La-Net

OBG 503

ANTENATAL CARE AND FOETAL MEDICINE

Download on the App Store

GET IT ON Google Play

Course video is available on our app

lanetonline.com

Course code: OBG 503

Course title: Antenatal Care and Foetal Medicine

Course credit load: 2 Units

Series 1: Foundations of Antenatal Care

- **Part 1.1: Concept and Forms of Antenatal Care**
    - Sub Part 1.1.1: Definition and concept of antenatal care
    - Sub Part 1.1.2: Forms and models of antenatal care delivery
    - Sub Part 1.1.3: Goals and principles of quality antenatal care
- **Part 1.2: Protocol and Schedule of Antenatal Care**
    - Sub Part 1.2.1: The booking visit
    - Sub Part 1.2.2: Schedule and content of follow-up visits
    - Sub Part 1.2.3: Risk assessment and referral pathways
- **Part 1.3: Antenatal Investigations**
    - Sub Part 1.3.1: Routine booking investigations
    - Sub Part 1.3.2: Screening investigations across pregnancy
    - Sub Part 1.3.3: Investigations for specific risk factors
- **Part 1.4: Conducting Antenatal Care in Practice**
    - Sub Part 1.4.1: Clinical skills for antenatal assessment
    - Sub Part 1.4.2: Health education and counselling in antenatal care
    - Sub Part 1.4.3: Quality antenatal care and pregnancy outcomes

Introduction

Picture a young woman attending her first antenatal visit, uncertain of what to expect and anxious about the months ahead. The quality of the care she receives from this very first contact, and at every visit that follows, will shape not only her experience of pregnancy but, in a very real sense, her chances and her baby's chances of a safe outcome. This Series lays the essential foundation for the whole of this course: what antenatal care is, how it is structured and delivered, the investigations woven through it, and, most practically, how to conduct it competently and compassionately in everyday clinical practice.

The aim of this Series is to equip you with a thorough understanding of the concept, protocol, and investigations of antenatal care, and the practical skill to conduct it competently and deliver good pregnancy outcomes.

We shall commence this Series by examining the concept and various forms of antenatal care. Next, we will consider the protocol and schedule of antenatal care, from the booking visit through to ongoing risk assessment. Following that, our attention turns to the investigations carried out during antenatal care, both routine and targeted. Finally, we will conclude by examining how to conduct antenatal care in practice, and how quality care translates into good pregnancy outcomes.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 1.1:** define antenatal care and its concept, and describe the various forms of antenatal care,
- **SLO 1.2:** list the components and describe the protocol and schedule of antenatal care,
- **SLO 1.3:** discuss why various investigations are carried out on pregnant women during antenatal care,
- **SLO 1.4:** describe investigations relevant to specific antenatal risk factors,
- **SLO 1.5:** demonstrate how to conduct proper antenatal care, and
- **SLO 1.6:** explain how quality antenatal care leads to good pregnancy outcomes.

1.1 Concept and Forms of Antenatal Care

1.1.1 Definition and concept of antenatal care

Antenatal care (ANC) is defined as the systematic supervision, examination, and advice given to a woman from the confirmation of pregnancy until the onset of labour, provided by a skilled health worker, with the overarching purpose of ensuring the best possible health outcome for both mother and baby throughout this period. It is built on the principle that pregnancy, while a normal physiological process for most women, carries an inherent and sometimes unpredictable risk of complications, and that regular, structured contact with a skilled provider allows these complications to be anticipated, detected early, and managed promptly, often long before they become clinically obvious to the woman herself.

The concept of antenatal care has evolved considerably over the past century, moving away from a purely risk-screening model, in which the primary aim was to identify women who might develop complications, towards a more holistic model that also emphasises health promotion,

psychosocial support, birth preparedness, and genuine partnership between the woman and her care providers. This shift reflects a growing recognition that good pregnancy outcomes depend not only on the early detection of pathology, but equally on empowering women with the knowledge, confidence, and support they need to navigate pregnancy, labour, and the early postnatal period safely and positively.

Fill in the blank: Antenatal care is provided from confirmation of pregnancy until the onset of _____. The modern concept of antenatal care emphasises health promotion and psychosocial _____ alongside risk screening.

1.1.2 Forms and models of antenatal care delivery

Antenatal care may be delivered through several different models, the choice of which depends on local resources, staffing patterns, and the risk profile of the population served. Midwife-led care, in which a midwife provides the majority of routine care for low-risk women with obstetric input reserved for identified complications, has become increasingly favoured in many settings, supported by strong evidence that it offers comparable safety to consultant-led care for uncomplicated pregnancies, alongside generally higher levels of maternal satisfaction and continuity of the caregiver relationship throughout pregnancy.

Shared or team-based care (typically dividing responsibility between a midwife, general practitioner, and obstetrician according to identified risk) and consultant-led care (reserved for pregnancies with significant identified risk factors requiring specialist obstetric oversight throughout) represent the other principal models in widespread use. Group antenatal care, in which several women at a similar gestational age attend structured sessions together combining clinical assessment with peer support and shared health education, is an increasingly adopted innovation, particularly valuable in resource-constrained settings where it can improve both efficiency and the quality of health education delivered.

Fill in the blank: Midwife-led care is generally favoured for _____-risk women, with obstetric input reserved for identified complications. Group antenatal care combines clinical assessment with peer support and shared health _____.

1.1.3 Goals and principles of quality antenatal care

The core goals of antenatal care are to confirm and date the pregnancy accurately, monitor the wellbeing of both mother and fetus throughout gestation, identify and appropriately manage risk factors and emerging complications, prepare the woman and her family practically and psychologically for childbirth and early parenthood, and provide consistent, evidence-based health education covering nutrition, danger signs, and birth preparedness. Together, these goals form an integrated package of care rather than a series of isolated tasks performed at each visit.

Quality antenatal care is further defined by the manner in which it is delivered, not merely its content: it should be respectful, individualised to the woman's circumstances and preferences, delivered by an appropriately skilled and adequately resourced provider, and free from unnecessary delay or discrimination. The World Health Organization has increasingly

emphasised this dimension of quality, recognising that a technically comprehensive antenatal programme delivered in a disrespectful, rushed, or inaccessible manner will ultimately fail to achieve its intended benefits, regardless of how well its clinical protocols are designed on paper.

Fill in the blank: The core goals of antenatal care include confirming and dating the pregnancy and monitoring the wellbeing of both mother and _____. Quality antenatal care should be respectful, individualised, and free from unnecessary delay or _____.

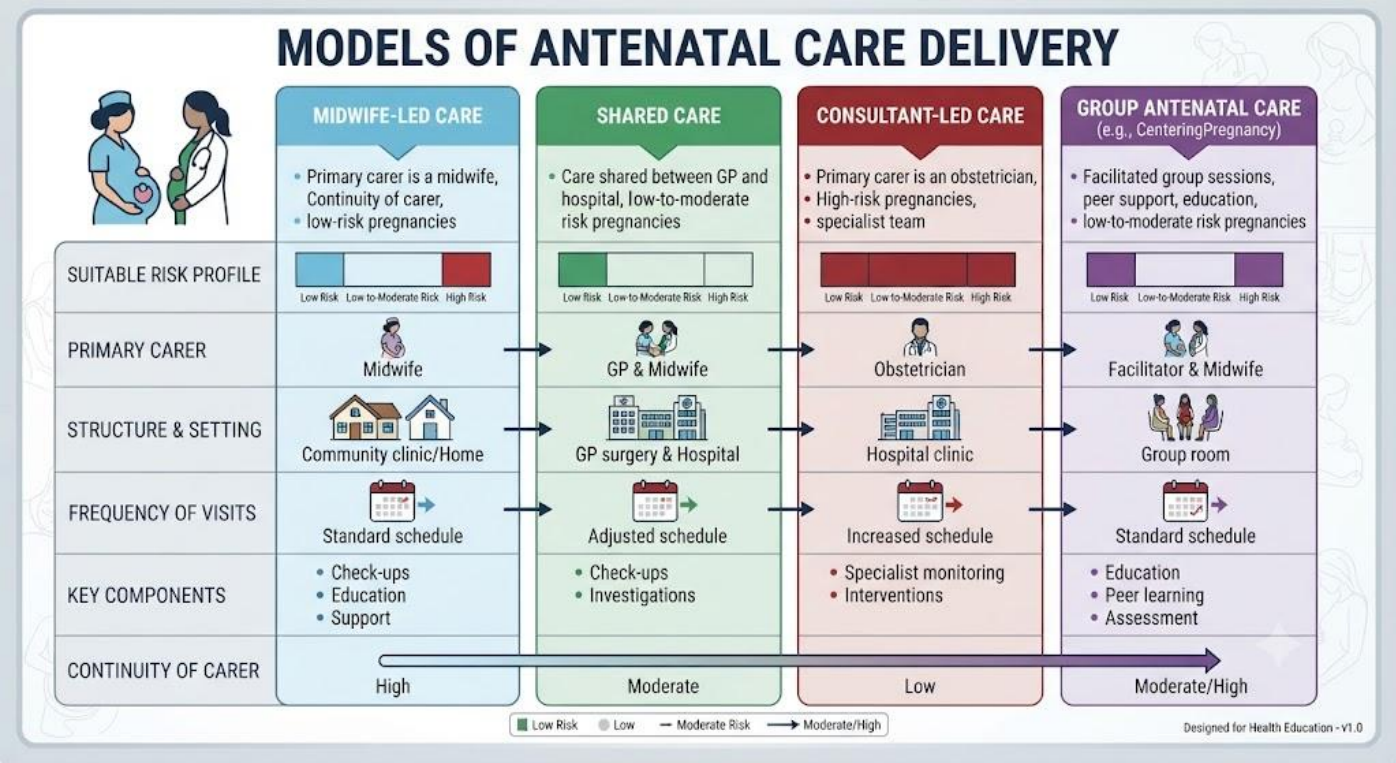


Figure 1.1: Comparison of the principal models of antenatal care delivery.

Pilot questions 1.1

1. Define antenatal care and explain its underlying rationale. (Linked to SLO 1.1)
2. Explain how the concept of antenatal care has evolved over time. (Linked to SLO 1.1)
3. Compare midwife-led and consultant-led models of antenatal care. (Linked to SLO 1.1)
4. Describe the structure and advantages of group antenatal care. (Linked to SLO 1.1)
5. Describe the core goals and principles of quality antenatal care. (Linked to SLO 1.1)

1.2 Protocol and Schedule of Antenatal Care

1.2.1 The booking visit

The booking visit is the first, most comprehensive antenatal encounter, ideally taking place before 12 weeks of gestation to allow adequate time for early screening, risk assessment, and planning of the remainder of antenatal care. It establishes a detailed baseline through structured history taking (covering medical, surgical, obstetric, family, and social history), general and, where indicated, focused examination, and a panel of initial investigations, all directed towards accurately dating the pregnancy and identifying any factor that will influence the planned model and intensity of subsequent care.

A central outcome of the booking visit is risk stratification, determining whether the woman is suitable for routine, midwife-led antenatal care or requires referral for shared or consultant-led care because of an identified medical, obstetric, or social risk factor. This early categorisation is not fixed, however, as risk status may change at any point during pregnancy, and every subsequent antenatal contact should include ongoing reassessment rather than treating the booking visit's initial categorisation as permanent for the remainder of the pregnancy.

Fill in the blank: The booking visit should ideally take place before _____ weeks of gestation. A central outcome of the booking visit is _____ stratification, determining the appropriate model of subsequent care.

1.2.2 Schedule and content of follow-up visits

The traditional schedule of antenatal visits for a low-risk pregnancy involves review at approximately four-weekly intervals until 28 weeks of gestation, two-weekly intervals from 28 to 36 weeks, and weekly intervals from 36 weeks until delivery, though this pattern has increasingly been questioned, with the World Health Organization now recommending a minimum of eight contacts across pregnancy for a positive pregnancy experience, reflecting evidence that more frequent contact improves both clinical outcomes and maternal satisfaction with care.

Each follow-up visit builds progressively on the baseline established at booking, incorporating gestation-specific elements such as the anomaly scan around 18 to 22 weeks, glucose tolerance testing where indicated around 24 to 28 weeks, and increasingly frequent fetal wellbeing assessment as the pregnancy approaches term, meaning that the content of antenatal care is not static but deliberately structured to match the changing clinical priorities at each stage of gestation.

Fill in the blank: The World Health Organization now recommends a minimum of _____ antenatal contacts across pregnancy. In a low-risk pregnancy, visits traditionally become weekly from _____ weeks until delivery.

1.2.3 Risk assessment and referral pathways

Ongoing risk assessment throughout antenatal care considers both factors present from booking (such as pre-existing medical conditions, previous obstetric complications, or extremes of maternal age) and factors that may develop during pregnancy itself, such as hypertension, reduced fetal movement, or abnormal growth on serial measurement, with a low threshold for

reassessment whenever a new symptom or finding emerges at any point in pregnancy, however apparently minor it may initially seem.

Clear, well-understood referral pathways between midwifery, general practice, and specialist obstetric services are essential to ensure that risk factors identified at any point translate promptly into an appropriate change in the level and location of care, rather than a woman with an emerging complication continuing along a low-risk care pathway simply because no formal mechanism exists to trigger timely reconsideration and escalation of her management plan.

Fill in the blank: Ongoing risk assessment should occur whenever a new symptom or finding emerges, however apparently _____ it may seem. Clear _____ pathways ensure identified risk factors translate promptly into an appropriate change in care.

Gestational Age Range	Key Assessments/Investigations
Booking Visit (≤12 weeks)	Full history, baseline blood pressure, urinalysis, blood tests (Hb, blood group, Rhesus, HIV, syphilis, hepatitis), ultrasound for dating.
Second Trimester (14–28 weeks)	Blood pressure, urinalysis, symphysio-fundal height, fetal heart rate, anomaly scan (around 20 weeks).
Third Trimester (28–36 weeks)	Blood pressure, urinalysis, symphysio-fundal height, fetal movement review, danger sign counselling, repeat Hb if indicated.
Late Third Trimester (36–40 weeks)	Weekly visits: blood pressure, urinalysis, symphysio-fundal height, fetal heart rate, presentation and lie, birth preparedness.
Post-Term (>40 weeks)	Twice-weekly visits: blood pressure, urinalysis, fetal surveillance (non-stress test, ultrasound for amniotic fluid), induction planning.

Table 1.2: Traditional antenatal visit schedule and key assessments by gestational age.

Pilot questions 1.2

1. Describe the purpose and key components of the booking visit. (Linked to SLO 1.2)
2. Explain the significance of risk stratification at the booking visit. (Linked to SLO 1.2)
3. Describe the traditional schedule of antenatal visits and the current WHO recommendation. (Linked to SLO 1.2)
4. Describe how the content of antenatal visits changes across gestation. (Linked to SLO 1.2)
5. Explain the importance of clear referral pathways in antenatal risk assessment. (Linked to SLO 1.2)

1.3 Antenatal Investigations

1.3.1 Routine booking investigations

Routine booking investigations typically include full blood count (screening for anaemia, which is common and often multifactorial in pregnancy), blood group and rhesus status (identifying women at risk of rhesus alloimmunisation who will require anti-D prophylaxis), haemoglobin genotype (of particular importance given the significant burden of sickle cell disease and trait in many populations), and screening for transmissible infections including HIV, hepatitis B, and syphilis, all performed early enough in pregnancy to allow timely intervention where a result requires action.

Urinalysis is performed at booking and repeated at subsequent visits to screen for proteinuria (relevant to hypertensive disorders of pregnancy and underlying renal disease) and glycosuria (which may prompt earlier glucose tolerance testing), while a midstream urine culture is often performed at booking specifically to identify and treat asymptomatic bacteriuria, a condition that, if untreated in pregnancy, carries a substantially increased risk of progressing to symptomatic urinary tract infection and pyelonephritis.

Fill in the blank: Haemoglobin genotype testing at booking is of particular importance given the burden of _____ disease and trait. Untreated asymptomatic bacteriuria in pregnancy carries an increased risk of progressing to _____.

1.3.2 Screening investigations across pregnancy

Ultrasound scanning is performed at defined points across pregnancy for distinct purposes: an early dating scan confirms viability, gestational age, and chorionicity in multiple pregnancy, an anomaly scan around 18 to 22 weeks systematically screens for structural fetal abnormality, and, in pregnancies identified as higher risk, serial growth scans in the third trimester monitor fetal growth velocity and detect early evidence of growth restriction that might otherwise go unrecognised on clinical examination alone.

Screening for chromosomal abnormality (using combined first-trimester or quadruple second-trimester screening, where available) and universal or risk-based screening for gestational diabetes around 24 to 28 weeks represent further important components of the structured screening programme delivered across pregnancy, each timed deliberately to coincide with the gestational window in which the relevant test offers optimal diagnostic performance and the greatest opportunity for timely intervention.

Fill in the blank: The anomaly scan, screening for structural fetal abnormality, is typically performed around _____ weeks of gestation. Screening for gestational diabetes is typically performed around _____ weeks in women with risk factors.

1.3.3 Investigations for specific risk factors

Beyond the routine screening programme applied to every pregnancy, additional targeted investigations are indicated according to specific identified risk factors, such as thyroid function tests in women with a personal or family history of thyroid disease, thrombophilia screening in women with a history of recurrent miscarriage or venous thromboembolism, and more frequent or specialised fetal surveillance, including uterine and umbilical artery Doppler studies, in pregnancies at higher risk of placental insufficiency or fetal growth restriction.

The principle guiding all targeted investigation in antenatal care is that testing should be purposefully directed by identified risk rather than applied indiscriminately, both to avoid the harms of over-investigation, including unnecessary anxiety and false-positive results requiring further invasive testing, and to ensure that limited healthcare resources are directed towards the women and pregnancies most likely to benefit from the additional surveillance being offered.

Fill in the blank: Doppler studies of the uterine and umbilical arteries are used in pregnancies at higher risk of placental _____. Targeted antenatal investigation should be purposefully directed by identified _____ rather than applied indiscriminately.

Category	Key Examples
Routine Booking Investigations	Blood group and Rhesus factor, haemoglobin, HIV, syphilis, hepatitis B, urinalysis, baseline blood pressure, dating ultrasound.
Key Screening Tests Across Gestation	Anomaly scan (around 20 weeks), gestational diabetes screening (24–28 weeks), repeat haemoglobin, Group B streptococcus screening (late third trimester where indicated).
Targeted Investigations for Risk Factors	Thrombophilia screen (if history of clotting disorders), thyroid function tests, sickle cell screening, TORCH screen, additional ultrasounds for growth restriction or multiple pregnancy.

Box 1.3: Summary of routine, screening, and targeted antenatal investigations.

Pilot questions 1.3

1. Describe the routine investigations performed at the antenatal booking visit. (Linked to SLO 1.3)
2. Explain why untreated asymptomatic bacteriuria is actively screened for and treated in pregnancy. (Linked to SLO 1.3)
3. Describe the purpose of ultrasound scanning at different stages of pregnancy. (Linked to SLO 1.3)
4. Describe examples of investigations indicated for specific antenatal risk factors. (Linked to SLO 1.4)

5. Explain the principle that should guide targeted antenatal investigation. (Linked to SLO 1.4)

1.4 Conducting Antenatal Care in Practice

1.4.1 Clinical skills for antenatal assessment

Practical antenatal assessment at each visit combines a focused history (asking specifically about fetal movement, any new symptoms, and danger signs since the last contact) with clinical examination, including blood pressure measurement using correctly sized equipment and technique, urinalysis, and abdominal examination assessing symphysio-fundal height, fetal lie and presentation as pregnancy advances, and auscultation of the fetal heart, each performed systematically and consistently at every contact to allow meaningful comparison over time.

Competence in these core clinical skills requires regular supervised practice, as subtle deviations from normal, such as a fundal height measurement plateauing rather than increasing as expected, or a fetal heart rate outside the expected range, may be the first clinical clue to an evolving problem, and are far more likely to be recognised by a clinician confident and consistent in their examination technique than by one who performs the assessment inconsistently or without a clear sense of what constitutes a normal finding at that gestation.

Fill in the blank: Abdominal examination in antenatal care assesses symphysio-fundal height, fetal lie, and _____. A plateauing fundal height measurement may be the first clinical clue to an evolving _____.

1.4.2 Health education and counselling in antenatal care

Health education delivered throughout antenatal care should be tailored to the woman's stage of pregnancy, individual risk factors, and personal circumstances rather than delivered as a generic, one-size-fits-all script, covering nutrition and supplementation, recognition of danger signs requiring urgent review, birth preparedness and complication readiness planning, and, in relevant settings, malaria prevention and other locally important public health interventions integrated seamlessly into routine antenatal contact.

