delivery, and Breastfeeding*

- HIV/AIDS
- STDs (chlamydia, syphilis, gonorrhea, etc.)
- Malaria
- Toxoplasmosis
- Rubella
- Cytomeglaovirus
- Zika
- Hepatitis B
- Listeria
- Drug and alcohol addiction
- Lyme disease

Source: Compiled by case writers.

Exhibit 2 *Essential RMNCH Interventions by Facility Level*

Continuum of Care	Adolescence & Pre-Pregnancy	Pregnancy (Antenatal)	Childbirth
All Levels: (Community, Primary, and Referral)	• Family planning (advice, hormonal and barrier methods) • Prevent and manage sexually transmitted infections, HIV • Folic acid fortification / supplementation to prevent neural tube defects	• Iron and folic acid supplementation • Tetanus vaccination • Prevention and management of malaria with insecticide-treated nets and antimalarial medicines • Prevention and management of sexually transmitted infections and HIV, including with antiretroviral medicines • Calcium supplementation to prevent hypertension (high blood pressure) • Interventions for cessation of smoking	• Prophylactic uteronics to prevent postpartum hemorrhage • Manage postpartum hemorrhage using uterine massage and uteronics • Social support during childbirth • Remain at facility at least 24 hours after childbirth
Primary and Referral	• Family planning (hormonal, barrier, and selected surgical methods)	• Screening for and treatment of syphilis • Low-dose aspirin to prevent preeclampsia for high-risk women • Antihypertensive drugs (to treat high blood pressure) • Magnesium sulfate for eclampsia • Antibiotics for preterm pre-labor rupture of membranes • Corticosteroids to prevent respiratory distress syndrome in preterm babies • Safe abortion • Post-abortion care	• Active management of third stage of labor plus controlled cord traction • Management of postpartum hemorrhage • Screen and manage HIV
Referral*	• Family planning (surgical methods)	• Reduce malpresentation at term with external cephalic version • Induction of labor to manage pre-labor rupture of membranes at term (initiate labor)	• C-section for maternal/fetal indication (to save the life of the mother/baby) • Prophylactic antibiotic for C-section • Induction of labor for prolonged pregnancy • Management of postpartum hemorrhage

Community Strategies	• Home visits for women and children across the continuum of care • Women's groups	
Postnatal (Mother)	**Postnatal (Newborn)**	**Infancy & Childhood**
• Family planning advice and contraceptives • Nutrition counseling	• Immediate thermal care to keep baby warm • Initiation of early breastfeeding (within the first hour) • Hygienic cord and skin care	• Exclusive breastfeeding for six months • Continued breastfeeding and complimentary feeding from six months • Prevention and case management of childhood malaria • Vitamin A supplementation from six months • Routine immunization plus *H. influenzae*, meningococcal, pneumococcal, and rotavirus vaccine • Management of severe acute malnutrition • Case management of childhood pneumonia • Case management of diarrhea
• Screen for and initiate or continue antiretroviral therapy for HIV • Treat maternal anemia	• Neonatal resuscitation with bag and mask • Kangaroo mother care for pre-term and underweight babies (less than 2,000g) • Extra support for feeding small and preterm babies • Management of newborns with jaundice • Initiate prophylactic antiretroviral therapy for babies exposed to HIV	• Comprehensive care of children infected with or exposed to HIV
• Direct and manage postpartum sepsis	• Presumptive antibiotic therapy for newborns at risk of bacterial infection • Use of surfactant (respiratory medication) to prevent respiratory distress syndrome in preterm babies • Continuous positive airway pressure (CPAP) to manage babies with respiratory distress syndrome • Case management of neonatal sepsis, meningitis, and pneumonia	• Case management of meningitis
*Family planning interventions at referral level include those provided at the primary level		

Source: (1) Adapted from World Health Organization. Essential Interventions, Commodities and Guidelines for Reproductive, Maternal, Newborn, and Child Health, 2011. (2) World Health Organization. WHO recommendations on postnatal care of the mother and newborn. 2013. (3) World Health Organization. New guidelines on antenatal care for a positive pregnancy experience. 2016.

Exhibit 3a *MDGs Related to MNCH*

MDG 4: Reduce child mortality

Child mortality rate: Globally, the under-5 mortality rate dropped from 90 to 43 deaths per 1,000 live births between 1990 and 2015. Despite population growth in the developing regions, the number of deaths of children under five declined from 12.7 million in 1990 to almost 6 million in 2015 globally.

Infectious diseases: Measles vaccination helped prevent nearly 15.6 million deaths between 2000 and 2013. The number of globally reported measles cases declined by 67%. About 84% of children worldwide received at least one dose of measles-containing vaccine in 2013, up from 73% in 2000.

MDG 5: Improve maternal health

Maternal mortality ratio (worldwide): Since 1990, it declined by almost half worldwide, and most of the reduction has occurred since 2000. Maternal mortality ratio (Southern Asia, sub-Saharan Africa): In Southern Asia, the maternal mortality ratio declined by 64% between 1990 and 2013, and in sub-Saharan Africa it fell by almost half.

Birth assistance: Close to three-quarters of births were assisted by skilled health personnel globally in 2014, an increase from 59% in 1990.