Effective counselling requires genuine two-way communication rather than one-directional instruction, actively inviting and addressing the woman's own questions and concerns, using accessible, non-technical language, and checking understanding before concluding each contact, as information delivered but not genuinely understood or retained provides little practical benefit in an emergency and represents a missed opportunity within an already limited number of antenatal contacts.

Fill in the blank: Health education in antenatal care should be tailored to the woman's stage of pregnancy and individual _____. Effective counselling requires checking a woman's _____ before concluding each antenatal contact.

1.4.3 Quality antenatal care and pregnancy outcomes

Quality antenatal care is consistently associated with improved pregnancy outcomes across multiple domains, including earlier detection and management of hypertensive disorders and gestational diabetes, higher rates of skilled attendance at birth, improved rates of exclusive breastfeeding initiation, and reduced perinatal and maternal mortality, an association demonstrated repeatedly across diverse healthcare settings and consistently robust to adjustment for other confounding social and economic factors.

Achieving this benefit in practice requires attention not only to the number of antenatal contacts a woman receives, but critically to their content, timeliness, and the manner in which they are delivered, reinforcing why investment in provider training, adequate staffing and resourcing, and respectful, woman-centred care culture is at least as important as simply increasing the recommended number of visits on a national antenatal care schedule.

Fill in the blank: Quality antenatal care is associated with improved rates of skilled attendance at birth and reduced perinatal and maternal _____. Achieving good outcomes requires attention to the content, timeliness, and _____ of antenatal contacts, not merely their number.

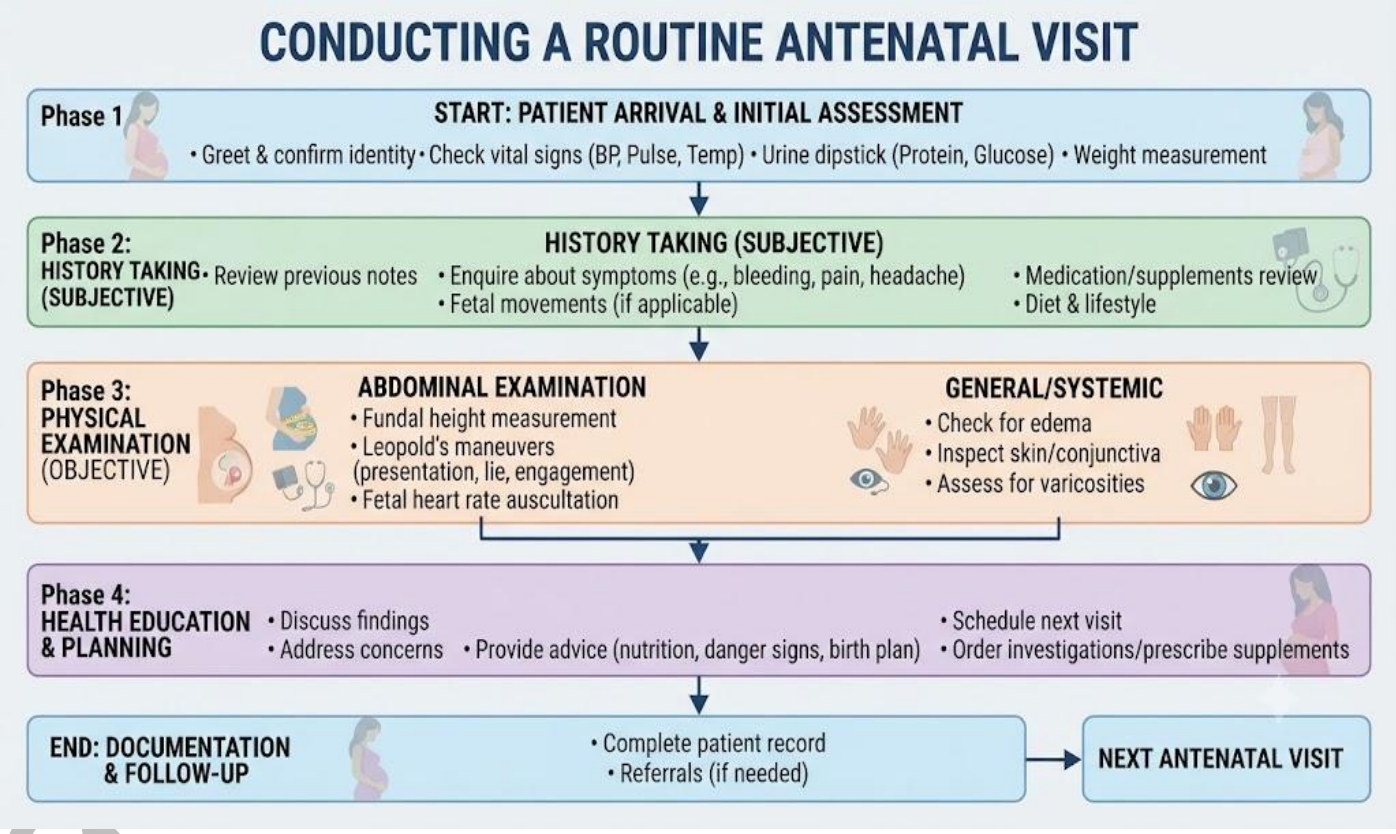


Figure 1.4: Sequential steps in conducting a routine antenatal visit.

Pilot questions 1.4

1. Describe the components of a focused antenatal history and examination at a routine visit. (Linked to SLO 1.5)

2. Explain why consistent examination technique is important in antenatal assessment. (Linked to SLO 1.5)
3. Describe the principles of effective health education and counselling in antenatal care. (Linked to SLO 1.5)
4. Describe the pregnancy outcomes associated with quality antenatal care. (Linked to SLO 1.6)
5. Explain why the manner and content of antenatal care matter as much as the number of visits. (Linked to SLO 1.6)

Series Summary

This Series has covered the concept and various forms of antenatal care, from midwife-led to group models of delivery, followed by the protocol and schedule of care from booking through to ongoing risk assessment and referral. It went on to examine the routine, screening, and targeted investigations performed during antenatal care, before concluding with the practical conduct of antenatal care and the relationship between quality of care and good pregnancy outcomes.

You should now be able to define antenatal care and describe its various forms, describe the protocol and schedule of antenatal care, discuss why various investigations are performed, demonstrate how to conduct proper antenatal care, and explain how quality antenatal care leads to good pregnancy outcomes (Linked to SLOs 1.1 to 1.6).

Glossary of Terms

- **Anti-D prophylaxis:** an injection given to rhesus-negative women to prevent rhesus alloimmunisation.
- **Asymptomatic bacteriuria:** the presence of bacteria in the urine without symptoms, actively screened for and treated in pregnancy.
- **Booking visit:** the first, most comprehensive antenatal visit, ideally taking place before 12 weeks of gestation.
- **Chorionicity:** the number of placentas in a multiple pregnancy, assessed on the early dating scan.
- **Fundal height:** the distance from the pubic symphysis to the top of the uterus, used to assess fetal growth.

- **Gestational diabetes:** diabetes first identified during pregnancy, screened for around 24 to 28 weeks in women with risk factors.
- **Group antenatal care:** a model in which several women at a similar gestational age attend structured sessions together.
- **Midwife-led care:** an antenatal care model in which a midwife provides the majority of routine care for low-risk women.
- **Risk stratification:** the process of categorising a pregnancy as low or higher risk to determine the appropriate model of care.
- **Symphysio-fundal height:** a measurement from the pubic symphysis to the uterine fundus, used to monitor fetal growth.
- **Thrombophilia screening:** investigation for an increased tendency to blood clotting, indicated in women with recurrent miscarriage or thromboembolism.
- **Uterine artery Doppler:** an ultrasound investigation assessing blood flow to the uterus, used in pregnancies at risk of placental insufficiency.

Concept Check Questions [Series 1]

Objective questions

1. Antenatal care is provided from confirmation of pregnancy until the onset of _____.
2. The booking visit should ideally take place before _____ weeks of gestation.
3. The World Health Organization now recommends a minimum of _____ antenatal contacts across pregnancy.
4. Haemoglobin genotype testing at booking is of particular importance given the burden of _____ disease and trait.
5. The anomaly scan is typically performed around _____ weeks of gestation.

Short-answer questions

6. Compare midwife-led and consultant-led models of antenatal care. (Linked to SLO 1.1)
7. Explain the significance of risk stratification at the booking visit. (Linked to SLO 1.2)
8. Explain why untreated asymptomatic bacteriuria is actively screened for and treated in pregnancy. (Linked to SLO 1.3)

9. Explain the principle that should guide targeted antenatal investigation. (Linked to SLO 1.4)
10. Describe the pregnancy outcomes associated with quality antenatal care. (Linked to SLO 1.6)

Long-answer questions

11. Define antenatal care and describe its various forms and models of delivery. (Linked to SLO 1.1)
12. Describe the protocol and schedule of antenatal care from booking to term. (Linked to SLO 1.2)
13. Describe the routine and screening investigations performed during antenatal care. (Linked to SLO 1.3)
14. Describe how to conduct a routine antenatal visit in practice. (Linked to SLO 1.5)
15. Explain how quality antenatal care leads to good pregnancy outcomes. (Linked to SLO 1.6)

Answers to Concept Check Questions [Series 1]

Objective questions

1. Labour.
2. 12.
3. Eight.
4. Sickle cell.
5. 18 to 22.

Short-answer questions

6. Midwife-led care suits low-risk women with comparable safety and higher satisfaction; consultant-led care is reserved for significant identified risk factors requiring specialist oversight.
7. Risk stratification determines whether a woman is suitable for routine midwife-led care or requires referral for shared or consultant-led care based on identified risk factors.
8. Untreated asymptomatic bacteriuria carries a substantially increased risk of progressing to symptomatic urinary tract infection and pyelonephritis in pregnancy.

9. Investigation should be purposefully directed by identified risk rather than applied indiscriminately, avoiding over-investigation while directing resources to those most likely to benefit.
10. Earlier detection of hypertensive disorders and gestational diabetes, higher skilled birth attendance, improved breastfeeding initiation, and reduced perinatal and maternal mortality.

Long-answer questions

11. **Basic response:** Antenatal care is systematic supervision from confirmation of pregnancy to labour, delivered through midwife-led, shared, consultant-led, or group care models depending on risk and resources.

Value-added response: The modern concept emphasises health promotion and psychosocial support alongside risk screening, reflecting a shift from a purely risk-focused historical model.

12. **Basic response:** Antenatal care begins with a comprehensive booking visit before 12 weeks, followed by a structured schedule of visits with content tailored to each stage of gestation.

Value-added response: Ongoing risk assessment and clear referral pathways ensure that emerging risk factors translate promptly into an appropriate change in the level of care provided.

13. **Basic response:** Routine investigations include full blood count, blood group and genotype, and infection screening, alongside scheduled ultrasound scanning and glucose and chromosomal screening.

Value-added response: Targeted investigations for specific risk factors, such as Doppler studies or thrombophilia screening, ensure resources are directed towards pregnancies most likely to benefit.

Answers to Pilot Questions [Series 1]

Part 1.1

1. Antenatal care is systematic supervision from confirmation of pregnancy to labour, ensuring the best outcome by detecting complications early.
2. It has moved from a purely risk-screening model towards a holistic model emphasising health promotion, psychosocial support, and partnership with the woman.
3. Midwife-led care suits low-risk women with comparable safety and satisfaction; consultant-led care suits significant identified risk requiring specialist oversight.

4. Several women at a similar gestational age attend structured sessions combining clinical assessment with peer support and shared health education.
5. Confirming and dating pregnancy, monitoring maternal and fetal wellbeing, identifying risk factors, preparing for childbirth, and providing health education.

Part 1.2

1. A comprehensive first visit before 12 weeks establishing baseline history, examination, investigations, and risk stratification.
2. It determines whether the woman is suitable for routine care or requires referral for shared or consultant-led care based on identified risk.
3. Traditionally four-weekly until 28 weeks, two-weekly until 36 weeks, and weekly thereafter, though WHO now recommends a minimum of eight contacts.
4. Content incorporates gestation-specific elements such as the anomaly scan, glucose testing, and increasingly frequent fetal wellbeing assessment near term.
5. Referral pathways ensure identified risk factors translate promptly into escalation of the model and location of care.

Part 1.3

1. Full blood count, blood group and rhesus status, haemoglobin genotype, and screening for HIV, hepatitis B, and syphilis.
2. It carries an increased risk of progressing to symptomatic urinary tract infection and pyelonephritis if untreated.
3. Dating scan confirms viability and gestational age, anomaly scan screens for structural abnormality, and growth scans monitor higher-risk pregnancies.
4. Thyroid function tests, thrombophilia screening, and uterine or umbilical artery Doppler studies according to identified risk factors.
5. Investigation should be purposefully directed by identified risk rather than applied indiscriminately to avoid over-investigation and direct resources appropriately.

Part 1.4

1. Focused history on fetal movement and danger signs, with blood pressure, urinalysis, and abdominal examination including fundal height and fetal heart auscultation.
2. Subtle deviations, such as a plateauing fundal height, are more reliably recognised by a clinician consistent and confident in their technique.
3. Tailoring education to the woman's stage and circumstances, using accessible language, and checking understanding before concluding the contact.
4. Earlier detection of complications, higher skilled birth attendance, improved breastfeeding initiation, and reduced perinatal and maternal mortality.
5. Investment in content, timeliness, and respectful delivery of care is at least as important as simply increasing the number of visits offered.

References and Attributions [Series 1]

Textual References

- Cunningham, F. G., Leveno, K. J., Dashe, J. S. et al. (2022). Williams Obstetrics (26th ed.). McGraw Hill.
- World Health Organization (2016). WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience. WHO Press.
- National Institute for Health and Care Excellence (2021). Antenatal Care: NICE Guideline NG201. NICE.
- National Population Commission and ICF (2019). Nigeria Demographic and Health Survey 2018. NPC and ICF.

Figures, Plates, Tables, and Boxes

- Figure 1.1: Comparison of the principal models of antenatal care delivery. AI-generated using the prompt: "Create a professional medical diagram titled Models of Antenatal Care Delivery, comparing midwife-led, shared, consultant-led, and group antenatal care by risk profile and structure. Clean clinical educational diagram style."
- Table 1.2: Traditional antenatal visit schedule and key assessments by gestational age. AI-generated using the prompt: "Create a clean reference table titled Antenatal Visit Schedule by Gestational Age, listing visit intervals and key assessments at each stage. Simple clinical reference table style with outside border."

- Box 1.3: Summary of routine, screening, and targeted antenatal investigations. AI-generated using the prompt: "Create a simple single-column reference box with an outside border titled Antenatal Investigations Summary, listing routine, screening, and targeted investigations. Clinical reference box style."
- Figure 1.4: Sequential steps in conducting a routine antenatal visit. AI-generated using the prompt: "Create a professional medical flowchart titled Conducting a Routine Antenatal Visit, showing the sequential steps from history through examination to health education and planning. Clean clinical educational diagram style."

Series 2: Maternal Health and Pregnancy Nutrition

- **Part 2.1: Energy, Macronutrient, and Weight Gain Requirements in Pregnancy**
    - Sub Part 2.1.1: Energy and macronutrient requirements in pregnancy
    - Sub Part 2.1.2: Weight gain in pregnancy
    - Sub Part 2.1.3: Common nutritional deficiencies in pregnancy
- **Part 2.2: Micronutrient Supplementation and Nutrition Education**
    - Sub Part 2.2.1: Iron and folic acid supplementation
    - Sub Part 2.2.2: Calcium, vitamin D, and other micronutrients
    - Sub Part 2.2.3: Nutrition education and dietary counselling
- **Part 2.3: Maternal Health Conditions in Pregnancy**
    - Sub Part 2.3.1: Anaemia in pregnancy
    - Sub Part 2.3.2: Hypertensive disorders of pregnancy
    - Sub Part 2.3.3: Diabetes in pregnancy
- **Part 2.4: Drug Use and Lifestyle in Pregnancy**
    - Sub Part 2.4.1: Principles of prescribing in pregnancy
    - Sub Part 2.4.2: Commonly used and commonly avoided drugs in pregnancy
    - Sub Part 2.4.3: Substance use, smoking, and alcohol in pregnancy

Introduction

In the last Series, we explored the foundations of antenatal care, its concept, protocol, and investigations. We now turn to two areas that sit at the very heart of everyday antenatal practice: nutrition, the fuel that sustains a healthy pregnancy, and the maternal health conditions and lifestyle factors that can either support or threaten it. Every antenatal consultation touches on these themes in some form, whether reassuring a woman about her diet, managing anaemia detected on a routine blood test, or advising on a medication she has been prescribed for an unrelated condition.

The aim of this Series is to equip you with a thorough understanding of nutritional requirements in pregnancy, the presentation and management of common maternal health conditions, and the principles of safe prescribing and lifestyle counselling during pregnancy.

We shall commence this Series by examining the energy, macronutrient, and weight gain requirements of pregnancy. Next, we will consider the micronutrient supplementation recommended throughout pregnancy and the principles of effective nutrition education. Following that, our attention turns to maternal health conditions in pregnancy, including anaemia, hypertensive disorders, and diabetes. Finally, we will conclude by examining drug use and lifestyle in pregnancy, including the principles of safe prescribing and the risks of smoking, alcohol, and other substance use.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 2.1:** enumerate the energy, macronutrient, and weight gain requirements of pregnancy,
- **SLO 2.2:** describe the micronutrient supplementation recommended in pregnancy,
- **SLO 2.3:** describe the presentation and management of anaemia and hypertensive disorders in pregnancy,
- **SLO 2.4:** describe the presentation and management of diabetes in pregnancy,
- **SLO 2.5:** explain the principles of safe prescribing in pregnancy, and
- **SLO 2.6:** discuss the effects of substance use, smoking, and alcohol on pregnancy.

2.1 Energy, Macronutrient, and Weight Gain Requirements in Pregnancy

2.1.1 Energy and macronutrient requirements in pregnancy

Energy requirements increase only modestly during pregnancy, by approximately 340 kilocalories per day in the second trimester and 450 kilocalories per day in the third trimester above the non-pregnant requirement, figures considerably more modest than the popular notion of eating substantially more, and no additional energy is required at all during the first trimester, when maternal metabolic adaptation and, for many women, reduced appetite from nausea largely offset the minimal early growth demands of the pregnancy.

Protein requirements increase more proportionally, reflecting the substantial protein needs of the growing fetus, placenta, and expanding maternal tissues including the uterus and breast, with

an additional 25 grams of protein per day recommended from good-quality sources such as legumes, fish, eggs, and dairy, alongside continued attention to a balanced intake of carbohydrate and healthy fat sources to meet the overall energy needs described above.

Fill in the blank: Energy requirements increase by approximately 340 kilocalories per day in the _____ trimester. An additional 25 grams of _____ per day is recommended during pregnancy.

2.1.2 Weight gain in pregnancy

Recommended total gestational weight gain varies according to a woman's pre-pregnancy body mass index, with the Institute of Medicine guidelines recommending 12.5 to 18 kilograms for women who are underweight, 11.5 to 16 kilograms for those of normal weight, 7 to 11.5 kilograms for those who are overweight, and 5 to 9 kilograms for those who are obese, reflecting the recognition that appropriate weight gain targets differ substantially according to a woman's starting nutritional status.

Both inadequate and excessive gestational weight gain carry recognised risks: inadequate gain is associated with an increased risk of low birth weight and preterm birth, while excessive gain is associated with an increased risk of macrosomia, gestational diabetes, hypertensive disorders, and difficult labour, making individualised monitoring and, where indicated, dietary counselling throughout pregnancy an important and ongoing component of antenatal care rather than a single conversation held only at booking.

Fill in the blank: Recommended gestational weight gain varies according to a woman's pre-pregnancy _____ mass index. Excessive gestational weight gain is associated with an increased risk of macrosomia and gestational _____.

2.1.3 Common nutritional deficiencies in pregnancy

Iron deficiency is the most common nutritional deficiency in pregnancy worldwide, and particularly prevalent in many Nigerian populations because of a combination of marginal dietary intake, increased physiological demand, and coexisting causes of blood loss such as hookworm infestation and malaria, together placing pregnant women at substantially elevated risk of iron deficiency anaemia if intake and supplementation are not actively addressed throughout pregnancy.

Other significant deficiencies encountered in pregnancy include folate deficiency (of particular concern given its established link with neural tube defects, discussed further in relation to supplementation), iodine deficiency (important for fetal neurodevelopment and still prevalent in some inland regions with limited access to iodised salt), and vitamin A deficiency, each carrying specific consequences for maternal and fetal health that make targeted dietary assessment and, where indicated, supplementation an essential part of comprehensive antenatal nutritional care.

Fill in the blank: Iron deficiency is the most common nutritional deficiency in pregnancy, worsened in Nigeria by coexisting causes of blood loss such as hookworm and _____. Folate deficiency in pregnancy is of particular concern given its link with _____ defects.

Pre-Pregnancy BMI Category	Recommended Total Weight Gain
Underweight (BMI < 18.5)	28–40 lbs (≈12.5–18 kg)
Normal Weight (BMI 18.5–24.9)	25–35 lbs (≈11.5–16 kg)
Overweight (BMI 25–29.9)	15–25 lbs (≈7–11.5 kg)
Obese (BMI ≥ 30)	11–20 lbs (≈5–9 kg)

Table 2.1: Recommended gestational weight gain by pre-pregnancy body mass index category.

Pilot questions 2.1

- Describe how energy requirements change across pregnancy. (Linked to SLO 2.1)
- Explain why protein requirements increase more proportionally than energy requirements in pregnancy. (Linked to SLO 2.1)
- Describe the recommended gestational weight gain ranges by pre-pregnancy BMI category. (Linked to SLO 2.1)
- Describe the risks associated with both inadequate and excessive gestational weight gain. (Linked to SLO 2.1)
- Describe the common nutritional deficiencies encountered in pregnancy and their causes. (Linked to SLO 2.1)

2.2 Micronutrient Supplementation and Nutrition Education

2.2.1 Iron and folic acid supplementation

Routine iron and folic acid supplementation is recommended for all pregnant women, not merely those with confirmed deficiency, reflecting the near-universal increase in iron and folate requirements imposed by pregnancy and the practical difficulty of reliably meeting these requirements through diet alone in most populations, with a standard daily dose of elemental iron

combined with folic acid recommended throughout pregnancy from as early as possible, ideally from before conception where planning allows.

Folic acid supplementation is of particular importance in the periconceptional period, as neural tube closure occurs very early in pregnancy, often before a woman is even aware she is pregnant, meaning that supplementation started only after a positive pregnancy test may occur too late to confer the intended protective benefit against neural tube defects, an important point to communicate clearly to women of reproductive age planning a future pregnancy, not solely to those already pregnant.

Fill in the blank: Iron and folic acid supplementation is recommended for _____ pregnant women, not only those with confirmed deficiency. Neural tube closure occurs very early in pregnancy, often before a woman is even aware she is _____.

2.2.2 Calcium, vitamin D, and other micronutrients

Calcium supplementation is recommended, particularly in populations with low dietary calcium intake, given evidence that it reduces the risk of hypertensive disorders of pregnancy, including pre-eclampsia, alongside its established role in fetal skeletal mineralisation, with recommended doses considerably higher in low-intake settings than the amount typically needed simply to prevent overt maternal deficiency.

Vitamin D supplementation is similarly recommended, particularly for women with limited sun exposure, darker skin pigmentation (which reduces cutaneous vitamin D synthesis for a given amount of sunlight exposure), or dietary patterns low in vitamin D-rich foods, supporting both maternal bone health and fetal skeletal development, while iodine, zinc, and vitamin A each play further specific roles that should be considered as part of a comprehensive, individualised approach to antenatal micronutrient supplementation rather than a single generic prescription applied uniformly to every woman.

Fill in the blank: Calcium supplementation in pregnancy reduces the risk of hypertensive disorders including _____. Darker skin pigmentation reduces cutaneous _____ synthesis for a given amount of sunlight exposure.

2.2.3 Nutrition education and dietary counselling

Practical nutrition education in antenatal care should be tailored to local food availability, cultural dietary practices, and household economic circumstances, translating general nutritional principles into specific, realistic, and affordable recommendations that a woman can genuinely implement, rather than generic advice referencing foods that may be unavailable, unfamiliar, or unaffordable within her particular household and community context.

Counselling should also address common food-related concerns and misconceptions encountered in pregnancy, including unfounded dietary restrictions rooted in cultural belief that may inadvertently limit intake of genuinely beneficial foods, alongside food safety advice regarding the specific risks of certain foods in pregnancy, such as those carrying a higher risk of

listeria or toxoplasma contamination, delivered sensitively and without dismissing the woman's own cultural context and beliefs.

Fill in the blank: Nutrition education should be tailored to local food availability, cultural practices, and household _____ circumstances. Food safety advice in pregnancy addresses risks such as _____ and toxoplasma contamination.

Supplement	Indication & Timing
Iron	Prevent and treat maternal anaemia; usually started in the second trimester and continued throughout pregnancy.
Folic Acid	Prevent neural tube defects; ideally begun preconception and continued through the first trimester.
Calcium	Reduce risk of pre-eclampsia and support fetal bone development; recommended from mid-pregnancy onwards.
Vitamin D	Support maternal bone health and fetal skeletal development; supplementation throughout pregnancy, especially in low sunlight exposure regions.

Box 2.2: Summary of key micronutrient supplementation recommended in pregnancy.

Pilot questions 2.2

1. Explain why routine iron and folic acid supplementation is recommended for all pregnant women. (Linked to SLO 2.2)
2. Explain why folic acid supplementation should ideally begin before conception. (Linked to SLO 2.2)
3. Describe the role and indication for calcium supplementation in pregnancy. (Linked to SLO 2.2)
4. Describe the factors that increase the need for vitamin D supplementation in pregnancy. (Linked to SLO 2.2)
5. Describe the principles of effective nutrition education in antenatal care. (Linked to SLO 2.2)

2.3 Maternal Health Conditions in Pregnancy

2.3.1 Anaemia in pregnancy

Anaemia in pregnancy is defined as a haemoglobin concentration below 11 grams per decilitre, most commonly due to iron deficiency but frequently multifactorial in Nigerian practice, with malaria, hookworm infestation, and haemoglobinopathy each contributing independently or in combination, presenting with fatigue, pallor, and, in more severe cases, breathlessness and reduced exercise tolerance that may be wrongly attributed simply to the physiological demands of pregnancy itself.

Management depends on severity and cause: mild to moderate iron deficiency anaemia is managed with oral iron supplementation, with intravenous iron considered where oral therapy is poorly tolerated or ineffective, and blood transfusion reserved for severe anaemia, particularly close to term or in the presence of symptomatic cardiovascular compromise, while any identified underlying contributing cause, such as malaria or hookworm, should be specifically treated alongside correction of the anaemia itself.

Fill in the blank: Anaemia in pregnancy is defined as a haemoglobin concentration below _____ grams per decilitre. Severe anaemia close to term or with symptomatic cardiovascular compromise may require blood _____.

2.3.2 Hypertensive disorders of pregnancy

Hypertensive disorders of pregnancy are classified as chronic hypertension (present before 20 weeks of gestation or pre-existing), gestational hypertension (new-onset hypertension after 20 weeks without proteinuria), and pre-eclampsia (new-onset hypertension after 20 weeks with proteinuria or other evidence of maternal organ dysfunction), a distinction of considerable practical importance as it directly determines the intensity of surveillance and management required for the remainder of the pregnancy.

Pre-eclampsia carries risk of progression to eclampsia (seizures) and other serious maternal complications including HELLP syndrome (haemolysis, elevated liver enzymes, and low platelets) and placental abruption, alongside fetal risks including growth restriction and placental insufficiency, making regular blood pressure and urinalysis screening at every antenatal contact, and prompt recognition and escalation of care when hypertensive disorders are identified, genuinely central to safe antenatal practice.

Fill in the blank: Pre-eclampsia is defined as new-onset hypertension after 20 weeks with proteinuria or other evidence of maternal organ _____. HELLP syndrome comprises haemolysis, elevated liver enzymes, and low _____.

2.3.3 Diabetes in pregnancy

Diabetes in pregnancy is classified as pre-existing (diagnosed before pregnancy) or gestational (first identified during pregnancy, typically around 24 to 28 weeks), with both categories carrying increased risk of macrosomia, polyhydramnios, birth trauma, neonatal hypoglycaemia,

and, in pre-existing diabetes particularly, congenital anomaly if glycaemic control is poor around the time of conception and during early organogenesis.

Management centres on achieving and maintaining tight glycaemic control throughout pregnancy, initially through dietary modification and structured exercise, escalating to insulin therapy where target glucose levels are not achieved through lifestyle measures alone, alongside increased fetal surveillance in the third trimester and careful planning of the timing and mode of delivery, reflecting the recognised increase in both maternal and fetal risk associated with poorly controlled diabetes throughout pregnancy.

Fill in the blank: Gestational diabetes is typically first identified around _____ weeks of pregnancy. Poor glycaemic control around conception in pre-existing diabetes increases the risk of congenital _____.

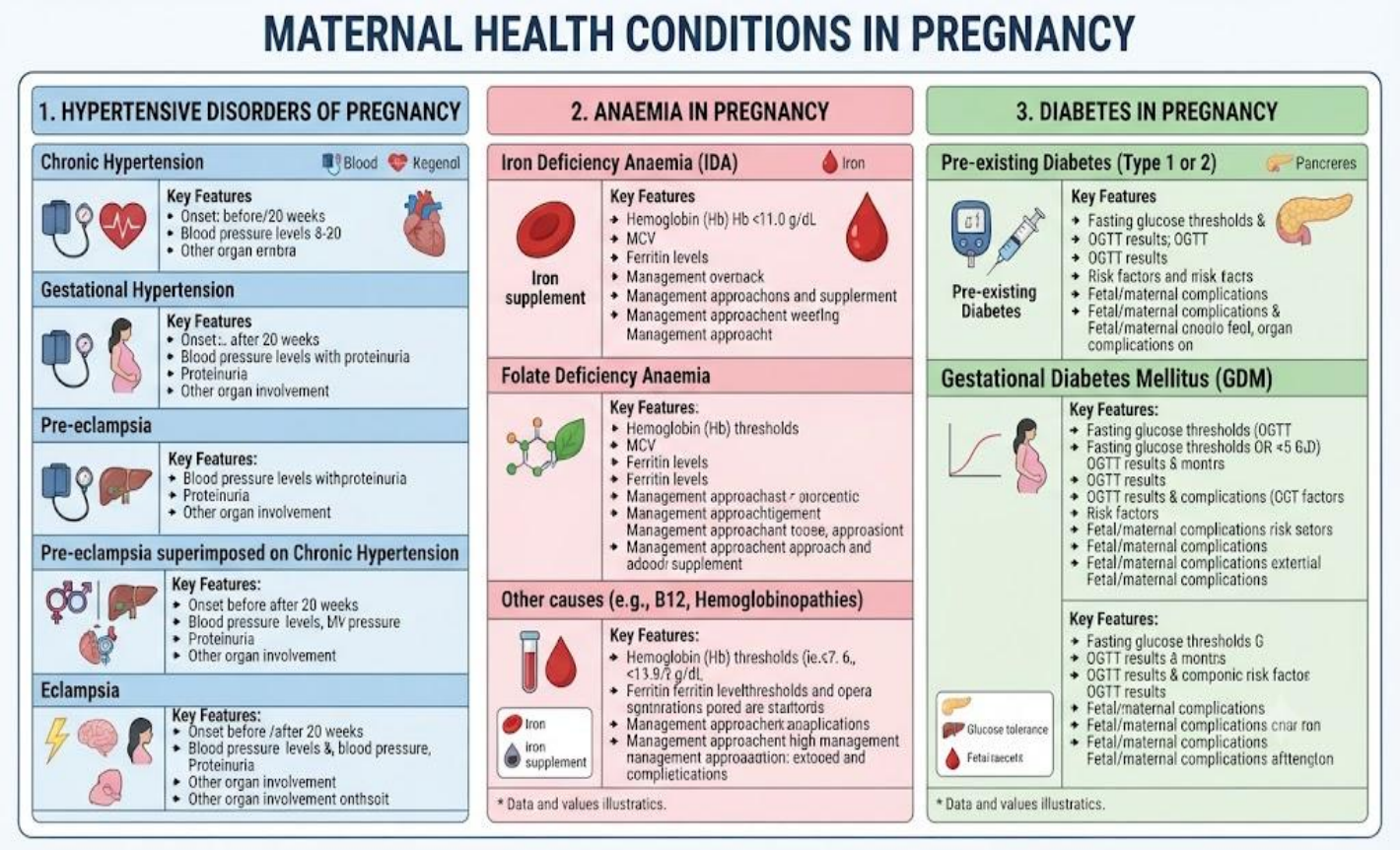


Figure 2.3: Classification of hypertensive disorders, anaemia, and diabetes in pregnancy.

Pilot questions 2.3

1. Describe the causes and management of anaemia in pregnancy. (Linked to SLO 2.3)
2. Classify the hypertensive disorders of pregnancy. (Linked to SLO 2.3)
3. Describe the maternal and fetal complications of pre-eclampsia. (Linked to SLO 2.3)

4. Distinguish pre-existing from gestational diabetes in pregnancy. (Linked to SLO 2.4)
5. Describe the management of diabetes in pregnancy. (Linked to SLO 2.4)

2.4 Drug Use and Lifestyle in Pregnancy

2.4.1 Principles of prescribing in pregnancy

Prescribing in pregnancy requires careful weighing of the benefit of treating the maternal condition against any potential risk to the developing fetus, recognising that untreated maternal illness itself frequently carries greater fetal risk than appropriate treatment, meaning that withholding necessary medication out of a generalised, undifferentiated caution about pregnancy is often the more harmful course of action rather than the safer one it may intuitively appear to be.

The concept of teratogenic risk varies considerably by gestational timing, with the greatest vulnerability to structural malformation occurring during the period of organogenesis, roughly weeks three to eight of gestation, while exposure later in pregnancy is more likely to affect fetal growth and functional organ development rather than cause structural malformation, an important principle when counselling a woman about a medication exposure that has already occurred earlier in her pregnancy.

Fill in the blank: The period of greatest vulnerability to structural malformation from drug exposure is roughly weeks three to _____ of gestation, the period of organogenesis. Withholding necessary medication out of generalised caution can itself be more harmful than appropriate _____.

2.4.2 Commonly used and commonly avoided drugs in pregnancy

Many commonly used medications are considered safe throughout pregnancy at standard therapeutic doses, including paracetamol for analgesia, most penicillin and cephalosporin antibiotics for infection, and labetalol or nifedipine for antihypertensive treatment, providing reassurance that effective, appropriate treatment of common maternal conditions need not be routinely withheld or unnecessarily delayed simply because a woman is pregnant.

Medications generally avoided in pregnancy include non-steroidal anti-inflammatory drugs (particularly in the third trimester, given the risk of premature closure of the fetal ductus arteriosus and reduced amniotic fluid volume), ACE inhibitors and angiotensin receptor blockers (associated with fetal renal impairment and other serious anomalies), warfarin (teratogenic, particularly in the first trimester), and isotretinoin (highly teratogenic, requiring strict pregnancy prevention measures during any course of treatment in a woman of reproductive age).

Fill in the blank: NSAIDs are generally avoided in the third trimester because of the risk of premature closure of the fetal ductus _____. Warfarin is particularly teratogenic when used in the _____ trimester.

2.4.3 Substance use, smoking, and alcohol in pregnancy

Smoking in pregnancy is associated with an increased risk of miscarriage, placental abruption, placenta praevia, low birth weight, and preterm birth, with the risk generally dose-dependent, meaning that any reduction in smoking, and ideally complete cessation, confers meaningful benefit even if achieved only partway through pregnancy, making smoking cessation support a valuable and worthwhile intervention to offer at every antenatal contact regardless of gestational age.

Alcohol consumption in pregnancy carries risk of fetal alcohol spectrum disorder, encompassing a range of physical, cognitive, and behavioural effects, with no level of alcohol consumption established as definitively safe during pregnancy, and other substances of misuse, including opioids and stimulants, carry their own specific patterns of fetal and neonatal risk, including, in the case of opioids, neonatal abstinence syndrome requiring specific recognition and management in the newborn period, making non-judgemental screening for substance use an important and integral part of routine antenatal assessment.

Fill in the blank: Fetal alcohol spectrum disorder encompasses a range of physical, cognitive, and _____ effects. Neonatal _____ syndrome can occur in infants born to mothers using opioids during pregnancy.

Drug Class	Example	Reason for Use / Avoidance
Analgesics – Safe	Paracetamol (acetaminophen)	Widely used for pain and fever; considered safe in all trimesters.
Analgesics – Avoid	NSAIDs (e.g., ibuprofen, indomethacin)	Risk of premature ductus arteriosus closure, oligohydramnios, and miscarriage.
Antibiotics – Safe	Penicillins, cephalosporins	Effective against infections; generally safe in pregnancy.
Antibiotics – Avoid	Tetracyclines	Cause fetal bone growth impairment and teeth discoloration.
Antihypertensives – Safe	Methyldopa, labetalol	Used for managing hypertension in pregnancy; safe profile.
Antihypertensives – Avoid	ACE inhibitors, ARBs	Associated with fetal renal dysgenesis and growth restriction.

Drug Class	Example	Reason for Use / Avoidance
Antiemetics – Safe	Ondansetron, doxylamine-pyridoxine	Used for nausea and vomiting in pregnancy; generally safe.
Anticonvulsants – Avoid	Valproate	Strongly teratogenic; risk of neural tube defects and developmental delay.

Table 2.4: Commonly used and commonly avoided medications in pregnancy.

Pilot questions 2.4

1. Explain the general principle guiding prescribing decisions in pregnancy. (Linked to SLO 2.5)
2. Describe the period of greatest teratogenic risk during pregnancy and why. (Linked to SLO 2.5)
3. List examples of medications generally considered safe in pregnancy. (Linked to SLO 2.5)
4. Describe the risks of smoking in pregnancy. (Linked to SLO 2.6)
5. Describe the risks of alcohol and other substance use in pregnancy. (Linked to SLO 2.6)

Series Summary

This Series has covered the energy, macronutrient, and weight gain requirements of pregnancy, followed by the micronutrient supplementation recommended throughout pregnancy and the principles of effective nutrition education. It went on to examine maternal health conditions including anaemia, hypertensive disorders, and diabetes in pregnancy, before concluding with drug use and lifestyle in pregnancy, including safe prescribing principles and the risks of smoking, alcohol, and substance use.

You should now be able to enumerate the nutritional requirements of pregnancy, describe the micronutrient supplementation recommended, describe the presentation and management of anaemia, hypertensive disorders, and diabetes in pregnancy, explain the principles of safe prescribing, and discuss the effects of substance use, smoking, and alcohol on pregnancy (Linked to SLOs 2.1 to 2.6).

Glossary of Terms

1. **Eclampsia:** the occurrence of seizures in a woman with pre-eclampsia, a serious complication of hypertensive disease of pregnancy.
2. **Fetal alcohol spectrum disorder:** a range of physical, cognitive, and behavioural effects resulting from alcohol exposure during pregnancy.
3. **Gestational diabetes:** diabetes first identified during pregnancy, typically around 24 to 28 weeks of gestation.
4. **Gestational weight gain:** the total weight gained during pregnancy, with recommended ranges varying by pre-pregnancy body mass index.
5. **HELLP syndrome:** haemolysis, elevated liver enzymes, and low platelets, a serious complication of pre-eclampsia.
6. **Neonatal abstinence syndrome:** a withdrawal syndrome occurring in infants born to mothers using opioids during pregnancy.
7. **Organogenesis:** the period of embryonic development, roughly weeks three to eight of gestation, during which organs form and structural malformation risk is highest.
8. **Periconceptional period:** the time around conception, of particular importance for folic acid supplementation given the timing of neural tube closure.
9. **Pre-eclampsia:** new-onset hypertension after 20 weeks of pregnancy with proteinuria or other evidence of maternal organ dysfunction.

10. **Teratogenic risk:** the potential of a substance to cause structural or functional abnormality in a developing fetus.
11. **Iron deficiency anaemia:** anaemia resulting from insufficient iron to support hemoglobin synthesis, the most common nutritional deficiency in pregnancy.
12. **Macrosomia:** a fetus or newborn significantly larger than average for gestational age, associated with maternal diabetes.

Concept Check Questions [Series 2]

Objective questions

- Energy requirements increase by approximately 340 kilocalories per day in the _____ trimester.
- Neural tube closure occurs very early in pregnancy, often before a woman is even aware she is _____.
- Anaemia in pregnancy is defined as a haemoglobin concentration below _____ grams per decilitre.
- NSAIDs are generally avoided in the third trimester because of the risk of premature closure of the fetal ductus _____.
- No level of _____ consumption has been established as definitively safe during pregnancy.