Source: UN Millennium Development Goals 2015 Report

Exhibit 3b *Millennium Development Goals Target 4.A: Reduce by Two-Thirds, Between 1990 and 2015, the Under-5 Mortality Rate*

Region	1990 U-5MR	2015 U-5MR	Goal	Goal met?
Sub-Saharan Africa	179	86	60	No
Oceana	74	51	25	No
Southern Asia	126	50	42	No
Caucasus and Central Asia	73	33	24	No
Southeast Asia	71	27	24	No
Northern Africa	73	24	24	Yes
Western Asia	65	23	21	No
Latin America and the Caribbean	54	17	18	Yes
Eastern Asia	53	11	18	Yes
Developed Regions	15	6	5	No
Developing Regions	100	47	33	No
World	90	43	30	No

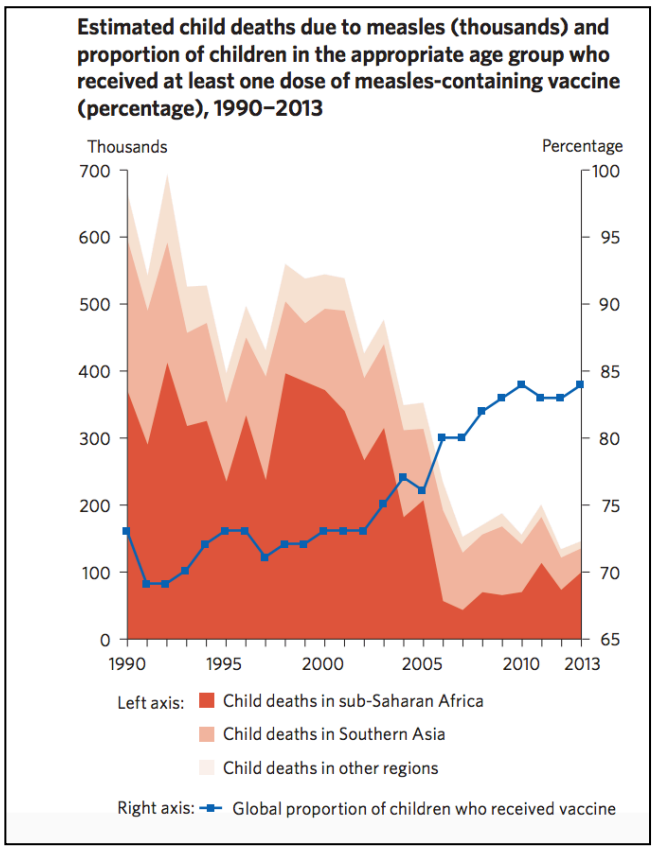
Source: UN Millennium Development Goals 2015 Report

Exhibit 3c *MDG Target 5.A: Reduce by Three-Quarters, Between 1990 and 2013, the Maternal Mortality Ratio (maternal deaths per 100,000 live births, women aged 15–49)*

Region	1990 MMR	2013 MMR	Goal	Goal met by 2013?
Sub-Saharan Africa	990	510	248	No
Southern Asia	530	190	133	No
Oceana	390	190	98	No
Caribbean	300	140	75	No
Southeast Asia	320	140	80	No
Latin America	130	77	33	No
Western Asia	130	74	33	No
Northern Africa	160	69	40	No
Caucasus and Central Asia	70	39	18	No
Eastern Asia	95	33	24	No
Developed Regions	26	16	7	No
Developing Regions	430	230	108	No
World	380	210	95	No

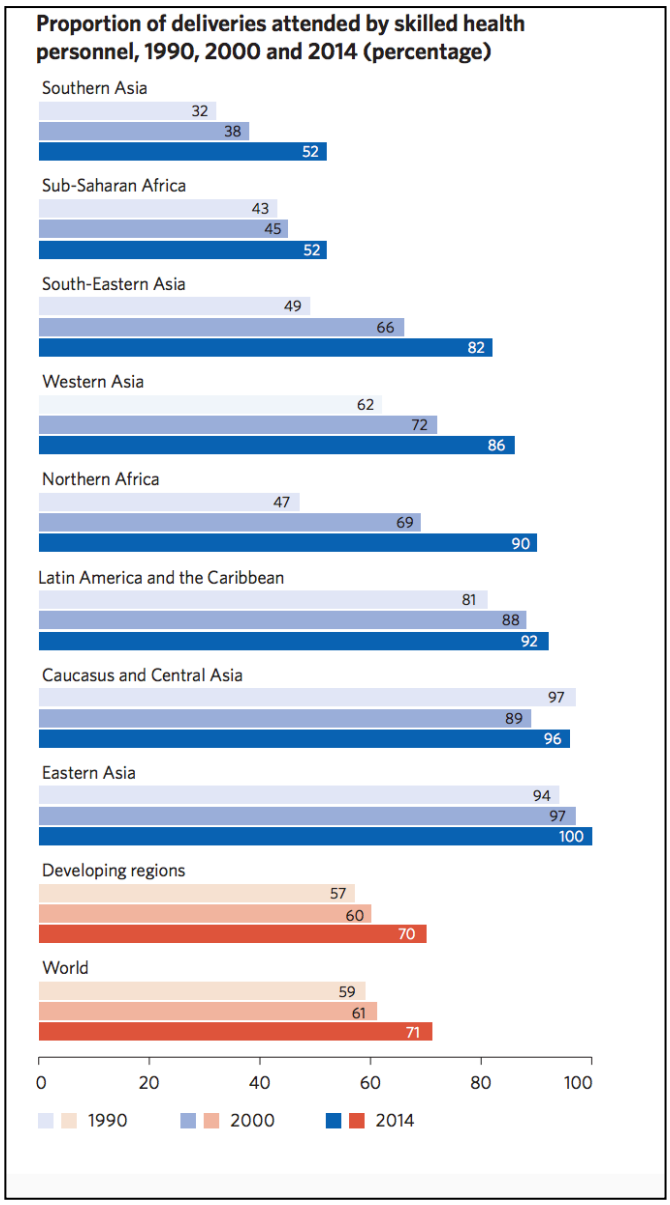
Source: UN Millennium Development Goals 2015 Report