Short-answer questions

1. Describe the risks associated with both inadequate and excessive gestational weight gain. (Linked to SLO 2.1)
2. Explain why folic acid supplementation should ideally begin before conception. (Linked to SLO 2.2)
3. Describe the maternal and fetal complications of pre-eclampsia. (Linked to SLO 2.3)
4. Describe the period of greatest teratogenic risk during pregnancy and why. (Linked to SLO 2.5)
5. Describe the risks of smoking in pregnancy. (Linked to SLO 2.6)

Long-answer questions

6. Describe the energy, macronutrient, and weight gain requirements of pregnancy. (Linked to SLO 2.1)
7. Describe the micronutrient supplementation recommended in pregnancy and its rationale. (Linked to SLO 2.2)
8. Describe the classification and management of hypertensive disorders of pregnancy. (Linked to SLO 2.3)
9. Describe the classification and management of diabetes in pregnancy. (Linked to SLO 2.4)
10. Explain the principles of safe prescribing in pregnancy and the risks of substance use. (Linked to SLO 2.5, SLO 2.6)

Answers to Concept Check Questions [Series 2]

Objective questions

11. Second.
12. Pregnant.
13. 11.
14. Arteriosus.
15. Alcohol.

Short-answer questions

16. Inadequate gain increases the risk of low birth weight and preterm birth, while excessive gain increases the risk of macrosomia, gestational diabetes, and hypertensive disorders.
17. Neural tube closure occurs very early in pregnancy, often before a woman is aware she is pregnant, so supplementation started only after a positive test may be too late.
18. Progression to eclampsia and HELLP syndrome, and placental abruption, alongside fetal risks including growth restriction and placental insufficiency.

19. Weeks three to eight of gestation, the period of organogenesis, when structural malformation risk from exposure is greatest.
20. Increased risk of miscarriage, placental abruption, placenta praevia, low birth weight, and preterm birth, generally dose-dependent.

Long-answer questions

21. **Basic response:** Energy needs increase modestly in the second and third trimesters, protein needs increase more proportionally, and weight gain targets vary by pre-pregnancy BMI.

Value-added response: Both inadequate and excessive gestational weight gain carry specific risks, making individualised monitoring throughout pregnancy important rather than a single assessment.

22. **Basic response:** Iron, folic acid, calcium, and vitamin D supplementation are each recommended in pregnancy, with folic acid ideally started before conception.

Value-added response: Nutrition education should be tailored to local food availability and cultural practices, translating general principles into realistic, affordable recommendations.

23. **Basic response:** Hypertensive disorders are classified as chronic, gestational, or pre-eclampsia, each requiring different intensity of surveillance and management.

Value-added response: Pre-eclampsia carries risk of progression to eclampsia and HELLP syndrome, making regular screening at every antenatal contact essential.

Answers to Pilot Questions [Series 2]

Part 2.1

1. No additional energy in the first trimester, approximately 340 kcal per day in the second, and 450 kcal per day in the third.
2. Protein needs reflect the substantial demands of fetal, placental, and maternal tissue growth, requiring an additional 25 grams per day.
3. 12.5 to 18 kg for underweight, 11.5 to 16 kg for normal weight, 7 to 11.5 kg for overweight, and 5 to 9 kg for obese women.

4. Inadequate gain increases risk of low birth weight and preterm birth; excessive gain increases risk of macrosomia and gestational diabetes.
5. Iron deficiency (worsened by hookworm and malaria), folate deficiency, iodine deficiency, and vitamin A deficiency.

Part 2.2

6. Near-universal increase in requirements makes dietary intake alone often insufficient, so supplementation benefits all pregnant women, not just those deficient.
7. Neural tube closure occurs very early, often before pregnancy is recognised, so supplementation must begin before conception to be protective.
8. Calcium reduces the risk of hypertensive disorders including pre-eclampsia and supports fetal skeletal mineralisation.
9. Limited sun exposure, darker skin pigmentation, and dietary patterns low in vitamin D-rich foods.
10. Tailoring advice to local food availability, cultural practices, and household economic circumstances with realistic, affordable recommendations.

Part 2.3

11. Iron deficiency, often multifactorial with malaria, hookworm, and haemoglobinopathy; managed with oral or intravenous iron, or transfusion if severe.
12. Chronic hypertension, gestational hypertension, and pre-eclampsia, distinguished by timing and presence of proteinuria or organ dysfunction.
13. Progression to eclampsia and HELLP syndrome, placental abruption, and fetal growth restriction from placental insufficiency.
14. Pre-existing diabetes is diagnosed before pregnancy; gestational diabetes is first identified during pregnancy, typically at 24 to 28 weeks.
15. Dietary modification and exercise initially, escalating to insulin if targets are not met, with increased fetal surveillance and delivery planning.

Part 2.4

1. Weighing maternal benefit against fetal risk, recognising untreated maternal illness often carries greater fetal risk than appropriate treatment.
2. Weeks three to eight of gestation, the period of organogenesis, when structural malformation risk is greatest.
3. Paracetamol, most penicillins and cephalosporins, and labetalol or nifedipine for hypertension.
4. Increased risk of miscarriage, placental abruption, placenta praevia, low birth weight, and preterm birth, generally dose-dependent.
5. Fetal alcohol spectrum disorder from alcohol, and specific risks from opioids and stimulants including neonatal abstinence syndrome.

References and Attributions [Series 2]

Textual References

1. Cunningham, F. G., Leveno, K. J., Dashe, J. S. et al. (2022). Williams Obstetrics (26th ed.). McGraw Hill.
2. Institute of Medicine (2009). Weight Gain During Pregnancy: Reexamining the Guidelines. National Academies Press.
3. World Health Organization (2016). WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience. WHO Press.
4. National Institute for Health and Care Excellence (2019). Hypertension in Pregnancy: Diagnosis and Management. NICE Guideline NG133.

Figures, Plates, Tables, and Boxes

1. Table 2.1: Recommended gestational weight gain by pre-pregnancy body mass index category. AI-generated using the prompt: "Create a clean reference table titled Recommended Gestational Weight Gain by BMI Category, listing weight gain ranges for underweight, normal weight, overweight, and obese categories. Simple clinical reference table style with outside border."
2. Box 2.2: Summary of key micronutrient supplementation recommended in pregnancy. AI-generated using the prompt: "Create a simple single-column reference box with an outside border titled Micronutrient Supplementation in Pregnancy, listing key supplements with their indication and timing. Clinical reference box style."
3. Figure 2.3: Classification of hypertensive disorders, anaemia, and diabetes in pregnancy. AI-generated using the prompt: "Create a professional medical diagram titled Maternal Health Conditions in Pregnancy, comparing classification of hypertensive disorders, anaemia, and diabetes with key features. Clean clinical educational diagram style."
4. Table 2.4: Commonly used and commonly avoided medications in pregnancy. AI-generated using the prompt: "Create a clean reference table titled Commonly Used and Commonly Avoided Medications in Pregnancy, listing drug class, example, and reason for use or avoidance. Simple clinical reference table style with outside border."

Series 3: Foetal Growth, Development and Assessment

- **Part 3.1: Foetal Lie, Presentation, Position, and Attitude**
    - Sub Part 3.1.1: Foetal lie and presentation
    - Sub Part 3.1.2: Foetal position and attitude
    - Sub Part 3.1.3: Engagement of the foetal presenting part
- **Part 3.2: The Maternal Pelvis and Imaging in Obstetrics**
    - Sub Part 3.2.1: The maternal pelvis and its obstetric significance
    - Sub Part 3.2.2: Ultrasound imaging in obstetrics
    - Sub Part 3.2.3: Other imaging modalities in obstetrics
- **Part 3.3: Foetal Growth and Development**
    - Sub Part 3.3.1: Stages of foetal growth and development
    - Sub Part 3.3.2: Placental function and foetal growth
    - Sub Part 3.3.3: Assessment of foetal growth
- **Part 3.4: Antenatal and Intrapartum Foetal Assessment**
    - Sub Part 3.4.1: Antenatal foetal surveillance
    - Sub Part 3.4.2: Doppler assessment of foetal wellbeing
    - Sub Part 3.4.3: Intrapartum foetal assessment

Introduction

In the last Series, we explored maternal health and nutrition in pregnancy. We now turn our attention to the foetus itself: how it lies and presents within the uterus, how it grows and develops across the course of pregnancy, and the methods available to assess its wellbeing both before and during labour. A clear, confident understanding of these foundations underpins almost every clinical decision made in obstetric practice, from a routine abdominal palpation in the antenatal clinic to the interpretation of a cardiotocograph trace in the delivery room.

The aim of this Series is to equip you with a thorough understanding of foetal lie, presentation, and position, the maternal pelvis and obstetric imaging, foetal growth and development, and the methods used to assess foetal wellbeing antenatally and during labour.

We shall commence this Series by examining foetal lie, presentation, position, and attitude, together with engagement of the presenting part. Next, we will consider the maternal pelvis and the imaging modalities used in obstetric practice. Following that, our attention turns to foetal growth and development and its clinical assessment. Finally, we will conclude by examining the methods of antenatal and intrapartum foetal assessment.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 3.1:** describe foetal lie, presentation, position, and attitude,
- **SLO 3.2:** explain engagement of the foetal presenting part and its clinical assessment,
- **SLO 3.3:** describe the maternal pelvis and its obstetric significance,
- **SLO 3.4:** describe the imaging techniques used in obstetrics,
- **SLO 3.5:** describe foetal growth and development and its clinical assessment, and
- **SLO 3.6:** describe the methods of antenatal and intrapartum foetal assessment.

3.1 Foetal Lie, Presentation, Position, and Attitude

3.1.1 Foetal lie and presentation

Foetal lie describes the relationship between the long axis of the foetus and the long axis of the maternal uterus, classified as longitudinal (the great majority of pregnancies at term, with the foetal spine parallel to the maternal spine), transverse (the foetal spine at right angles to the maternal spine), or oblique (an intermediate, generally unstable orientation that typically converts to longitudinal or transverse before or during labour).

Foetal presentation refers to the foetal part that occupies the lower pole of the uterus and will present first at the pelvic inlet during labour, most commonly cephalic (head presenting, the normal and safest presentation for vaginal birth) or breech (buttocks or feet presenting), with presentation determined by lie together with the specific orientation of the presenting part, and cephalic presentation itself further subdivided according to the degree of flexion of the foetal head.

Fill in the blank: A foetal lie in which the foetal spine lies at right angles to the maternal spine is termed _____. The foetal part occupying the lower pole of the uterus is called the foetal _____.

3.1.2 Foetal position and attitude

Foetal position describes the relationship of a defined reference point on the presenting part to specific landmarks on the maternal pelvis, most commonly described using the occiput as the reference point in a cephalic presentation, giving positions such as occipito-anterior, occipito-transverse, or occipito-posterior, terminology of considerable practical importance as it directly influences the likely progress and potential difficulty of labour.

Foetal attitude describes the relationship of the foetal head and limbs to the foetal trunk, ranging from the well-flexed attitude typical and favourable for labour (chin tucked to chest, presenting the smallest possible diameter of the foetal head to the maternal pelvis) to varying degrees of deflexion and, at the extreme, complete extension producing a face or brow presentation, each associated with a progressively larger presenting diameter and, consequently, a more difficult labour.

Fill in the blank: In a cephalic presentation, foetal position is most commonly described in relation to the _____. A well-flexed foetal attitude presents the _____ possible diameter of the foetal head to the maternal pelvis.

3.1.3 Engagement of the foetal presenting part

Engagement refers to the passage of the widest diameter of the foetal presenting part through the pelvic inlet, assessed clinically by abdominal palpation in fifths, describing how much of the foetal head remains palpable above the pelvic brim, with a head assessed as two-fifths or less palpable abdominally considered engaged, as three-fifths or more of its total diameter has by this point passed below the level of the pelvic inlet.

In primigravid women (those in their first pregnancy), engagement typically occurs from around 36 weeks of gestation onwards, reflecting the firmer, less distensible pelvic floor and abdominal musculature typical of a first pregnancy, whereas in multigravid women engagement often does not occur until labour has actually begun, an important point when counselling a multigravid woman whose head remains unengaged as she approaches her expected date of delivery, as this finding alone is far less concerning in this context than it would be in a primigravida.

Fill in the blank: Engagement is assessed clinically by abdominal palpation, with a head two-fifths or less palpable considered _____. In primigravid women, engagement typically occurs from around _____ weeks of gestation.

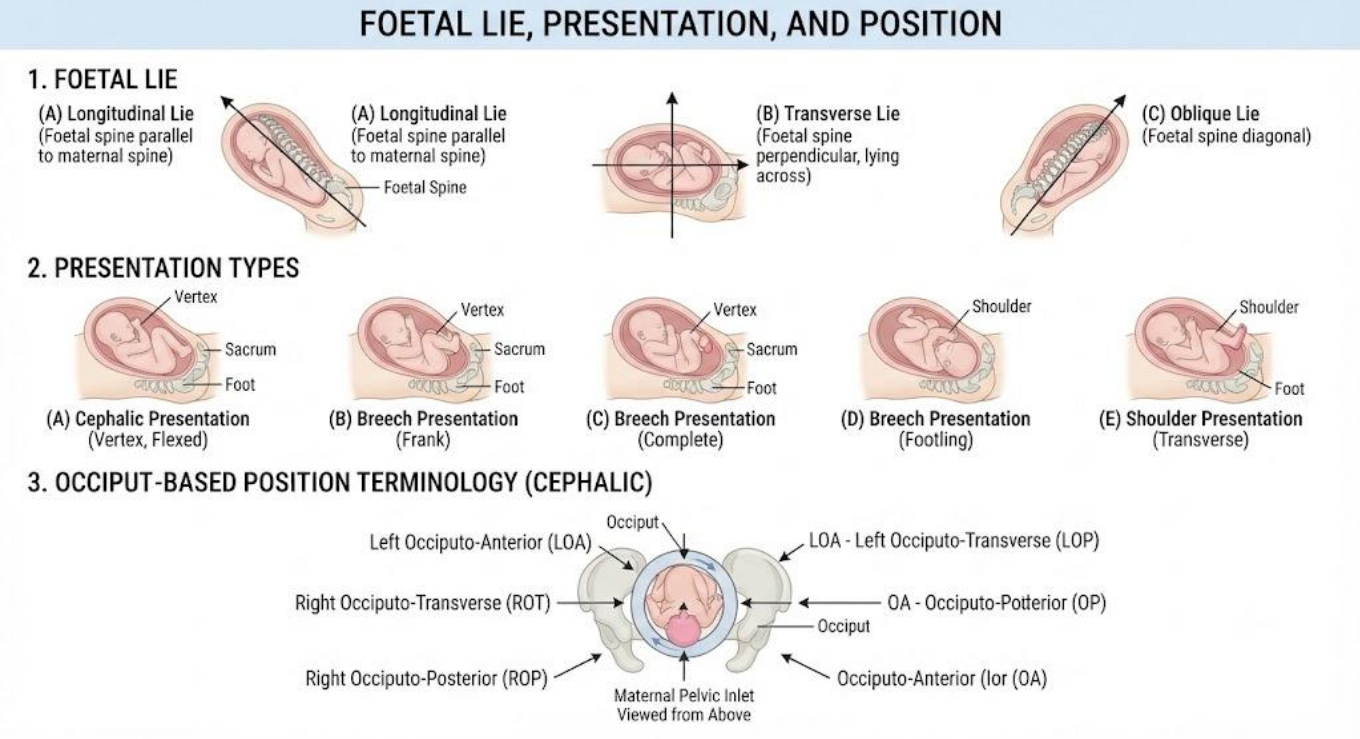


Figure 3.1: Foetal lie, presentation, and position at term.

Pilot questions 3.1

- Describe the classification of foetal lie. (Linked to SLO 3.1)
- Distinguish cephalic from breech presentation. (Linked to SLO 3.1)
- Describe how foetal position is determined in a cephalic presentation. (Linked to SLO 3.1)
- Describe foetal attitude and its effect on the presenting diameter of the foetal head. (Linked to SLO 3.1)
- Explain how engagement is assessed clinically and how this differs between primigravid and multigravid women. (Linked to SLO 3.2)

3.2 The Maternal Pelvis and Imaging in Obstetrics

3.2.1 The maternal pelvis and its obstetric significance

The maternal pelvis must accommodate the passage of the foetus through three distinct planes during labour, the pelvic inlet, mid-cavity, and pelvic outlet, each with its own characteristic dimensions and diameters that the foetal head must successfully negotiate, with the overall

adequacy of the pelvis for vaginal delivery, termed clinical pelvic adequacy, assessed through a combination of clinical examination and the observed progress of labour itself, rather than through pelvic measurement alone.

Cephalopelvic disproportion describes a mismatch between the size of the foetal head and the dimensions of the maternal pelvis sufficient to prevent safe vaginal delivery, a diagnosis made principally on the basis of poor progress in labour despite adequate uterine contractions, rather than through antenatal pelvic measurement, which has generally proved a poor and unreliable predictor of whether an individual labour will in fact progress successfully to vaginal birth.

Fill in the blank: The foetal head must negotiate three distinct planes of the pelvis: the inlet, mid-cavity, and _____. Cephalopelvic disproportion is diagnosed principally on the basis of poor progress in _____.

3.2.2 Ultrasound imaging in obstetrics

Ultrasound is the principal imaging modality in obstetric practice, valued for its safety (no ionising radiation), accessibility, and real-time visualisation, used across pregnancy for dating, structural anomaly screening, placental localisation, assessment of foetal growth and wellbeing, and guidance for invasive procedures such as amniocentesis, making competent, systematic ultrasound assessment a genuinely core skill for anyone practising obstetrics.

Doppler ultrasound specifically assesses blood flow velocity within maternal and foetal vessels, most commonly the umbilical artery, middle cerebral artery, and uterine arteries, providing valuable information about placental function and foetal cardiovascular adaptation to any degree of placental insufficiency, and forming an increasingly central component of surveillance in pregnancies identified as being at higher risk of foetal growth restriction or other placentally mediated complications.

Fill in the blank: Ultrasound is valued in obstetric practice for its safety, as it uses no _____ radiation. Doppler ultrasound of the umbilical artery provides information about _____ function.

3.2.3 Other imaging modalities in obstetrics

Magnetic resonance imaging (MRI) is used selectively in obstetric practice, particularly for detailed characterisation of complex foetal structural anomalies identified on ultrasound, assessment of suspected placenta accreta spectrum disorders, and maternal pelvimetry or soft tissue assessment in specific clinical scenarios, offering superior soft tissue resolution to ultrasound but at greater cost and with more limited availability in many settings, including much of Nigeria.

Plain radiography has a very limited role in modern obstetric practice given the availability of ultrasound and concerns regarding ionising radiation exposure to the foetus, now largely reserved for specific circumstances such as confirming foetal skeletal abnormality where ultrasound findings are equivocal, or, historically, for pelvimetry, a use now almost entirely

superseded by clinical assessment of labour progress given its demonstrated poor predictive value for delivery outcome.

Fill in the blank: MRI is particularly useful for assessment of suspected placenta _____ spectrum disorders. Plain radiography has a very limited role in obstetrics given concerns about _____ radiation exposure to the foetus.

Modality	Principal Use	Key Advantage	Key Limitation
Ultrasound	Routine fetal growth, anatomy, and wellbeing assessment	Widely available, safe, non-invasive	Operator-dependent, limited by maternal habitus and fetal position
Doppler Ultrasound	Assess uteroplacental and fetal circulation	Provides real-time blood flow information	Requires expertise, interpretation variability
MRI	Detailed evaluation of fetal anomalies and maternal pelvic pathology	Superior soft tissue contrast, no ionizing radiation	Expensive, less available, contraindicated in unstable patients
Plain Radiography	Rarely used; may assess maternal pelvis or trauma	Quick, widely available	Ionizing radiation exposure, limited fetal utility

Table 3.2: Comparison of imaging modalities used in obstetric practice.

Pilot questions 3.2

1. Describe the three planes of the maternal pelvis that the foetal head must negotiate during labour. (Linked to SLO 3.3)
2. Explain why cephalopelvic disproportion is diagnosed on the basis of labour progress rather than pelvic measurement. (Linked to SLO 3.3)
3. Describe the uses of ultrasound across pregnancy. (Linked to SLO 3.4)
4. Describe the role of Doppler ultrasound in obstetric assessment. (Linked to SLO 3.4)
5. Describe the selective uses of MRI in obstetric practice. (Linked to SLO 3.4)

3.3 Foetal Growth and Development

3.3.1 Stages of foetal growth and development

Human intrauterine development is divided into the pre-embryonic period (the first two weeks, dominated by implantation and initial cellular differentiation), the embryonic period (weeks three to eight, during which organogenesis occurs and the developing conceptus is most

vulnerable to teratogenic insult), and the foetal period (from nine weeks until birth, characterised principally by growth and functional maturation of organ systems already established during the preceding embryonic period).

Foetal growth itself follows a broadly predictable pattern, with early growth predominantly reflecting cellular hyperplasia (increase in cell number), later growth increasingly reflecting cellular hypertrophy (increase in cell size) as gestation advances, and the greatest absolute weight gain occurring in the third trimester, a pattern with direct clinical relevance to the timing and interpretation of growth restriction, which affects different organ systems to differing degrees depending on precisely when in gestation it occurs.

Fill in the blank: The embryonic period, weeks three to eight of gestation, is when _____ occurs and the conceptus is most vulnerable to teratogenic insult. Early foetal growth predominantly reflects cellular _____, while later growth increasingly reflects cellular hypertrophy.

3.3.2 Placental function and foetal growth

The placenta is the principal determinant of foetal growth, mediating the exchange of oxygen, nutrients, and waste products between the maternal and foetal circulations, and producing hormones essential for the maintenance and support of pregnancy, meaning that adequate placental development and function, established progressively through the process of trophoblast invasion of the maternal spiral arteries in early pregnancy, is fundamental to normal foetal growth throughout gestation.

Placental insufficiency (inadequate placental function relative to foetal demand) is the leading cause of foetal growth restriction, typically arising from incomplete or abnormal trophoblast invasion in early pregnancy, resulting in reduced uteroplacental blood flow and impaired nutrient and oxygen transfer that becomes progressively more evident and clinically apparent as gestation advances and foetal metabolic demands increase relative to the placenta's constrained capacity to meet them.

Fill in the blank: The placenta mediates exchange of oxygen, nutrients, and waste products between the maternal and foetal _____. Placental insufficiency is the leading cause of foetal growth _____.

3.3.3 Assessment of foetal growth

Clinical assessment of foetal growth using symphysio-fundal height measurement at each antenatal visit provides a simple, low-cost screening tool, plotted against gestational age on a customised growth chart, though it has recognised limitations in accuracy, particularly in women who are obese or have a large fibroid uterus, meaning that ultrasound biometry remains the definitive method of assessment wherever growth restriction or excessive growth is genuinely suspected.

Ultrasound biometry measures several standard foetal parameters, including biparietal diameter, head circumference, abdominal circumference, and femur length, from which an estimated foetal weight is calculated and plotted on a growth chart relative to gestational age, with serial measurements over time, rather than a single isolated assessment, providing the most reliable information about the trajectory and adequacy of foetal growth throughout the remainder of the pregnancy.

Fill in the blank: Symphysio-fundal height measurement has recognised limitations in accuracy, particularly in women who are obese or have a large _____ uterus. Ultrasound biometry measures parameters including biparietal diameter, head circumference, abdominal circumference, and _____ length.

Stage / Parameter	Key Details
Pre-Embryonic Stage	0–2 weeks; fertilization, zygote formation, implantation.
Embryonic Stage	3–8 weeks; organogenesis, neural tube closure, limb bud formation.
Foetal Stage	9 weeks to birth; growth, maturation of organ systems, viability after 24 weeks.
Ultrasound Biometry Parameters	Crown–rump length (early dating), biparietal diameter, head circumference, abdominal circumference, femur length (growth and wellbeing assessment).

Box 3.3: Stages of intrauterine development and standard ultrasound biometry parameters.

Pilot questions 3.3

1. Describe the pre-embryonic, embryonic, and foetal periods of intrauterine development. (Linked to SLO 3.5)
2. Explain the pattern of cellular growth across gestation and its clinical relevance. (Linked to SLO 3.5)
3. Describe the role of the placenta in foetal growth. (Linked to SLO 3.5)
4. Explain the mechanism by which placental insufficiency causes foetal growth restriction. (Linked to SLO 3.5)
5. Compare symphysio-fundal height measurement and ultrasound biometry for assessing foetal growth. (Linked to SLO 3.5)

3.4 Antenatal and Intrapartum Foetal Assessment

3.4.1 Antenatal foetal surveillance

Maternal perception of foetal movement is a simple, accessible, and clinically valuable form of foetal surveillance available to every pregnant woman, with a persistent reduction in previously normal movement pattern warranting prompt clinical assessment, as it may represent an early warning sign of evolving foetal compromise that precedes other, more overt clinical findings, making clear counselling on this point an important part of routine antenatal education.

Cardiotocography (CTG) records the foetal heart rate pattern alongside uterine activity, assessed for baseline rate, variability, the presence of accelerations, and any decelerations, providing a more objective assessment of foetal wellbeing than movement counting alone, while the biophysical profile combines ultrasound assessment of foetal movement, tone, breathing movements, and amniotic fluid volume with cardiotocography, offering a more comprehensive picture in pregnancies where a single test result is equivocal or additional reassurance is required.

Fill in the blank: A persistent reduction in previously normal foetal movement pattern warrants prompt clinical _____. The biophysical profile combines ultrasound assessment with _____ (CTG).

3.4.2 Doppler assessment of foetal wellbeing

Umbilical artery Doppler assesses resistance to blood flow within the umbilical artery, with progressively abnormal waveforms, from raised resistance through absent end-diastolic flow to, in the most severe cases, reversed end-diastolic flow, reflecting progressively worsening placental insufficiency and an escalating risk of foetal compromise that directly informs decisions around the timing of delivery in a growth-restricted foetus.

Middle cerebral artery Doppler complements umbilical artery assessment by detecting the foetal cardiovascular adaptive response to hypoxia, termed brain-sparing, in which cerebral vascular resistance falls to preferentially maintain cerebral perfusion at the expense of other organs, a compensatory mechanism that itself becomes an important marker of foetal compromise once identified, particularly when interpreted together with umbilical artery findings rather than in isolation.

Fill in the blank: The most severe finding on umbilical artery Doppler, reflecting critical placental insufficiency, is reversed end-_____ flow. The foetal cardiovascular adaptation to hypoxia that preferentially maintains cerebral perfusion is termed brain-_____.

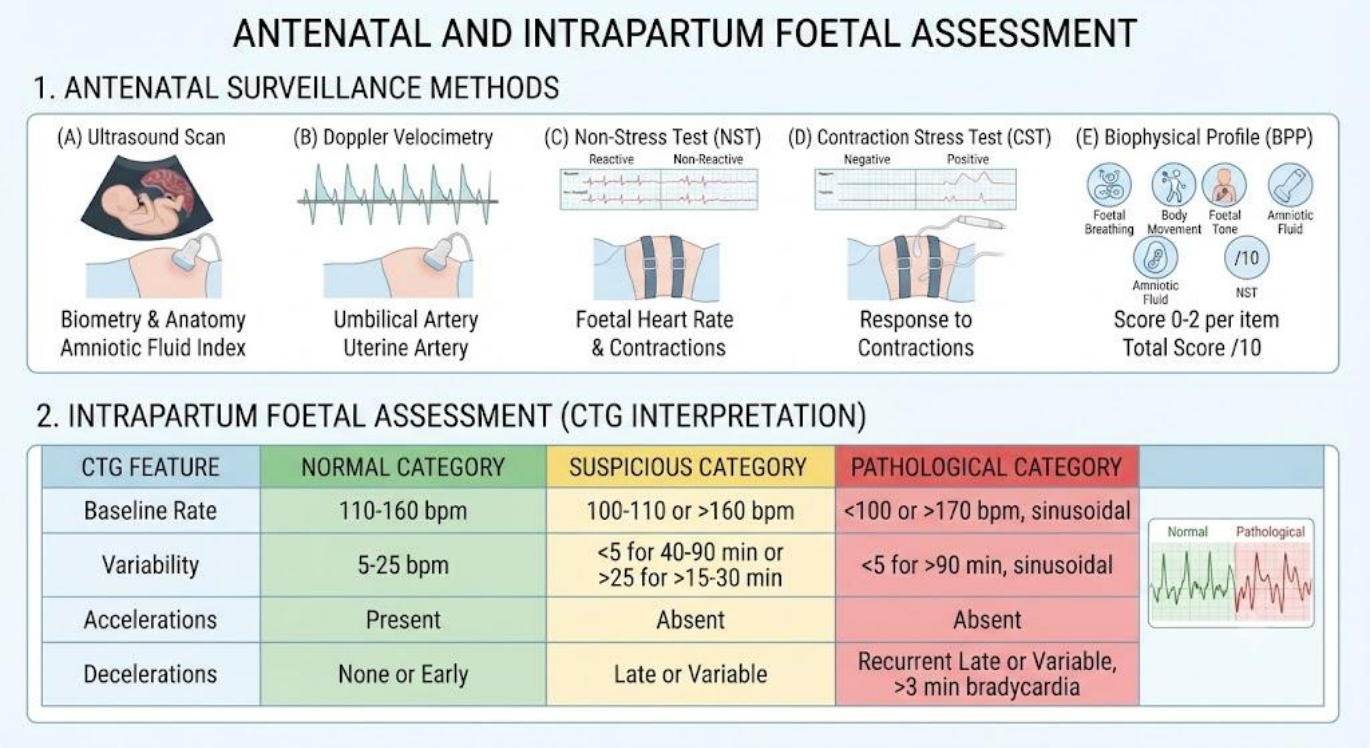
3.4.3 Intrapartum foetal assessment

Intrapartum foetal assessment monitors foetal wellbeing during the additional physiological stress of labour, using intermittent auscultation for low-risk labours (listening to the foetal heart at defined intervals, typically after a contraction) or continuous electronic foetal monitoring for

labours identified as higher risk, interpreting the CTG trace using a structured framework assessing baseline rate, variability, accelerations, and decelerations, alongside the pattern and frequency of uterine contractions.

Foetal blood sampling (measuring pH and, where available, lactate from a small sample taken from the foetal scalp) may be used to provide additional objective information when a CTG trace is classified as suspicious or pathological and delivery is not judged immediately necessary on clinical grounds alone, helping distinguish a foetus that is genuinely becoming acidotic and requiring expedited delivery from one that is tolerating labour well despite an atypical but not truly pathological trace.

Fill in the blank: Intermittent auscultation is used for foetal monitoring in _____-risk labours. Foetal blood sampling measures pH and, where available, _____ from a scalp sample to assess for acidosis.



CTG FEATURE	NORMAL CATEGORY	SUSPICIOUS CATEGORY	PATHOLOGICAL CATEGORY
Baseline Rate	110-160 bpm	100-110 or >160 bpm	<100 or >170 bpm, sinusoidal
Variability	5-25 bpm	<5 for 40-90 min or >25 for >15-30 min	<5 for >90 min, sinusoidal
Accelerations	Present	Absent	Absent
Decelerations	None or Early	Late or Variable	Recurrent Late or Variable, >3 min bradycardia

Figure 3.4: Methods of antenatal and intrapartum foetal assessment.

Pilot questions 3.4

1. Explain the clinical significance of reduced foetal movement. (Linked to SLO 3.6)
2. Describe the components of the biophysical profile. (Linked to SLO 3.6)
3. Describe the findings on umbilical artery Doppler and their clinical significance. (Linked to SLO 3.6)

4. Explain the concept of brain-sparing on middle cerebral artery Doppler. (Linked to SLO 3.6)
5. Describe the role of foetal blood sampling in intrapartum assessment. (Linked to SLO 3.6)

Series Summary

This Series has covered foetal lie, presentation, position, and attitude, together with engagement of the presenting part, followed by the maternal pelvis and the imaging modalities used in obstetric practice. It went on to examine foetal growth and development and the central role of the placenta, before concluding with the methods of antenatal and intrapartum foetal assessment, from movement counting and cardiotocography to Doppler studies and foetal blood sampling.

You should now be able to describe foetal lie, presentation, position, and attitude, explain engagement and its clinical assessment, describe the maternal pelvis and obstetric imaging, describe foetal growth and development, and describe the methods of antenatal and intrapartum foetal assessment (Linked to SLOs 3.1 to 3.6).

Glossary of Terms

1. **Attitude:** the relationship of the foetal head and limbs to the foetal trunk.
2. **Biophysical profile:** an assessment combining ultrasound evaluation of foetal movement, tone, and breathing with amniotic fluid volume and cardiotocography.
3. **Brain-sparing:** the foetal cardiovascular adaptation to hypoxia in which cerebral vascular resistance falls to preferentially maintain cerebral perfusion.
4. **Cardiotocography (CTG):** a recording of the foetal heart rate pattern alongside uterine activity.
5. **Cephalopelvic disproportion:** a mismatch between foetal head size and maternal pelvic dimensions sufficient to prevent safe vaginal delivery.
6. **Engagement:** the passage of the widest diameter of the foetal presenting part through the pelvic inlet.
7. **Foetal lie:** the relationship between the long axis of the foetus and the long axis of the maternal uterus.
8. **Foetal presentation:** the foetal part occupying the lower pole of the uterus that will present first at the pelvic inlet.
9. **Placental insufficiency:** inadequate placental function relative to foetal demand, the leading cause of foetal growth restriction.
10. **Trophoblast invasion:** the process by which placental trophoblast cells invade the maternal spiral arteries in early pregnancy, establishing placental blood supply.

11. **Umbilical artery Doppler:** an ultrasound investigation assessing resistance to blood flow in the umbilical artery, used to evaluate placental function.
12. **Ultrasound biometry:** the measurement of standard foetal parameters by ultrasound to estimate foetal weight and assess growth.

Concept Check Questions [Series 3]

Objective questions

- A foetal lie in which the foetal spine lies at right angles to the maternal spine is termed _____.
- A head two-fifths or less palpable abdominally is considered _____.
- Cephalopelvic disproportion is diagnosed principally on the basis of poor progress in _____.
- The leading cause of foetal growth restriction is placental _____.
- The most severe finding on umbilical artery Doppler is reversed end-_____ flow.

Short-answer questions

1. Describe foetal attitude and its effect on the presenting diameter of the foetal head. (Linked to SLO 3.1)
2. Explain how engagement differs between primigravid and multigravid women. (Linked to SLO 3.2)
3. Describe the role of Doppler ultrasound in obstetric assessment. (Linked to SLO 3.4)
4. Explain the mechanism by which placental insufficiency causes foetal growth restriction. (Linked to SLO 3.5)
5. Explain the concept of brain-sparing on middle cerebral artery Doppler. (Linked to SLO 3.6)

Long-answer questions

6. Describe foetal lie, presentation, position, and attitude, and the assessment of engagement. (Linked to SLO 3.1, SLO 3.2)
7. Describe the maternal pelvis and the imaging modalities used in obstetric practice. (Linked to SLO 3.3, SLO 3.4)
8. Describe the stages of foetal growth and development and the role of the placenta. (Linked to SLO 3.5)
9. Describe the methods of antenatal foetal surveillance. (Linked to SLO 3.6)
10. Describe the methods of intrapartum foetal assessment. (Linked to SLO 3.6)

Answers to Concept Check Questions [Series 3]

Objective questions

11. Transverse.
12. Engaged.
13. Labour.
14. Insufficiency.
15. Diastolic.

Short-answer questions

16. A well-flexed attitude presents the smallest diameter and favours labour; extension towards face or brow presentation increases the presenting diameter and difficulty.
17. Engagement typically occurs from 36 weeks in primigravidae, but often not until labour begins in multigravidae, making an unengaged head less concerning in this group.
18. Doppler assesses blood flow velocity in maternal and foetal vessels, providing information on placental function and foetal cardiovascular adaptation to insufficiency.
19. Incomplete trophoblast invasion reduces uteroplacental blood flow, impairing nutrient and oxygen transfer, becoming more apparent as foetal demand increases.
20. Cerebral vascular resistance falls to preferentially maintain cerebral perfusion during hypoxia, a compensatory mechanism itself indicating foetal compromise.

Long-answer questions

21. **Basic response:** Foetal lie, presentation, position, and attitude describe the foetal orientation within the uterus, with engagement assessed by abdominal palpation in fifths.

Value-added response: Engagement timing differs between primigravid and multigravid women, an important consideration when interpreting an unengaged head near term.

22. **Basic response:** The maternal pelvis has three planes the foetal head must negotiate, with cephalopelvic disproportion diagnosed by labour progress rather than measurement.

Value-added response: Ultrasound is the principal obstetric imaging modality, with MRI and radiography reserved for specific, more limited indications.

23. **Basic response:** Foetal growth passes through pre-embryonic, embryonic, and foetal periods, with the placenta the principal determinant of growth throughout gestation.

Value-added response: Placental insufficiency from abnormal trophoblast invasion is the leading cause of foetal growth restriction, becoming more apparent as gestation advances.

Answers to Pilot Questions [Series 3]

Part 3.1

1. Longitudinal, transverse, or oblique, describing the relationship between the foetal and maternal long axes.
2. Cephalic presentation is head first and normally the safest for vaginal birth; breech presentation is buttocks or feet first.
3. By the position of the occiput relative to landmarks on the maternal pelvis, such as occipito-anterior or occipito-posterior.
4. Attitude describes flexion of the head and limbs; a well-flexed attitude presents the smallest diameter, while extension increases the presenting diameter.
5. Engagement is assessed in fifths palpable abdominally; it occurs earlier (from 36 weeks) in primigravidae than in multigravidae, who often engage only in labour.

Part 3.2

6. The pelvic inlet, mid-cavity, and pelvic outlet, each with characteristic dimensions the foetal head must negotiate.
7. Antenatal pelvic measurement is a poor predictor of labour outcome, so diagnosis relies on observed progress despite adequate contractions.
8. Dating, structural anomaly screening, placental localisation, growth and wellbeing assessment, and guidance for invasive procedures.
9. It assesses blood flow velocity in maternal and foetal vessels, informing placental function and surveillance in higher-risk pregnancies.
10. Detailed characterisation of complex foetal anomalies, suspected placenta accreta spectrum, and specific maternal pelvimetry or soft tissue assessment.

Part 3.3

11. Pre-embryonic (implantation, first two weeks), embryonic (organogenesis, weeks three to eight), and foetal (growth and maturation, nine weeks to birth).
12. Early growth is predominantly cellular hyperplasia, later growth increasingly cellular hypertrophy, with greatest weight gain in the third trimester.
13. The placenta mediates exchange of oxygen, nutrients, and waste, and produces hormones essential for pregnancy maintenance.
14. Incomplete trophoblast invasion reduces uteroplacental blood flow, impairing nutrient and oxygen transfer to the growing foetus.
15. Symphysio-fundal height is simple but limited in accuracy; ultrasound biometry is definitive, especially with serial measurement over time.

Part 3.4

1. A persistent reduction may be an early warning sign of foetal compromise preceding other clinical findings, warranting prompt assessment.
2. Ultrasound assessment of foetal movement, tone, and breathing movements, combined with amniotic fluid volume and cardiotocography.

3. Progressively abnormal waveforms from raised resistance through absent to reversed end-diastolic flow reflect worsening placental insufficiency.
4. Cerebral vascular resistance falls to preferentially maintain cerebral perfusion during hypoxia, itself a marker of foetal compromise.
5. It measures pH and lactate from a foetal scalp sample to distinguish genuine acidosis from a non-pathological but atypical CTG trace.

References and Attributions [Series 3]

Textual References

1. Cunningham, F. G., Leveno, K. J., Dashe, J. S. et al. (2022). Williams Obstetrics (26th ed.). McGraw Hill.
2. Hoffman, B. L., Schorge, J. O., Halvorson, L. M. et al. (2020). Williams Gynecology (4th ed.). McGraw Hill.
3. National Institute for Health and Care Excellence (2022). Fetal Monitoring in Labour: NICE Guideline NG229. NICE.
4. International Society of Ultrasound in Obstetrics and Gynecology (2019). Practice Guidelines for Performing Fetal Biometry. Ultrasound in Obstetrics and Gynecology, 53(6), 715 to 723.

Figures, Plates, Tables, and Boxes

1. Figure 3.1: Foetal lie, presentation, and position at term. AI-generated using the prompt: "Create a professional medical diagram titled Foetal Lie, Presentation, and Position, showing lie types, presentation types, and occiput-based position terminology. Clean clinical educational diagram style."
2. Table 3.2: Comparison of imaging modalities used in obstetric practice. AI-generated using the prompt: "Create a clean reference table titled Imaging Modalities in Obstetric Practice, comparing ultrasound, Doppler, MRI, and radiography by use, advantage, and limitation. Simple clinical reference table style with outside border."
3. Box 3.3: Stages of intrauterine development and standard ultrasound biometry parameters. AI-generated using the prompt: "Create a simple single-column reference box with an outside border titled Stages of Intrauterine Development and Ultrasound Biometry, listing key stages and biometry parameters. Clinical reference box style."
4. Figure 3.4: Methods of antenatal and intrapartum foetal assessment. AI-generated using the prompt: "Create a professional medical diagram titled Antenatal and Intrapartum Foetal Assessment, showing surveillance methods and CTG interpretation categories. Clean clinical educational diagram style."