Exhibit 3d *Measles Immunization Progress, 1990–2015*



Source: UN Millennium Development Goals 2015 Report

Exhibit 3e *Percentage of Deliveries Attended by Skilled Health Personnel by Region in 1990, 2000, and 2014*



Source: UN Millennium Development Goals 2015 Report

Exhibit 3f *Percentage of Women Aged 15–49 Seen Four or More Times by a Provider During Pregnancy in 1990, 2000, and 2014, and Unmet Need in 2015*

Region	1990	2000	2014	Unmet need (2015)
Southern Asia	23	27	36	14
Sub-Saharan Africa	47	47	49	24
Southeast Asia	45	71	84	12
Northern Africa	50	58	89	12
Latin America and the Caribbean	75	92	97	11
Developing Regions	35	42	52	Data not available

Source: UN Millennium Development Goals 2015 Report

Exhibit 4 *Sustainable Development Goals (SDGs) Related to Maternal, Neonatal, and Child Health*

- By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births
- By 2030, end preventable deaths of newborns and children under five years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births
- By 2030, ensure universal access to sexual and reproductive healthcare services, including for family planning, information and education, and the integration of reproductive health into national strategies and programs
- Achieve universal health coverage, including financial risk protection, access to quality essential healthcare services, and access to safe, effective, quality, and affordable essential medicines and vaccines for all
- Support the research and development of vaccines and medicines for the communicable and noncommunicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health and, in particular, provide access to medicines for all
- Substantially increase health financing and the recruitment, development, training, and retention of the health workforce in developing countries, especially in least developed countries and small island developing states

Source: UN Sustainable Development Goals. http://www.un.org/sustainabledevelopment/health/

Exhibit 5 *WHO Safe Childbirth Checklist*

On Arrival	
Does mother need referral? ☐ No ☐ Yes	Check your facility's criteria
Partograph stared? ☐ No, it will start when ≥4cm ☐ Yes	Start plotting when cervix ≥4cm, then cervix should dilate ≥1cm/hr • Every 30 min: Plot HR, contractions, fetal HR • Every 2 hrs: Plot temperature • Every 4 hrs: Plot BP
Does mother need to start: Antibiotics? ☐ No ☐ Yes, given Magnesium sulfate and antihypertensive treatment? ☐ No ☐ Yes, magnesium sulfate given ☐ Yes, antihypertensive medication given	Ask for allergies before administration of any medication Give antibiotics to mother if any of: • Mother's temperature ≥38°C • History of foul-smelling vaginal discharge • Rupture of membranes > 18 hrs Give magnesium sulfate to mother if any of: • Diastolic BP ≥110 mmHg and 3+ proteinurea • Diastolic BP ≥90 mmHg and 2+ proteinurea, and any: severe headache, visual disturbance, epigastric pain Give antihypertensive medication to the mother if systolic BP > 160mmHg • Goal: keep BP <150/100 mmHg
☐ Confirm supplies are available to clean hands and wear gloves for each vaginal exam	
☐ Encourage birth companion to be present at birth	
☐ Confirm that mother or companion will call for help during labor if needed	Call for help if any of: • Bleeding • Severe abdominal pain • Severe headache or visual disturbance • Unable to urinate • Urge to push
Just Before Pushing (or Before Caesarean)	
Does mother need to start: Antibiotics? ☐ No ☐ Yes, given Magnesium sulfate and antihypertensive treatment? ☐ No ☐ Yes, magnesium sulfate given ☐ Yes, antihypertensive medication given	Ask for allergies before administration of any medication Give antibiotics to mother if any of: • Mother's temperature ≥38°C • History of foul-smelling vaginal discharge • Rupture of membranes > 18 hrs • Caesarean section Give magnesium sulfate to mother if any of: • Diastolic BP ≥110 mmHg and 3+ proteinurea • Diastolic BP ≥90 mmHg and 2+ proteinurea, and any: severe headache, visual disturbance, epigastric pain