Series 4: Congenital Anomalies and Foetal Disorders

- **Part 4.1: Multiple Pregnancy**
    - Sub Part 4.1.1: Types and determination of chorionicity in multiple pregnancy
    - Sub Part 4.1.2: Complications of multiple pregnancy
    - Sub Part 4.1.3: Management of multiple pregnancy
- **Part 4.2: Disorders of Amniotic Fluid and Foetal Growth**
    - Sub Part 4.2.1: Polyhydramnios
    - Sub Part 4.2.2: Oligohydramnios
    - Sub Part 4.2.3: Foetal growth restriction
- **Part 4.3: Congenital Anomalies**
    - Sub Part 4.3.1: Classification and causes of congenital anomalies
    - Sub Part 4.3.2: Common structural congenital anomalies
    - Sub Part 4.3.3: Prenatal diagnosis and counselling
- **Part 4.4: Rhesus Isoimmunisation and Intrauterine Death**
    - Sub Part 4.4.1: Rhesus isoimmunisation
    - Sub Part 4.4.2: Management of rhesus disease
    - Sub Part 4.4.3: Intrauterine foetal death

Introduction

In the last Series, we explored foetal lie, growth, and the methods used to assess foetal wellbeing. We now turn to a Series that asks us to confront some of the most challenging scenarios in obstetric practice: pregnancies complicated by more than one foetus, disorders of amniotic fluid and growth, congenital anomaly, rhesus disease, and, at its most difficult, the death of a baby before birth. These topics test not only clinical knowledge but the compassion and communication skill required to support women and families through some of the most difficult moments they will ever face.

The aim of this Series is to equip you with the knowledge to recognise and manage multiple pregnancy, disorders of amniotic fluid and foetal growth, congenital anomalies, rhesus isoimmunisation, and intrauterine foetal death.

We shall commence this Series by examining multiple pregnancy, its types, complications, and management. Next, we will consider disorders of amniotic fluid and foetal growth, including polyhydramnios, oligohydramnios, and foetal growth restriction. Following that, our attention turns to congenital anomalies, their classification, common presentations, and the principles of prenatal diagnosis and counselling. Finally, we will conclude by examining rhesus isoimmunisation and intrauterine foetal death.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 4.1:** describe the types, complications, and management of multiple pregnancy,
- **SLO 4.2:** describe the causes, assessment, and management of polyhydramnios and oligohydramnios,
- **SLO 4.3:** describe the assessment and classification of foetal growth restriction,
- **SLO 4.4:** classify congenital anomalies and describe common structural anomalies,
- **SLO 4.5:** describe the principles of prenatal diagnosis and genetic counselling,
- **SLO 4.6:** describe the pathophysiology, prevention, and management of rhesus isoimmunisation, and
- **SLO 4.7:** describe the causes and management of intrauterine foetal death.

4.1 Multiple Pregnancy

4.1.1 Types and determination of chorionicity in multiple pregnancy

Multiple pregnancy arises either from fertilisation of two separate ova (dizygotic twins, always dichorionic and diamniotic, with each foetus having its own separate placenta and amniotic sac) or from division of a single fertilised ovum (monozygotic twins, in which chorionicity and amnionicity depend on precisely when the division occurs, ranging from dichorionic diamniotic if division occurs very early to the rare and higher-risk monochorionic monoamniotic pattern if division occurs later.

Chorionicity (the number of placentas) is the single most important determinant of the risk profile of a twin pregnancy, and is most accurately and reliably determined by ultrasound in the first trimester, using the presence or absence of the lambda sign (a triangular projection of placental tissue at the site where the dividing membrane meets the placenta, present in dichorionic and absent in monochorionic pregnancies) rather than at any later gestation, when this distinguishing sonographic feature becomes progressively more difficult to identify with confidence.

Fill in the blank: Dizygotic twins are always dichorionic and _____, each with a separate placenta and amniotic sac. Chorionicity is most accurately determined by ultrasound in the _____ trimester using the lambda sign.

4.1.2 Complications of multiple pregnancy

Multiple pregnancy carries substantially increased risk of almost every major obstetric complication compared with singleton pregnancy, including preterm birth (the leading cause of perinatal morbidity and mortality in twins, with monochorionic twins delivering earlier on average than dichorionic twins), hypertensive disorders, gestational diabetes, and postpartum haemorrhage, reflecting the combined effect of increased uterine distension, greater placental mass, and, in monochorionic pregnancies specifically, shared placental circulation.

Twin-to-twin transfusion syndrome (TTTS) is a complication unique to monochorionic twin pregnancies, resulting from unbalanced blood flow through shared placental vascular anastomoses, causing one twin (the donor) to become progressively volume-depleted with oligohydramnios while the other (the recipient) becomes volume-overloaded with polyhydramnios, a condition requiring specialist referral and, in significant cases, laser ablation of the causative anastomoses to achieve the best chance of survival for both twins.

Fill in the blank: The leading cause of perinatal morbidity and mortality in twin pregnancy is _____ birth. Twin-to-twin transfusion syndrome is unique to _____ twin pregnancies.

4.1.3 Management of multiple pregnancy

Antenatal management of multiple pregnancy involves more frequent surveillance than for a singleton pregnancy, with the specific schedule determined by chorionicity, monochorionic pregnancies requiring more intensive ultrasound surveillance (typically fortnightly from around 16 weeks) specifically to detect twin-to-twin transfusion syndrome at the earliest possible stage, when intervention offers the greatest chance of a good outcome for both twins.

Decisions around timing and mode of delivery in multiple pregnancy are individualised according to chorionicity, presentation of the leading twin, and any complicating factors identified during pregnancy, with uncomplicated dichorionic twin pregnancy generally delivered somewhat earlier than a singleton pregnancy, and vaginal delivery a reasonable option when the leading twin presents cephalically, though the decision ultimately requires careful, individualised discussion between the woman and her obstetric team.

Fill in the blank: Monochorionic twin pregnancies typically require ultrasound surveillance _____ from around 16 weeks. The mode of delivery in twin pregnancy depends substantially on the presentation of the _____ twin.

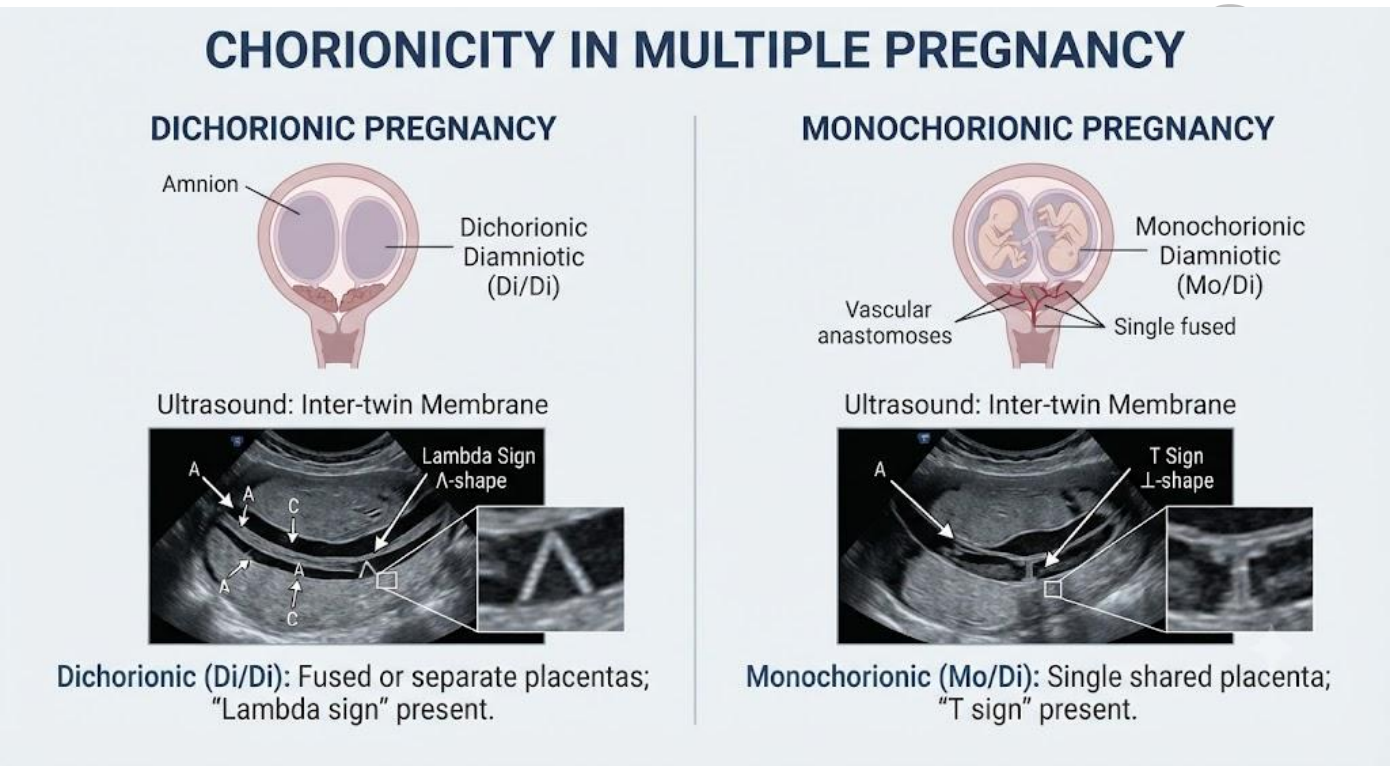


Figure 4.1: Chorionicity patterns in multiple pregnancy and their ultrasound identification.

Pilot questions 4.1

- Describe the origin and chorionicity of dizygotic and monozygotic twins. (Linked to SLO 4.1)
- Explain how chorionicity is determined by ultrasound and why timing matters. (Linked to SLO 4.1)
- Describe the complications associated with multiple pregnancy. (Linked to SLO 4.1)
- Describe the pathophysiology of twin-to-twin transfusion syndrome. (Linked to SLO 4.1)
- Describe the principles of antenatal surveillance and delivery planning in multiple pregnancy. (Linked to SLO 4.1)

4.2 Disorders of Amniotic Fluid and Foetal Growth

4.2.1 Polyhydramnios

Polyhydramnios is an excess of amniotic fluid, most commonly idiopathic but with recognised causes including maternal diabetes (from foetal polyuria driven by maternal hyperglycaemia), foetal structural anomalies that impair swallowing (such as oesophageal atresia or anencephaly, given that foetal swallowing of amniotic fluid is a principal route of its removal), and multiple pregnancy, particularly the recipient twin in twin-to-twin transfusion syndrome.

Clinical assessment is by ultrasound measurement of the amniotic fluid index or single deepest pocket, with management guided by severity and underlying cause: mild, idiopathic polyhydramnios is usually managed with reassurance and increased surveillance, while more severe cases may require investigation for an underlying cause, and, in symptomatic women with significant maternal discomfort or breathlessness, therapeutic amnioreduction to relieve symptoms.

Fill in the blank: Polyhydramnios may result from foetal anomalies that impair _____, given that this is a principal route of amniotic fluid removal. Polyhydramnios is assessed by ultrasound measurement of the amniotic fluid index or single deepest _____.

4.2.2 Oligohydramnios

Oligohydramnios is a deficiency of amniotic fluid, commonly resulting from placental insufficiency (reduced foetal renal perfusion leading to reduced urine output, the principal source of amniotic fluid in later pregnancy), premature rupture of membranes, foetal renal or urinary tract anomalies impairing urine production, and post-term pregnancy, reflecting the progressive physiological decline in amniotic fluid volume that normally occurs as pregnancy advances beyond term.

Severe, early-onset oligohydramnios carries particular risk of pulmonary hypoplasia, as adequate amniotic fluid volume is essential for normal foetal lung development, alongside limb deformity from prolonged mechanical compression in a reduced fluid environment, together known as Potter sequence when caused by severe, early bilateral renal agenesis, underscoring why the underlying cause and gestational timing of oligohydramnios both critically determine the overall prognosis.

Fill in the blank: Oligohydramnios commonly results from placental insufficiency, reducing foetal renal perfusion and therefore _____ output. Severe early-onset oligohydramnios carries particular risk of pulmonary _____.

4.2.3 Foetal growth restriction

Foetal growth restriction (FGR) describes a foetus failing to reach its genetically determined growth potential, distinguished from a constitutionally small-for-gestational-age foetus (small but appropriately grown and not at increased risk) principally on the basis of Doppler findings, growth trajectory over serial measurements, and amniotic fluid volume, rather than estimated foetal weight considered in isolation at a single point in time.

Early-onset FGR (before 32 weeks, typically from severe placental insufficiency) tends to follow a more predictable, gradually deteriorating pattern of Doppler and biophysical changes, while late-onset FGR (after 32 weeks, often from milder, more subtle placental dysfunction) may present with more limited or absent Doppler abnormality despite clinically significant growth restriction, making its detection and management considerably more diagnostically challenging in clinical practice.

Fill in the blank: Foetal growth restriction is distinguished from a constitutionally small foetus principally on the basis of _____ findings and growth trajectory. Early-onset FGR, occurring before _____ weeks, typically results from severe placental insufficiency.

Condition	Principal Causes	Key Diagnostic Findings	Associated Risks
Polyhydramnios	Maternal diabetes, fetal anomalies (e.g., GI obstruction, anencephaly), idiopathic	Excess amniotic fluid on ultrasound (AFI > 24 cm or deepest pocket > 8 cm)	Preterm labour, malpresentation, cord prolapse, postpartum haemorrhage
Oligohydramnios	Placental insufficiency, ruptured membranes, fetal renal anomalies	Reduced amniotic fluid (AFI < 5 cm or deepest pocket < 2 cm)	Fetal distress, pulmonary hypoplasia, skeletal deformities, cord compression
Foetal Growth Restriction (FGR)	Uteroplacental insufficiency, maternal hypertension, smoking, infections	Estimated fetal weight <10th percentile, abnormal Doppler findings	Stillbirth, neonatal morbidity, long-term developmental delay

Table 4.2: Comparison of polyhydramnios, oligohydramnios, and foetal growth restriction.

Pilot questions 4.2

1. Describe the causes of polyhydramnios. (Linked to SLO 4.2)
2. Describe the assessment and management of polyhydramnios. (Linked to SLO 4.2)
3. Describe the causes of oligohydramnios. (Linked to SLO 4.2)
4. Explain the risks associated with severe early-onset oligohydramnios. (Linked to SLO 4.2)
5. Distinguish foetal growth restriction from a constitutionally small-for-gestational-age foetus. (Linked to SLO 4.3)

4.3 Congenital Anomalies

4.3.1 Classification and causes of congenital anomalies

Congenital anomalies are broadly classified by cause as chromosomal (such as trisomy 21, resulting from an abnormal number of chromosomes), single-gene disorders (following recognised Mendelian inheritance patterns), multifactorial (resulting from the combined effect of multiple genetic and environmental factors, such as most neural tube defects), and teratogenic (resulting from a specific harmful environmental exposure during a vulnerable period of development, such as certain medications, infections, or maternal illness).

Most congenital anomalies are in fact multifactorial in origin, reflecting the combined contribution of genetic predisposition and environmental factors such as maternal nutrition, folate status, and specific exposures during the vulnerable embryonic period, and it is precisely this multifactorial group that population-level interventions such as folic acid fortification of staple foods are specifically designed to address, aiming to reduce anomaly incidence at a whole-population level rather than through individual case-by-case risk assessment.

Fill in the blank: Congenital anomalies are broadly classified as chromosomal, single-gene, _____, and teratogenic. Most congenital anomalies are _____ in origin, reflecting combined genetic and environmental contribution.

4.3.2 Common structural congenital anomalies

Neural tube defects (including anencephaly and spina bifida) result from failure of complete closure of the neural tube in early embryonic development, a process substantially preventable through adequate periconceptional folic acid supplementation, while congenital heart defects, the most common category of major congenital anomaly overall, range widely in severity from small, clinically insignificant septal defects to complex anomalies requiring staged surgical correction in the neonatal period.

Other commonly encountered structural anomalies include cleft lip and palate (resulting from incomplete fusion of the facial processes during early development), abdominal wall defects such as gastroschisis and exomphalos (each with distinct anatomical features, associations, and prognosis), and urinary tract anomalies, many of which are now routinely detected on the second-trimester anomaly scan, allowing appropriate antenatal counselling, planning, and, where indicated, referral to a specialist foetal medicine centre for further assessment.

Fill in the blank: Neural tube defects are substantially preventable through adequate periconceptional _____ supplementation. Congenital heart defects are the most common category of major congenital _____ overall.

4.3.3 Prenatal diagnosis and counselling

Prenatal diagnosis combines screening tests (such as combined first-trimester screening or the anomaly scan, which estimate risk without providing a definitive diagnosis) with diagnostic tests

(chorionic villus sampling or amniocentesis, which provide a definitive genetic diagnosis but carry a small procedure-related risk of miscarriage), with the choice between screening and diagnostic testing, and the specific test selected, guided by the woman's individual risk, gestational age, and personal preference.

Genetic and prenatal counselling following an abnormal screening or diagnostic result requires sensitive, accurate, non-directive communication of the diagnosis, its likely implications, and the full range of available options, delivered by an appropriately trained counsellor or clinician, always respecting the woman and her partner's own values, cultural context, and ultimate autonomy in the difficult decisions that so often follow such a finding.

Fill in the blank: Screening tests estimate risk without providing a definitive diagnosis, unlike diagnostic tests such as chorionic villus sampling or _____. Genetic counselling should be sensitive, accurate, and _____, respecting the woman's own values and autonomy.

Category / Test	Key Details & Example
Chromosomal Anomalies	Abnormal number or structure of chromosomes; e.g., Trisomy 21 (Down syndrome).
Single-Gene Disorders	Mutation in one gene; e.g., Cystic fibrosis.
Multifactorial Anomalies	Interaction of genetic and environmental factors; e.g., Neural tube defects.
Teratogenic Anomalies	Result from exposure to harmful agents; e.g., Fetal alcohol syndrome.
Screening Tests	Non-invasive, population-based; e.g., ultrasound, maternal serum screening.
Diagnostic Tests	Definitive, invasive; e.g., amniocentesis, chorionic villus sampling.

Box 4.3: Classification of congenital anomalies and screening versus diagnostic prenatal testing.

Pilot questions 4.3

1. Describe the classification of congenital anomalies by cause. (Linked to SLO 4.4)
2. Explain why most congenital anomalies are considered multifactorial in origin. (Linked to SLO 4.4)
3. Describe neural tube defects and their prevention. (Linked to SLO 4.4)
4. Distinguish screening from diagnostic prenatal tests. (Linked to SLO 4.5)
5. Describe the principles of genetic counselling following an abnormal prenatal test result. (Linked to SLO 4.5)

4.4 Rhesus Isoimmunisation and Intrauterine Death

4.4.1 Rhesus isoimmunisation

Rhesus isoimmunisation occurs when a rhesus-negative woman is exposed to rhesus-positive foetal red blood cells, most commonly at delivery but also through any sensitising event during pregnancy such as miscarriage, invasive testing, or antepartum haemorrhage, prompting maternal production of anti-D antibodies that, in a subsequent rhesus-positive pregnancy, can cross the placenta and cause progressive destruction of foetal red blood cells, a condition known as haemolytic disease of the foetus and newborn.

Sensitisation is now largely preventable through routine antenatal anti-D prophylaxis given at defined points in pregnancy to all rhesus-negative women, alongside additional doses given after any recognised potentially sensitising event, a public health intervention that has dramatically reduced the incidence of severe rhesus disease in settings where it has been consistently and reliably implemented across the antenatal population.

Fill in the blank: Rhesus isoimmunisation prompts maternal production of anti-_____ antibodies. Sensitisation is now largely preventable through routine antenatal _____ prophylaxis.

4.4.2 Management of rhesus disease

Once sensitisation has occurred in a subsequent pregnancy, surveillance focuses on middle cerebral artery Doppler, with a raised peak systolic velocity indicating foetal anaemia significant enough to warrant further investigation and, where appropriate, intervention, an approach that has largely replaced the previously used but more invasive method of serial amniocentesis for bilirubin estimation, offering a safer, non-invasive means of monitoring for the development of significant foetal anaemia.

Intrauterine transfusion (delivering compatible red blood cells directly into the foetal circulation, typically via the umbilical vein under ultrasound guidance) is the definitive treatment for significant foetal anaemia identified before a gestation at which delivery would itself be considered a safer alternative, requiring specialist foetal medicine expertise and, once affected significantly, often repeated procedures throughout the remainder of the affected pregnancy.

Fill in the blank: A raised peak systolic velocity on middle cerebral artery Doppler indicates significant foetal _____. Intrauterine transfusion delivers compatible red blood cells directly into the foetal circulation, typically via the umbilical _____.

4.4.3 Intrauterine foetal death

Intrauterine foetal death (stillbirth) is defined, according to gestational age thresholds that vary somewhat by country and organisation, as the death of a foetus after a specified gestational age (commonly 20 to 28 weeks depending on the definition used) before birth, with causes

including placental insufficiency, congenital anomaly, infection, cord accident, and, in a significant proportion of cases despite thorough investigation, no cause ultimately identified.

Management following diagnosis focuses on sensitive communication of the diagnosis, offering choices around the timing and mode of delivery wherever the woman's condition allows genuine choice, appropriate investigation to identify a cause where possible (including postmortem examination, placental histology, and relevant maternal and foetal testing with informed consent), and comprehensive bereavement support extending well beyond the immediate delivery, recognising the profound and lasting grief that follows this devastating outcome for the woman and her family.

Fill in the blank: Intrauterine foetal death is defined as death of a foetus after a specified gestational age, commonly between _____ and 28 weeks depending on the definition used. Management following stillbirth includes comprehensive _____ support extending well beyond the immediate delivery.

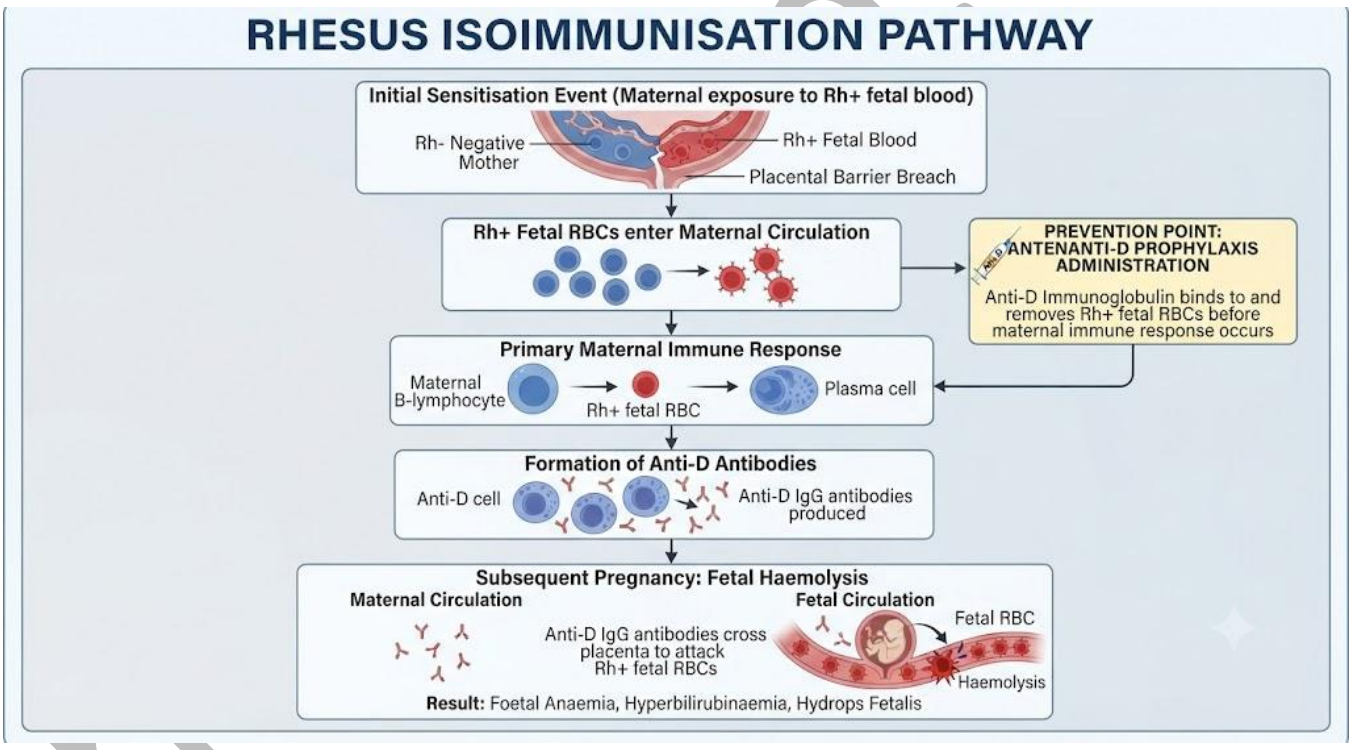


Figure 4.4: Pathway of rhesus isoimmunisation and the point of interruption by anti-D prophylaxis.

Pilot questions 4.4

1. Describe the mechanism of rhesus isoimmunisation and haemolytic disease of the foetus and newborn. (Linked to SLO 4.6)
2. Describe the role of anti-D prophylaxis in preventing rhesus sensitisation. (Linked to SLO 4.6)

3. Describe the surveillance and management of a sensitised rhesus-negative pregnancy. (Linked to SLO 4.6)
4. Describe the causes of intrauterine foetal death. (Linked to SLO 4.7)
5. Describe the principles of management following a diagnosis of intrauterine foetal death. (Linked to SLO 4.7)

Series Summary

This Series has covered multiple pregnancy, its types, complications, and management, followed by disorders of amniotic fluid and foetal growth, including polyhydramnios, oligohydramnios, and foetal growth restriction. It went on to examine congenital anomalies, their classification, common presentations, and the principles of prenatal diagnosis and counselling, before concluding with rhesus isoimmunisation and intrauterine foetal death.

You should now be able to describe the types, complications, and management of multiple pregnancy, describe the causes and management of polyhydramnios, oligohydramnios, and foetal growth restriction, classify congenital anomalies and describe prenatal diagnosis, and describe the pathophysiology and management of rhesus isoimmunisation and intrauterine foetal death (Linked to SLOs 4.1 to 4.7).

Glossary of Terms

1. **Chorionicity:** the number of placentas in a multiple pregnancy, the most important determinant of its risk profile.
2. **Haemolytic disease of the foetus and newborn:** destruction of foetal red blood cells caused by maternal antibodies crossing the placenta, most commonly from rhesus isoimmunisation.
3. **Intrauterine foetal death (stillbirth):** the death of a foetus after a specified gestational age before birth.
4. **Intrauterine transfusion:** delivery of compatible red blood cells directly into the foetal circulation, the definitive treatment for significant foetal anaemia.
5. **Lambda sign:** a sonographic finding indicating dichorionic twin pregnancy, seen at the site where the dividing membrane meets the placenta.
6. **Oligohydramnios:** a deficiency of amniotic fluid.
7. **Polyhydramnios:** an excess of amniotic fluid.
8. **Prenatal diagnosis:** the combination of screening and diagnostic tests used to identify congenital anomalies before birth.
9. **Sensitising event:** an episode during pregnancy, such as antepartum haemorrhage or miscarriage, that may expose a rhesus-negative woman to foetal red blood cells.
10. **Small-for-gestational-age:** a foetus that is small but appropriately grown and not at increased risk, distinguished from foetal growth restriction.

11. **Twin-to-twin transfusion syndrome:** unbalanced blood flow through shared placental vascular anastomoses in monochorionic twin pregnancy.
12. **Neural tube defect:** a congenital anomaly resulting from failure of complete closure of the neural tube in early embryonic development.

Concept Check Questions [Series 4]

Objective questions

- Dizygotic twins are always dichorionic and _____.
- The leading cause of perinatal morbidity and mortality in twin pregnancy is _____ birth.
- Foetal growth restriction is distinguished from a constitutionally small foetus principally on the basis of _____ findings.
- Most congenital anomalies are _____ in origin, reflecting combined genetic and environmental contribution.
- Rhesus isoimmunisation prompts maternal production of anti-_____ antibodies.

Short-answer questions

1. Describe the pathophysiology of twin-to-twin transfusion syndrome. (Linked to SLO 4.1)
2. Explain the risks associated with severe early-onset oligohydramnios. (Linked to SLO 4.2)
3. Distinguish screening from diagnostic prenatal tests. (Linked to SLO 4.5)
4. Describe the role of anti-D prophylaxis in preventing rhesus sensitisation. (Linked to SLO 4.6)
5. Describe the causes of intrauterine foetal death. (Linked to SLO 4.7)

Long-answer questions

6. Describe the types, complications, and management of multiple pregnancy. (Linked to SLO 4.1)

7. Describe the causes, assessment, and management of polyhydramnios and oligohydramnios. (Linked to SLO 4.2)
8. Describe the classification of congenital anomalies and the principles of prenatal diagnosis. (Linked to SLO 4.4, SLO 4.5)
9. Describe the pathophysiology and management of rhesus isoimmunisation. (Linked to SLO 4.6)
10. Describe the causes and management of intrauterine foetal death. (Linked to SLO 4.7)

Answers to Concept Check Questions [Series 4]

Objective questions

11. Diamniotic.
12. Preterm.
13. Doppler.
14. Multifactorial.
15. D.

Short-answer questions

16. Unbalanced blood flow through shared placental anastomoses causes the donor twin to become volume-depleted and the recipient volume-overloaded.
17. Pulmonary hypoplasia from impaired lung development, and limb deformity from prolonged mechanical compression, together termed Potter sequence if from renal agenesis.
18. Screening tests estimate risk without a definitive diagnosis; diagnostic tests provide a definitive genetic diagnosis but carry a small miscarriage risk.
19. Routine antenatal anti-D prophylaxis at defined points in pregnancy, plus additional doses after any recognised sensitising event, prevents antibody formation.
20. Placental insufficiency, congenital anomaly, infection, cord accident, and, in a significant proportion of cases, no cause identified despite investigation.

Long-answer questions

21. **Basic response:** Multiple pregnancy is classified by chorionicity, determined by first-trimester ultrasound, and carries increased risk of preterm birth and other complications.

Value-added response: Monochorionic pregnancies require more intensive surveillance to detect twin-to-twin transfusion syndrome, a complication unique to shared placental circulation.

22. **Basic response:** Polyhydramnios and oligohydramnios have distinct causes related to foetal swallowing and urine production respectively, assessed by ultrasound fluid measurement.

Value-added response: Severe early-onset oligohydramnios carries particular risk of pulmonary hypoplasia, reflecting the essential role of amniotic fluid in normal lung development.

23. **Basic response:** Congenital anomalies are classified as chromosomal, single-gene, multifactorial, or teratogenic, with prenatal diagnosis combining screening and diagnostic testing.

Value-added response: Genetic counselling should be sensitive, accurate, and non-directive, respecting the woman and her partner's own values and autonomy in decision-making.

Answers to Pilot Questions [Series 4]

Part 4.1

1. Dizygotic twins arise from two ova, always dichorionic diamniotic; monozygotic twins arise from one ovum, with chorionicity depending on timing of division.
2. By ultrasound in the first trimester using the lambda sign; this distinguishing feature becomes harder to identify with confidence at later gestation.
3. Preterm birth, hypertensive disorders, gestational diabetes, and postpartum haemorrhage, all increased compared with singleton pregnancy.
4. Unbalanced blood flow through shared placental anastomoses causes donor twin volume depletion and recipient twin volume overload.

5. More frequent surveillance determined by chorionicity, with delivery timing and mode individualised according to chorionicity and presentation.

Part 4.2

6. Idiopathic causes, maternal diabetes, foetal anomalies impairing swallowing, and multiple pregnancy, particularly the TTTS recipient twin.
7. Assessed by ultrasound amniotic fluid index or deepest pocket; mild cases are managed with reassurance, severe cases may need amnioreduction.
8. Placental insufficiency reducing foetal urine output, premature rupture of membranes, foetal renal anomalies, and post-term pregnancy.
9. Pulmonary hypoplasia from impaired lung development and limb deformity from mechanical compression, together termed Potter sequence.
10. FGR reflects failure to reach genetic growth potential, distinguished by Doppler and growth trajectory; SGA is small but appropriately grown.

Part 4.3

11. Chromosomal, single-gene, multifactorial, and teratogenic causes, according to the underlying mechanism of the anomaly.
12. Most reflect combined genetic predisposition and environmental factors such as maternal nutrition and folate status.
13. Failure of complete neural tube closure, substantially preventable through adequate periconceptional folic acid supplementation.
14. Screening estimates risk without a definitive diagnosis; diagnostic testing (CVS or amniocentesis) provides a definitive result with a small miscarriage risk.
15. Sensitive, accurate, non-directive communication respecting the woman and her partner's own values and autonomy in decision-making.

Part 4.4

1. Exposure to rhesus-positive foetal cells prompts maternal anti-D antibody production, which crosses the placenta and destroys foetal red cells in a subsequent pregnancy.
2. Routine antenatal prophylaxis at defined points plus additional doses after sensitising events prevents antibody formation in most cases.
3. Middle cerebral artery Doppler surveillance for foetal anaemia, with intrauterine transfusion as definitive treatment where significant anaemia is identified.
4. Placental insufficiency, congenital anomaly, infection, cord accident, and, in many cases, no cause identified despite investigation.
5. Sensitive communication, informed choice around delivery, appropriate investigation for cause, and comprehensive bereavement support.

References and Attributions [Series 4]

Textual References

1. Cunningham, F. G., Leveno, K. J., Dashe, J. S. et al. (2022). Williams Obstetrics (26th ed.). McGraw Hill.
2. National Institute for Health and Care Excellence (2019). Twin and Triplet Pregnancy: NICE Guideline NG137. NICE.
3. Royal College of Obstetricians and Gynaecologists (2016). Green-top Guideline No. 31: The Investigation and Management of the Small-for-Gestational-Age Fetus. RCOG Press.
4. British Committee for Standards in Haematology (2014). Guidelines for the Use of Prophylactic Anti-D Immunoglobulin. British Journal of Haematology, 176(4), 522 to 542.

Figures, Plates, Tables, and Boxes

1. Figure 4.1: Chorionicity patterns in multiple pregnancy and their ultrasound identification. AI-generated using the prompt: "Create a professional medical diagram titled Chorionicity in Multiple Pregnancy, showing dichorionic and monochorionic configurations with the lambda and T sign ultrasound findings. Clean clinical educational diagram style."
2. Table 4.2: Comparison of polyhydramnios, oligohydramnios, and foetal growth restriction. AI-generated using the prompt: "Create a clean reference table titled Polyhydramnios, Oligohydramnios, and Foetal Growth Restriction, comparing causes, diagnostic findings, and risks. Simple clinical reference table style with outside border."
3. Box 4.3: Classification of congenital anomalies and screening versus diagnostic prenatal testing. AI-generated using the prompt: "Create a simple single-column reference box with an outside border titled Congenital Anomaly Classification and Prenatal Testing, listing anomaly categories and test types. Clinical reference box style."
4. Figure 4.4: Pathway of rhesus isoimmunisation and the point of interruption by anti-D prophylaxis. AI-generated using the prompt: "Create a professional medical diagram titled Rhesus Isoimmunisation Pathway, showing the sequence from sensitising event to foetal haemolysis, with the anti-D prophylaxis prevention point marked. Clean clinical educational diagram style."

Series 5: Labour, Newborn Care and Complications

- **Part 5.1: Normal Labour**
    - Sub Part 5.1.1: Stages and mechanism of normal labour
    - Sub Part 5.1.2: Monitoring progress of labour (partograph)
    - Sub Part 5.1.3: Management of the third stage of labour
- **Part 5.2: Abnormal and Operative Labour**
    - Sub Part 5.2.1: Prolonged and obstructed labour
    - Sub Part 5.2.2: Induction and augmentation of labour
    - Sub Part 5.2.3: Instrumental and operative delivery
- **Part 5.3: Immediate Newborn Care and Assessment**
    - Sub Part 5.3.1: Immediate care of the newborn at birth
    - Sub Part 5.3.2: Neonatal resuscitation
    - Sub Part 5.3.3: Newborn examination and Apgar scoring
- **Part 5.4: Obstetric Emergencies and Complications**
    - Sub Part 5.4.1: Postpartum haemorrhage
    - Sub Part 5.4.2: Shoulder dystocia and cord prolapse
    - Sub Part 5.4.3: Other peripartum emergencies

Introduction

In the last Series, we explored congenital anomalies and foetal disorders. We conclude this course, and this journey through Antenatal Care and Foetal Medicine, at the moment all of that antenatal preparation has been building towards: labour itself, the arrival of the newborn, and the emergencies that can arise in these final, intense hours. Few moments in medicine demand the combination of calm, structured knowledge and rapid, decisive action quite like the delivery room, and this Series aims to prepare you for exactly that.

The aim of this Series is to equip you with a thorough understanding of normal and abnormal labour, immediate newborn care and resuscitation, and the recognition and management of the major obstetric emergencies.

We shall commence this Series by examining normal labour, its stages, mechanism, and monitoring using the partograph, together with management of the third stage. Next, we will consider abnormal and operative labour, including prolonged and obstructed labour, induction, augmentation, and instrumental delivery. Following that, our attention turns to immediate newborn care, neonatal resuscitation, and newborn assessment. Finally, we will conclude by examining the major obstetric emergencies, bringing this course to a close.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 5.1:** describe the stages and mechanism of normal labour,
- **SLO 5.2:** describe how to monitor the progress of labour using the partograph,
- **SLO 5.3:** describe the management of the third stage of labour,
- **SLO 5.4:** describe the causes and management of abnormal and operative labour,
- **SLO 5.5:** describe immediate newborn care and the principles of neonatal resuscitation,
- **SLO 5.6:** describe newborn assessment, including Apgar scoring and the routine examination, and
- **SLO 5.7:** describe the recognition and management of the major obstetric emergencies.

5.1 Normal Labour

5.1.1 Stages and mechanism of normal labour

Labour is divided into three stages: the first stage, from the onset of regular, painful contractions to full cervical dilatation (itself subdivided into a slower latent phase and a faster active phase), the second stage, from full dilatation to delivery of the baby, and the third stage, from delivery of the baby to delivery of the placenta and membranes, each with distinct physiological features and expected duration that guide the assessment of normal progress.

The mechanism of normal labour describes the sequence of positional changes the foetus undergoes as it negotiates the maternal pelvis, comprising engagement, descent, flexion, internal rotation, extension (as the head delivers), restitution and external rotation (as the shoulders rotate

into the anteroposterior diameter of the pelvis), and finally delivery of the shoulders and body, each step reflecting the foetal head and body adapting to the changing dimensions of the successive pelvic planes it must pass through.

Fill in the blank: The first stage of labour is subdivided into a slower latent phase and a faster _____ phase. The mechanism of labour includes engagement, descent, flexion, internal rotation, and _____.

5.1.2 Monitoring progress of labour (partograph)

The partograph is a standardised graphical tool used to monitor the progress of labour, plotting cervical dilatation against time alongside maternal and foetal observations, including foetal heart rate, contraction frequency and duration, maternal vital signs, and, where relevant, descent of the presenting part, providing an at-a-glance visual record that allows early, objective recognition of labour deviating from an expected normal pattern.

The alert and action lines plotted on the partograph provide a structured, standardised threshold for escalating concern and intervention when cervical dilatation crosses the expected trajectory, with crossing of the alert line prompting closer observation and consideration of the underlying cause of slow progress, and crossing of the action line prompting active intervention, such as augmentation of contractions or, where appropriate, expedited delivery, making the partograph a genuinely central tool in the safe, systematic conduct of labour.

Fill in the blank: The partograph plots cervical dilatation against _____, alongside maternal and foetal observations. Crossing the _____ line on the partograph prompts active intervention such as augmentation or expedited delivery.

5.1.3 Management of the third stage of labour

Active management of the third stage of labour (comprising prophylactic administration of a uterotonic agent, typically oxytocin, immediately after delivery of the baby, controlled cord traction, and early cord clamping and cutting, though the latter is now often delayed briefly to allow placental transfusion) has been shown to substantially reduce the risk of postpartum haemorrhage compared with expectant, physiological management, and is now the recommended standard approach in the great majority of deliveries.

Following delivery of the placenta it should be carefully examined for completeness, as retained placental tissue is a recognised cause of both immediate and delayed postpartum haemorrhage, alongside inspection of the maternal genital tract for any tear requiring repair, with the mother's uterine tone and vaginal blood loss monitored closely in the immediate period following delivery, when the risk of postpartum haemorrhage remains highest.

Fill in the blank: Active management of the third stage includes prophylactic administration of a _____ agent immediately after delivery. Following delivery, the placenta should be carefully examined for _____ to exclude retained tissue.