	Give antihypertensive medication to the mother if systolic BP > 160mmHg • Goal: keep BP <150/100 mmHg
Confirm essential supplies are at bedside and prepare for delivery: For mother: ☐ Gloves ☐ Alcohol-based handrub or soap and clean water ☐ Oxytocin 10 units in syringe For baby: ☐ Clean towel ☐ Tie or cord clamp ☐ Sterile blade to cut cord ☐ Suction device ☐ Bag and mask	Prepare to care for mother immediately after birth: Confirm single baby only (not multiple birth) 1. Give oxytocin within 1 minute after birth 2. Deliver placenta 1–3 minutes after birth 3. Massage uterus after placenta is delivered 4. Confirm uterus is contracted Prepare to care for baby immediately after birth: 1. Dry baby, keep warm 2. If not breathing, simulate and clear airway 3. If not still breathing: • Clamp and cut cord • Clean airway if necessary • Ventilate with bag and mask • Shout for help
☐ Assistant identified and ready to help at birth if needed	
Soon After Birth (Within One Hour)	
Is mother bleeding abnormally? ☐ No ☐ Yes, shout for help	If bleeding abnormally: • Massage uterus • Consider more uteronic • Start IV fluids and keep mother warm • Treat cause: uterine atony, retained placenta/fragments, vaginal tear, uterine rupture
Does mother need to start Antibiotics? ☐ No ☐ Yes, given Magnesium sulfate and antihypertensive treatment? ☐ No ☐ Yes, magnesium sulfate given ☐ Yes, antihypertensive medication given	Ask for allergies before administration of any medication Give antibiotics to mother if placenta manually removed or if mother's temperature is ≥38°C and any of: • Chills • Foul-smelling vaginal discharge If the mother has a third or fourth degree of perinatal tear, give antibiotics to prevent infection Give magnesium sulfate to mother if any of: • Diastolic BP ≥110 mmHg and 3+ proteinurea • Diastolic BP ≥90 mmHg and 2+ proteinurea, and any: severe headache, visual disturbance, epigastric pain Give antihypertensive medication to mother if systolic BP > 160mmHg • Goal: keep BP <150/100 mmHg
Does baby need: Referral?	Check your facility's criteria

☐ No ☐ Yes, organized Antibiotics? ☐ No ☐ Yes, given	Give baby antibiotics if antibiotics given to mother for treatment of maternal infection during childbirth or if baby has any of: • Respiratory rate >60/min or <30/min • Chest in-drawing, grunting, or convulsions • Poor movement on stimulation • Baby's temperature <35°C (and not rising after warming) or baby's temperature ≥38°C Arrange special care/monitoring for baby if any: • More than one month early • Birth weight <2500 grams • Needs antibiotics • Required resuscitation
☐ Started breastfeeding and skin-to-skin contact (if mother and baby are well)	
☐ Confirm mother/companion will call for help if danger signs present	
Before Discharge	
☐ Confirm stay at facility for 24 hours after delivery	
Does mother need to start antibiotics? ☐ No ☐ Yes, given and delay discharge	Ask for allergies before administration of any medication Give antibiotics to mother if any of: • Mother's temperature is ≥38°C • Foul-smelling vaginal discharge
Is mother's blood pressure normal? ☐ No, treat and delay discharge ☐ Yes	Give magnesium sulfate to mother if any of: • Diastolic BP ≥110 mmHg and 3+ proteinurea • Diastolic BP ≥90 mmHg and 2+ proteinurea, and any: severe headache, visual disturbance, epigastric pain Give antihypertensive medication to mother if systolic BP > 160mmHg • Goal: keep BP <150/100 mmHg
Is mother bleeding abnormally? ☐ No ☐ Yes, treat and delay discharge	If pulse >110 beats per minute and blood pressure <9 mmHg • Start IV and keep mother warm • Treat cause (hypovolemic shock)
Does baby need to start antibiotics? ☐ No ☐ Yes, give antibiotics, delay discharge, and give special care	Give antibiotics to baby if any of: • Respiratory rate >60/min or <30/min • Chest in-drawing, grunting, or convulsions • Poor movement on stimulation • Baby's temperature <35°C (and not rising after warming) or baby's temperature ≥38°C • Stopped breastfeeding well • Umbilicus redness extending to skin or draining pus
Is baby feeding well? ☐ No, establish good	

breastfeeding practices and delay discharge ☐ Yes	
☐ Discuss and offer family planning options to mother	
☐ Arrange follow-up and confirm mother/companion will seek help if danger signs appear after discharge	
Danger Signs	
Mother has any of: • Bleeding • Severe abdominal pain • Severe headache or visual disturbance • Breathing difficulty • Fever or chills • Difficulty emptying bladder • Epigastric pain	**Baby** has any of: • Fast/difficult breathing • Fever • Unusually cold • Stops feeding well • Less activity than normal • Whole body becomes yellow
Completed by: _____	

Source: WHO Safe Childbirth Checklist. 2015.
http://www.who.int/patientsafety/implementation/checklists/childbirth/en/

Exhibit 6 *WHO Standards for Improving Quality of Maternal and Newborn Care in Health Facilities*

Standard 1: Every woman and newborn receives routine, evidence-based care and management of complications during labor, childbirth and the early postnatal period, according to WHO guidelines.
Quality statements
1.1a: Women are assessed routinely on admission and during labor and childbirth and are given timely, appropriate care.
1.1b: Newborns receive routine care immediately after birth. 1.1c: Mothers and newborns receive routine postnatal care.
1.2: Women with pre-eclampsia or eclampsia promptly receive appropriate interventions, according to WHO guidelines.
1.3: Women with postpartum hemorrhage promptly receive appropriate interventions, according to WHO guidelines.
1.4: Women with delay in labor or whose labor is obstructed receive appropriate interventions, according to WHO guidelines.
1.5: Newborns who are not breathing spontaneously receive appropriate stimulation and resuscitation with a bag-and-mask within 1 min of birth, according to WHO guidelines.
1.6a: Women in preterm labor receive appropriate interventions for both themselves and their babies, according to WHO guidelines.
1.6b: Preterm and small babies receive appropriate care, according to WHO guidelines.
1.7a: Women with or at risk for infection during labor, childbirth or the early postnatal period promptly receive appropriate interventions, according to WHO guidelines.
1.7b: Newborns with suspected infection or risk factors for infection are promptly given antibiotic treatment, according to WHO guidelines.
1.8: All women and newborns receive care according to standard precautions for preventing hospital-acquired infections.
1.9: No woman or newborn is subjected to unnecessary or harmful practices during labor, childbirth and the early postnatal period.
Standard 2: The health information system enables use of data to ensure early, appropriate action to improve the care of every woman and newborn.
Quality statements
2.1: Every woman and newborn has a complete, accurate, standardized medical record during labor, childbirth and the early postnatal period.
2.2: Every health facility has a mechanism for data collection, analysis and feedback as part of its activities for monitoring and improving performance around the time of childbirth.
Standard 3: Every woman and newborn with condition(s) that cannot be dealt with effectively with the available resources is appropriately referred.
Quality statements
3.1: Every woman and newborn is appropriately assessed on admission, during labor and in the early postnatal period to determine whether referral is required, and the decision to refer is made without delay.
3.2: For every woman and newborn who requires referral, the referral follows a pre-established plan that can be implemented without delay at any time.
3.3: For every woman and newborn referred within or between health facilities, there is appropriate information exchange and feedback to relevant health care staff.

Standard 4: Communication with women and their families is effective and responds to their needs and preferences.
Quality statements
4.1: All women and their families receive information about the care and have effective interactions with staff.
4.2: All women and their families experience coordinated care, with clear, accurate information exchange between relevant health and social care professionals.
Standard 5: Women and newborns receive care with respect and preservation of their dignity.
Quality statements
5.1: All women and newborns have privacy around the time of labor and childbirth, and their confidentiality is respected
5.2: No woman or newborn is subjected to mistreatment, such as physical, sexual or verbal abuse, discrimination, neglect, detainment, extortion or denial of services.
5.3: All women have informed choices in the services they receive, and the reasons for interventions or outcomes are clearly explained.
Standard 6: Every woman and her family are provided with emotional support that is sensitive to their needs and strengthens the woman's capability.
Quality statements
6.1: Every woman is offered the option to experience labor and childbirth with the companion of her choice.
6.2: Every woman receives support to strengthens her capability during childbirth.
Standard 7: For every woman and newborn, competent, motivated staff are consistently available to provide routine care and manage complications.
Quality statements
7.1: Every woman and child has access at all times to at least one skilled birth attendant and support staff for routine care and management of complications.
7.2: The skilled birth attendants and support staff have appropriate competence and skills mix to meet the requirements of labor, childbirth and the early postnatal period.
7.3: Every health facility has managerial and clinical leadership that is collectively responsible for developing and implementing appropriate policies and fosters an environment that supports facility staff in continuous quality improvement.
Standard 8: The health facility has an appropriate physical environment, with adequate water, sanitation and energy supplies, medicines, supplies and equipment for routine maternal and newborn care and management of complications.
Quality statements
8.1: Water, energy, sanitation, hand hygiene and waste disposal facilities are functional, reliable, safe and sufficient to meet the needs of staff, women and their families.
8.2: Areas for labor, childbirth and postnatal care are designed, organized and maintained so that every woman and newborn can be cared for according to their needs in private, to facilitate the continuity of care.
8.3: An adequate stock of medicines, supplies and equipment is available for routine care and management of complications.

Source: World Health Organization. Standards for improving quality of maternal and newborn care in health facilities. 2016. http://apps.who.int/iris/bitstream/10665/249155/1/9789241511216-eng.pdf?ua=1

Exhibit 7a *World Health Organization's Global Strategy: Key Maternal, Newborn, and Child Health Indicators*

- Maternal mortality ratio
- Under-5 child mortality, with the proportion of newborn deaths
- Children under five who are stunted
- Proportion of demand for family planning satisfied (met need for contraception)
- Antenatal care coverage (at least four times during pregnancy)
- Antiretroviral (ARV) prophylaxis among HIV positive pregnant women to prevent HIV transmission and antiretroviral therapy for [pregnant] women who are treatment-eligible
- Skilled attendant at birth
- Postnatal care for mothers and babies within two days of birth
- Exclusive breastfeeding for six months (0–5 months)
- Three doses of combined diphtheria-tetanus pertussis (DTP3) immunization coverage (12–23 months)
- Antibiotic treatment for suspected pneumonia

Source: World Health Organization, Accountability for Women's and Children's Health: Health Indicators. 2012. http://www.who.int/woman_child_accountability/progress_information/recommendation2/en/

Exhibit 7b *Key Indicators by Region*

Region	Maternal Mortality Ratio (deaths/100,000 live births) 2015	Under-5 Mortality Rate (deaths/1,000 live births) 2015	Skilled Attendant at Birth (%) 2014	Children Under Five Moderately or Severely Underweight (%) 2015
Global	216	43	71	14
Sub-Saharan Africa	546	83	52	20
Southern Asia	176	51	52	28
Oceania	187	51	-	19
Caucasus and Central Asia	33	32	96	4
Southeast Asia	110	27	82	16
Western Asia	91	22	86	4
Northern Asia	70	24	90	4
Latin America and the Caribbean	67	18	92	2
Eastern Asia	27	11	100	2
Developed Regions	12	6	-	-
Developing Regions	239	47	70	-

Source: The US Government and Global Maternal & Child Health Efforts. Kaiser Family Foundation. June 20, 2016. http://kff.org/global-health-policy/fact-sheet/the-u-s-government-and-global-maternal-and-child-health/

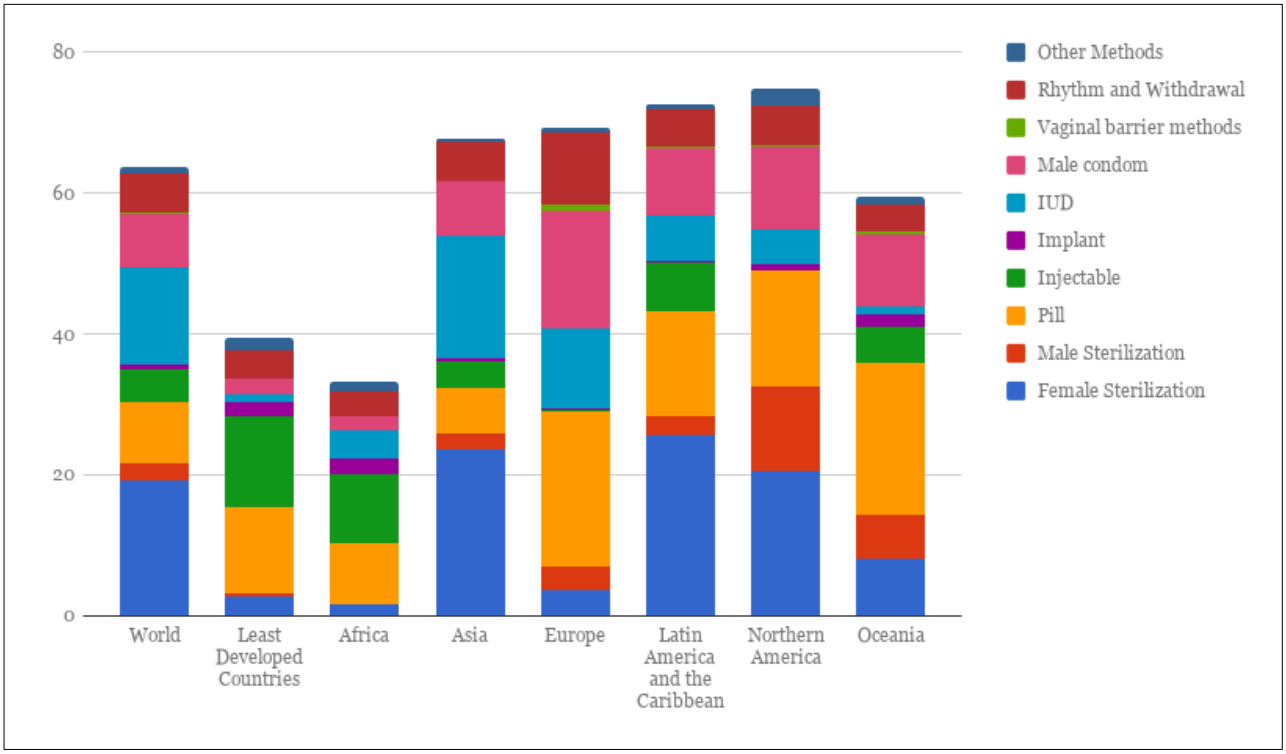
Exhibit 8 *Recommended Nutrition Pre-Pregnancy and During Pregnancy*

Nutrient	Function of Nutrient	Timing of Recommended Intake	Natural Sources of Nutrient	Recommended as Supplement vs. Diet
Vitamins				
Vitamin A	Maintenance in maternal visual function, aids in glycoprotein synthesis, promotes cellular growth and differentiation in other tissues	During pregnancy and during lactation	Leafy vegetables and yellow-orange vegetables	Diet
Vitamin B-1 (Thiamine)	Involved in carbohydrate metabolism	During pregnancy and lactation	Milk and raw grains	Diet
Vitamin B-2 (Riboflavin)	Involved in the release of energy from cells	During pregnancy and lactation	Green vegetables, milk, eggs, cheese, fish	Diet
Vitamin B-6 (Pyridoxine)	Involved in protein, carbohydrate, and lipid metabolism	During pregnancy and lactation	Vegetables	Diet
Vitamin B-12 (Cobalamin)	Essential for DNA synthesis and cell division (embryogenesis in pregnancy), helps form red blood cells and maintains the nervous system	During pregnancy and lactation	Animal proteins	Diet
Vitamin C (ascorbic acid)	Reduces free radicals and assists in procollagen formation and the absorption of iron	During pregnancy and lactation	Fruits and vegetables	Diet
Vitamin D	Associated with tooth enamel hypoplasia, responsible for the promotion of healthy bone growth, eyesight, and skin in the fetus	During pregnancy and lactation	Fortified milk (exposure to ultraviolet light is necessary for vitamin conversion)	Diet
Vitamin E	Serves as an important antioxidant	During pregnancy and lactation	Animal and protein fats	Diet
Vitamin K	Required for the synthesis of clotting factors VII, IX, and X (essential for normal coagulation)	During pregnancy and lactation, recommendation to give neonate intramuscular supplementation at birth	Green leafy vegetables, tomatoes, dairy products, and eggs	Diet
Folic acid	DNA synthesis and cell replication, deficiency in	Beginning three months prior to	Fortified grains, dried beans, and	Fortification recommended

	pregnancy linked with maternal megaloblastic anemia and fetal neural tube defects	conception and throughout the first trimester	leafy greens	(practiced as policy in some countries); additional supplement recommended
Niacin	Involved in the release of energy from cells	During pregnancy and lactation	Fish, poultry, nuts	Diet
Minerals and Trace Elements				
Iodine	Essential for healthy brain development in the fetus and young children, critical for thyroid hormone production	During pregnancy and lactation	Iodized salt, dairy products, some breads and seafoods	Fortification (iodized salt) and diet
Iron	Essential for the production of hemoglobin	During pregnancy (especially the second trimester) and lactation	Animal protein, dried beans, fortified grains, any food cooked in cast iron cookware	Supplement, fortification, diet; absorption enhanced by concurrent ingestion of foods containing vitamin C
Calcium	Large quantities are required in pregnancy for construction of fetal tissues, especially in the third trimester. Essential for the mother's own bone mass (if under 25)	During pregnancy and lactation	Dairy products and leafy green vegetables such as collard, kale, turnip, and mustard greens	Diet; vitamin D is required for calcium absorption
Phosphorus	Required for bone formation	During pregnancy and lactation	Animal proteins, milk, beans, lentils, nuts, whole grains, vegetables and fruits	Diet
Zinc	Involved in nucleic acid and protein metabolism, important in early gestation for growth and development	During pregnancy and lactation	Red meat and poultry, beans, nuts, certain seafood, whole grains, dairy products	Diet, unless iron supplementation exceeds 60 mg/d
Sodium	Maintains normal fluid levels in the body, controls blood volume and pressure	During lactation and pregnancy	Celery, beets, milk, packaged and prepared foods	Diet (reduction in sodium may be necessary)

Source: Prepared by case writers with the aid of Medscape's Prenatal Nutrition guide. http://emedicine.medscape.com/article/259059-overview#a5

Exhibit 9 *Contraceptive Usage by Type and Geography, 2015 (%)*



Note: Vaginal barrier methods include diaphragms, cervical caps, spermicidal foams, jelly, cream, and sponges. Other methods may include emergency contraception, female condom, and modern methods not reported separately, lactational amenorrhea method (LAM), prolonged abstinence, douching, folk methods, and traditional methods not reported separately. The rhythm method is also called *periodic abstinence* or the *calendar method*.

Source: Adapted from UN Trends in Contraceptive Use Worldwide 2015 Report. http://www.un.org/en/development/desa/population/publications/pdf/family/trendsContraceptiveUse2015Report.pdf

Exhibit 10 *WHO Antenatal Care Recommendations, 2016*

Intervention	Recommendation	
Dietary interventions	Counseling about proper nutrition and exercise during pregnancy.	Recommended
	Nutrient and protein supplementation in undernourished populations.	Context-specific recommendation
Iron and folic acid supplements	Daily iron (60 mg) and folic acid (2.8 mg) supplements.	Recommended
	Intermittent iron (120 mg) and folic acid (2.8 mg) for those who cannot tolerate daily supplementation side effects and in populations with less than anemia prevalence rates of less than 20%.	Context-specific recommendation
Calcium supplements	Calcium supplements (1.5–2.0 g) for women in populations with low dietary calcium.	Context-specific recommendation
Vitamin A supplements	Only for women in areas where vitamin A deficiency is a severe public health problem.	Context-specific recommendation
Zinc supplements	Recommended only in the context of rigorous research.	Context-specific recommendation (research)
Multiple micronutrient supplements	Not recommended to improve maternal and perinatal outcomes.	Not recommended
Vitamin B6 supplements	Not recommended to improve maternal and perinatal outcomes.	Not recommended
Vitamin E and C supplements	Not recommended to improve maternal and perinatal outcomes.	Not recommended
Vitamin D supplements	Not recommended to improve maternal and perinatal outcomes.	Not recommended
Restricting caffeine intake	Women should reduce their caffeine intake if it exceeds 300 mg per day.	Context-specific recommendation
Maternal and fetal assessment		
Maternal assessment	**Recommendation**	**Type of recommendation**
Anemia	Full blood count testing, if available. If not, on-site hemoglobin testing to diagnose anemia in pregnancy.	Context-specific recommendation
Asymptomatic bacteria	Midstream urine culture, if available. If not, on-site midstream urine Gram staining to diagnose asymptomatic bacteria in pregnancy.	Context-specific recommendation
Intimate partner violence	Clinical inquiry about intimate partner violence and subsequent care where there is capacity to provide a supportive response.	Context-specific recommendation
Gestational diabetes mellitus	Hyperglycemia detected at any stage of pregnancy should be classified as gestational diabetes mellitus or diabetes mellitus.	Recommended
Tobacco use	Clinical inquiry about tobacco use and exposure to	Recommended

	secondhand smoke at every antenatal visit.	
Substance use	Clinical inquiry about use of alcohol and other substances as early as possible in the pregnancy and in every antenatal visit.	Recommended
Human immunodeficiency virus and syphilis	In high prevalence settings, provider-initiated testing and counseling (PITC) for HIV should be a routine component of the antenatal care package. Integrate HIV testing with syphilis, viral, or other key tests.	Recommended
Tuberculosis	In settings where the prevalence of TB in the general population is 100/100,000 or higher, systematic screening for active TB should be a routine component of the antenatal care package.	Context-specific recommendation
Fetal assessment		
Daily fetal movement counting	Recommended only in the context of rigorous research.	Context-specific recommendation (research)
Symphysis-fundal height measurement	Replacing abdominal palpitation with symphysis-fundal height measurement for the assessment of fetal growth is not recommended to improve perinatal outcomes.	Context-specific recommendation
Antenatal cardiotocography	Not recommended to improve maternal and perinatal outcomes.	Not recommended
Ultrasound scan	One ultrasound scan before 24 weeks of gestation (early ultrasound) is recommended for pregnant women to estimate gestational age, improve detection of fetal anomalies and multiple pregnancies, reduce induction of labor for post-term pregnancy, and improve a woman's pregnancy experience.	Recommended
Doppler ultrasound of fetal blood vessels	Not recommended to improve maternal and perinatal outcomes.	Not recommended
Preventative measures		
Preventative measures	**Recommendation**	**Type of recommendation**
Antibiotics for asymptomatic bacteriuria	Seven-day antibiotic regimen recommended for women with asymptomatic bacteriuria to prevent persistent bacteria, preterm birth, and low birth weight.	Recommended
Antibiotic prophylaxis to prevent recurrent urinary tract infections	Recommended only in the context of rigorous research.	Context-specific recommendation (research)
Antenatal anti-D immunoglobulin administration	Recommended only in the context of rigorous research.	Context-specific recommendation (research)
Preventative anthelminthic	In endemic areas, preventative anthelminthic treatment is recommended for pregnant women after the first	Context-specific recommendation

treatment	trimester.	
Tetanus toxoid vaccination	Recommended for all pregnant women to prevent neonatal mortality from tetanus.	Recommended
Malaria prevention: Intermittent preventative treatment in pregnancy	In malaria-endemic areas, intermittent preventative treatment is recommended for all pregnant women. Dosing should start in the second trimester and should be given at least one month apart. All women should receive at least three doses.	Context-specific recommendation
Pre-exposure prophylaxis for HIV prevention	Oral pre-exposure prophylaxis should be offered as an additional prevention choice for pregnant women at substantial risk of HIV infection	Context-specific recommendation
Interventions for common physiological symptoms		
Interventions for common physiological symptoms	**Recommendation**	**Type of recommendation**
Nausea and vomiting	Ginger, chamomile, vitamin B6, and/or acupuncture are recommended, if available.	Recommended
Heartburn	Advice on diet and lifestyle modifications is recommended. Antacid preparations can be offered to women with symptoms not relieved by diet and lifestyle modifications.	Recommended
Leg cramps	Magnesium, calcium, and non-pharmaceutical options recommended based on availability and woman's preference.	Recommended
Low back and pelvic pain	Regular exercise during pregnancy is recommended. Further treatment options include physiotherapy, support belts, and acupuncture based on availability and woman's preference.	Recommended
Constipation	Wheat bran or other fiber supplements recommended.	Recommended
Varicose veins and edema	Non-pharmacological options, such as compression stockings, leg elevation, and water immersion can be used based on availability and woman's preference.	Recommended

Source: Adapted from World Health Organization. New guidelines on antenatal care for a positive pregnancy experience. 2016.

Exhibit 11 *Recommended Immunizations for Children 0–5 Years Old*

	Age (Months)								Age (Years)	
Birth	**1**	**2**	**4**	**6**	**12**	**15**	**18**	**19–23**	**2–3**	**4–6**
Hep B	Hep B			Hep B						
		RV	RV	RV						
		DTaP	DTaP	DTaP		DTaP				DTaP
		Hib	Hib	Hib	Hib					
		PCV	PCV	PCV	PCV					
		IPV	IPV	IPV						IPV
				Influenza (yearly)						
					MMR					MMR
					Varicella					Varicella
					Hep A					

Source: Centers for Disease Control. 2017 recommended immunizations for children from birth through 6 years old. Available at: https://www.cdc.gov/vaccines/parents/downloads/parent-ver-sch-0-6yrs.pdf.

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