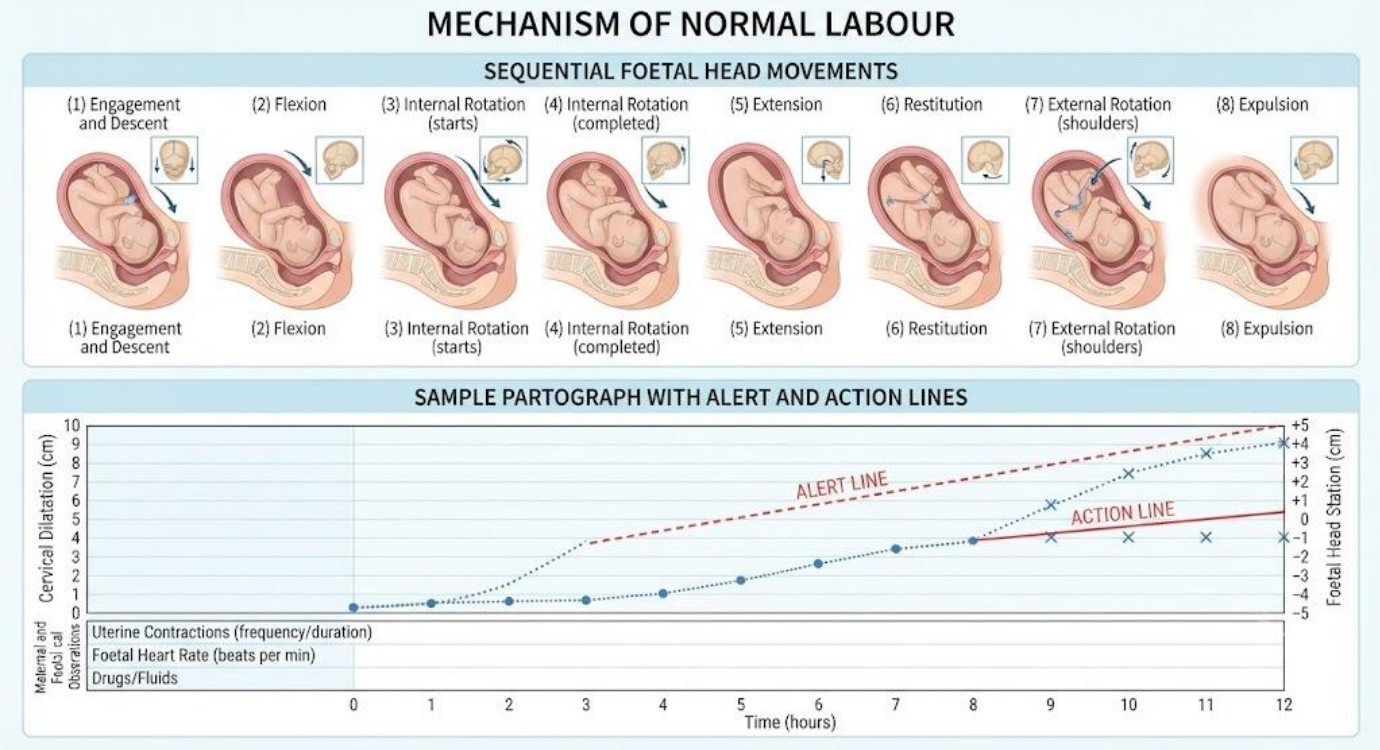


Figure 5.1: Mechanism of normal labour and the partograph alert and action lines.

Pilot questions 5.1

- Describe the three stages of labour. (Linked to SLO 5.1)
- Describe the mechanism of normal labour. (Linked to SLO 5.1)
- Describe the purpose and components of the partograph. (Linked to SLO 5.2)
- Explain the significance of the alert and action lines on the partograph. (Linked to SLO 5.2)
- Describe active management of the third stage of labour and its benefits. (Linked to SLO 5.3)

5.2 Abnormal and Operative Labour

5.2.1 Prolonged and obstructed labour

Prolonged labour refers to labour progressing more slowly than expected, most commonly from inefficient uterine contractions, malposition or malpresentation of the foetus, or cephalopelvic disproportion, identified through careful partograph monitoring, while obstructed labour describes a more severe situation in which mechanical obstruction genuinely prevents any further

descent of the presenting part despite strong uterine contractions, a serious obstetric emergency if not promptly recognised and appropriately managed.

Untreated obstructed labour carries substantial risk of serious maternal and foetal complications, including uterine rupture, obstetric fistula formation from prolonged pressure necrosis of adjacent tissues, and foetal death, complications that remain tragically common in settings with limited access to timely emergency obstetric care, underscoring why early recognition of poor labour progress and timely escalation to appropriate intervention represents such a genuinely life-saving clinical skill.

Fill in the blank: Obstructed labour describes mechanical obstruction that prevents further _____ of the presenting part despite strong contractions. Untreated obstructed labour carries risk of uterine rupture and obstetric _____ formation.

5.2.2 Induction and augmentation of labour

Induction of labour (artificially initiating labour before its spontaneous onset) is indicated when the risk of continuing the pregnancy is judged to outweigh the risk of delivery, such as in post-term pregnancy, pre-eclampsia, or suspected foetal compromise, using methods including membrane sweeping, prostaglandin administration, mechanical cervical ripening, and, once the cervix is favourable, amniotomy combined with oxytocin infusion.

Augmentation of labour (increasing the strength or frequency of contractions in an already established but slowly progressing labour) is distinct from induction and is typically achieved with oxytocin infusion following amniotomy where membranes remain intact, always requiring careful, continuous foetal monitoring throughout, given the recognised risk of uterine hyperstimulation and consequent foetal compromise associated with oxytocin use.

Fill in the blank: Induction of labour is indicated when the risk of continuing pregnancy is judged to _____ the risk of delivery. Augmentation of labour requires careful, continuous foetal _____ throughout, given the risk of uterine hyperstimulation.

5.2.3 Instrumental and operative delivery

Instrumental vaginal delivery (using either forceps or vacuum extraction) is indicated for a prolonged or delayed second stage of labour, suspected foetal compromise in the second stage, or maternal exhaustion, requiring specific prerequisites including full cervical dilatation, a known and favourable foetal position, and an experienced operator, with the choice between forceps and vacuum guided by the specific clinical circumstances, foetal station, and operator experience and preference.

Caesarean section is indicated for a wide range of maternal and foetal indications, ranging from planned, elective procedures (such as placenta praevia or breech presentation where vaginal delivery is not appropriate) to genuine emergencies (such as foetal compromise, cord prolapse, or failed instrumental delivery), with the specific urgency category assigned guiding the target time from decision to delivery in each individual case.

Fill in the blank: Instrumental vaginal delivery requires full cervical dilatation, a known favourable foetal position, and an experienced _____. Caesarean section indications range from planned procedures such as placenta praevia to genuine _____ such as cord prolapse.

Condition / Intervention	Definition	Causes	Management
Prolonged Labour	Labour lasting longer than expected for stage and parity	Inefficient uterine contractions, malposition, cephalopelvic disproportion	Monitor progress, correct malposition, consider augmentation or operative delivery
Obstructed Labour	Labour where mechanical obstruction prevents descent of fetus	Cephalopelvic disproportion, malpresentation, pelvic tumour	Immediate intervention, caesarean section, manage complications (e.g., fistula, sepsis)
Induction of Labour	Artificial initiation of labour before spontaneous onset	Post-term pregnancy, pre-eclampsia, intrauterine growth restriction	Cervical ripening (prostaglandins), oxytocin infusion, amniotomy
Augmentation of Labour	Strengthening or speeding up labour already in progress	Ineffective uterine contractions, slow progress	Oxytocin infusion, amniotomy, close monitoring of mother and fetus

Table 5.2: Comparison of prolonged labour, obstructed labour, induction, and augmentation.

Pilot questions 5.2

1. Distinguish prolonged labour from obstructed labour. (Linked to SLO 5.4)
2. Describe the complications of untreated obstructed labour. (Linked to SLO 5.4)
3. Describe the indications and methods of induction of labour. (Linked to SLO 5.4)
4. Distinguish augmentation from induction of labour. (Linked to SLO 5.4)
5. Describe the indications and prerequisites for instrumental vaginal delivery. (Linked to SLO 5.4)

5.3 Immediate Newborn Care and Assessment

5.3.1 Immediate care of the newborn at birth

Immediate care of the newborn at birth prioritises warmth (drying and covering the baby promptly to prevent heat loss, a genuinely simple but critical intervention), assessment of breathing and tone, and, for the majority of healthy term babies, early skin-to-skin contact with

the mother, which supports thermoregulation, early breastfeeding initiation, and the beginning of maternal-infant bonding, all recognised as important components of good immediate newborn care.

Delayed cord clamping (waiting at least one minute, or until pulsation ceases, before clamping the umbilical cord in a baby not requiring immediate resuscitation) allows placental transfusion of blood to the newborn, improving iron stores in infancy, and is now recommended as routine practice for the majority of births, reserved only in circumstances where immediate resuscitation is required, in which case cord clamping should not be delayed at the expense of prompt resuscitative care.

Fill in the blank: Immediate newborn care prioritises warmth, assessment of breathing and tone, and, for healthy babies, early skin-to-_____ contact. Delayed cord clamping improves the newborn's _____ stores in infancy.

5.3.2 Neonatal resuscitation

Neonatal resuscitation follows a structured, stepwise algorithm beginning with drying, stimulation, and positioning the airway, progressing to face mask ventilation if the baby remains apnoeic or the heart rate is inadequate despite these initial steps, and, in a small minority of babies, chest compressions and medication if the heart rate remains inadequate despite effective ventilation, with the overwhelming majority of newborns requiring resuscitation responding fully to the early, basic steps alone.

Effective ventilation is widely recognised as the single most important step in neonatal resuscitation, and every effort should be made to ensure adequate mask seal, appropriate head position, and visible chest movement before escalating to more advanced interventions, as most neonatal resuscitation failures reflect inadequate execution of this fundamental step rather than a genuine need for the more advanced interventions that follow it in the resuscitation algorithm.

Fill in the blank: Neonatal resuscitation begins with drying, stimulation, and positioning the _____. The single most important step in neonatal resuscitation is effective _____.

5.3.3 Newborn examination and Apgar scoring

The Apgar score assesses five parameters, heart rate, respiratory effort, muscle tone, reflex irritability, and colour, each scored zero to two at one and five minutes after birth, providing a structured, rapid, standardised assessment of the newborn's immediate condition and response to any resuscitative intervention, though it should never be used in isolation to guide the timing or nature of resuscitation itself, which must always be based on real-time clinical assessment.

The routine newborn examination performed within the first 24 to 72 hours of life systematically assesses every major body system, including cardiac and respiratory examination, abdominal palpation, examination of the hips for developmental dysplasia, and genital examination, providing an important opportunity to identify any congenital anomaly or other abnormality not detected antenatally, before the baby is discharged home.

Fill in the blank: The Apgar score assesses heart rate, respiratory effort, muscle tone, reflex irritability, and _____, scored at one and five minutes. The routine newborn examination includes assessment of the hips for developmental _____.

Step / Parameter	Key Details
Dry and Stimulate	Immediately after birth, dry the baby and gently stimulate to initiate breathing.
Position Airway	Place the infant's head in a neutral position, clear secretions if needed.
Ventilate	Provide positive pressure ventilation if breathing is inadequate or absent.
Compressions and Medication	If heart rate <60 bpm despite ventilation, start chest compressions and consider epinephrine.
Apgar Score Parameters	Appearance (color), Pulse (heart rate), Grimace (reflex irritability), Activity (muscle tone), Respiration (breathing effort).

Box 5.3: Neonatal resuscitation algorithm and Apgar score parameters.

Pilot questions 5.3

1. Describe the priorities of immediate newborn care at birth. (Linked to SLO 5.5)
2. Explain the benefits of delayed cord clamping. (Linked to SLO 5.5)
3. Describe the stepwise approach to neonatal resuscitation. (Linked to SLO 5.5)
4. Explain why effective ventilation is considered the most important step in neonatal resuscitation. (Linked to SLO 5.5)
5. Describe the components of the Apgar score and the routine newborn examination. (Linked to SLO 5.6)

5.4 Obstetric Emergencies and Complications

5.4.1 Postpartum haemorrhage

Postpartum haemorrhage (PPH) is defined as blood loss of 500 millilitres or more following vaginal delivery, or 1000 millilitres or more following caesarean section, and remains the leading direct cause of maternal death worldwide and in Nigeria, with causes traditionally summarised by the four Ts: tone (uterine atony, the most common cause by far), tissue (retained placental fragments), trauma (genital tract laceration), and thrombin (coagulation disorder).

Management follows a structured, stepwise approach: initial resuscitation with intravenous fluids and, where indicated, blood products, uterine massage and uterotonic drugs to address atony as the most likely cause, examination to identify and repair any trauma or evacuate any retained tissue, and, where bleeding continues despite these measures, escalation to balloon tamponade, surgical interventions such as compression sutures, or, as a last resort, hysterectomy to achieve definitive control of life-threatening haemorrhage.

Fill in the blank: Postpartum haemorrhage is defined as blood loss of _____ millilitres or more following vaginal delivery. The four Ts summarising the causes of PPH are tone, tissue, trauma, and _____.

5.4.2 Shoulder dystocia and cord prolapse

Shoulder dystocia is an obstetric emergency in which the foetal shoulders fail to deliver spontaneously after delivery of the head, requiring additional specific manoeuvres, managed with a structured, stepwise sequence beginning with the McRoberts manoeuvre (maternal hip hyperflexion) and suprapubic pressure, progressing to internal manoeuvres such as delivery of the posterior arm if these initial measures fail, with prompt, systematic action essential given the risk of foetal hypoxia and brachial plexus injury the longer the delay to delivery.

Umbilical cord prolapse occurs when the umbilical cord descends below the presenting part, typically after rupture of membranes, risking cord compression between the presenting part and the maternal pelvis and consequent acute foetal hypoxia, managed as a genuine emergency with manual elevation of the presenting part to relieve cord compression, maternal repositioning, and immediate expedited delivery, almost always by emergency caesarean section unless vaginal delivery is imminently achievable.

Fill in the blank: Shoulder dystocia is initially managed with the _____ manoeuvre and suprapubic pressure. Umbilical cord prolapse risks cord compression and acute foetal _____.

5.4.3 Other peripartum emergencies

Uterine rupture (complete or partial disruption of the uterine wall, most commonly at the site of a previous caesarean scar) presents with sudden severe abdominal pain, foetal compromise, and, if significant, maternal haemorrhagic shock, requiring immediate resuscitation and emergency laparotomy, while amniotic fluid embolism, a rare but frequently catastrophic event in which amniotic fluid enters the maternal circulation, presents with sudden collapse, hypoxia, and coagulopathy, requiring immediate, aggressive multidisciplinary supportive management.

Eclampsia (seizures occurring in a woman with pre-eclampsia) requires immediate management with magnesium sulphate, both to control the seizure and to prevent recurrence, alongside control of severe hypertension and, once the mother is stabilised, expedited delivery, as delivery remains the only truly definitive treatment for the underlying hypertensive disorder driving the eclamptic process.

Fill in the blank: Uterine rupture most commonly occurs at the site of a previous _____ scar. Eclampsia is managed with immediate administration of magnesium _____.

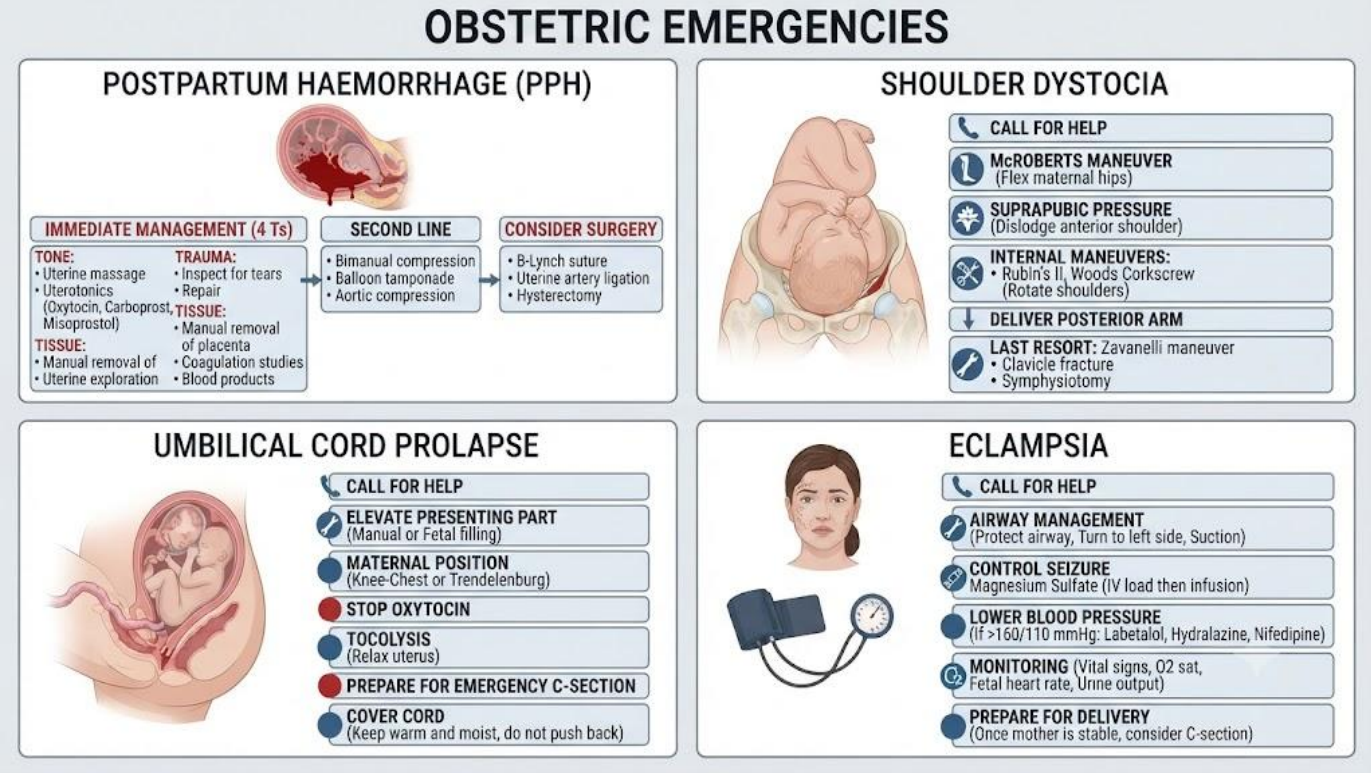


Figure 5.4: Recognition and management of the major obstetric emergencies.

Pilot questions 5.4

1. Describe the causes of postpartum haemorrhage summarised by the four Ts. (Linked to SLO 5.7)
2. Describe the stepwise management of postpartum haemorrhage. (Linked to SLO 5.7)
3. Describe the management of shoulder dystocia. (Linked to SLO 5.7)
4. Describe the emergency management of umbilical cord prolapse. (Linked to SLO 5.7)
5. Describe the presentation and management of uterine rupture and eclampsia. (Linked to SLO 5.7)

Series Summary

This Series has covered normal labour, its stages, mechanism, and monitoring using the partograph, together with management of the third stage, followed by abnormal and operative labour, including prolonged and obstructed labour, induction, and instrumental delivery. It went on to examine immediate newborn care, neonatal resuscitation, and newborn assessment, before concluding with the recognition and management of the major obstetric emergencies, bringing this course on Antenatal Care and Foetal Medicine to a close.

You should now be able to describe the stages and mechanism of labour, monitor labour progress using the partograph, describe the management of the third stage, describe abnormal and operative labour, describe immediate newborn care and resuscitation, describe newborn assessment, and recognise and manage the major obstetric emergencies (Linked to SLOs 5.1 to 5.7).

Glossary of Terms

1. **Active management of the third stage:** a package of care comprising uterotonic administration, controlled cord traction, and cord clamping, reducing the risk of postpartum haemorrhage.
2. **Apgar score:** a structured assessment of heart rate, respiratory effort, tone, reflex irritability, and colour at one and five minutes after birth.
3. **Augmentation of labour:** increasing the strength or frequency of contractions in an already established but slowly progressing labour.
4. **Cord prolapse:** descent of the umbilical cord below the presenting part, risking cord compression and acute foetal hypoxia.
5. **Induction of labour:** artificially initiating labour before its spontaneous onset.
6. **McRoberts manoeuvre:** maternal hip hyperflexion used as the first-line manoeuvre in the management of shoulder dystocia.
7. **Obstructed labour:** mechanical obstruction that prevents further descent of the presenting part despite strong uterine contractions.
8. **Partograph:** a standardised graphical tool used to monitor the progress of labour.
9. **Postpartum haemorrhage:** blood loss of 500 millilitres or more after vaginal delivery, or 1000 millilitres or more after caesarean section.
10. **Shoulder dystocia:** an obstetric emergency in which the foetal shoulders fail to deliver spontaneously after delivery of the head.

11. **Uterine atony:** failure of the uterus to contract adequately after delivery, the most common cause of postpartum haemorrhage.
12. **Uterine rupture:** complete or partial disruption of the uterine wall, most commonly at the site of a previous caesarean scar.

Concept Check Questions [Series 5]

Objective questions

- The first stage of labour is subdivided into a latent phase and an _____ phase.
- Crossing the _____ line on the partograph prompts active intervention such as augmentation.
- Delayed cord clamping improves the newborn's _____ stores in infancy.
- The single most important step in neonatal resuscitation is effective _____.
- Postpartum haemorrhage is defined as blood loss of _____ millilitres or more following vaginal delivery.

Short-answer questions

1. Describe active management of the third stage of labour and its benefits. (Linked to SLO 5.3)
2. Distinguish augmentation from induction of labour. (Linked to SLO 5.4)
3. Explain why effective ventilation is considered the most important step in neonatal resuscitation. (Linked to SLO 5.5)
4. Describe the components of the Apgar score. (Linked to SLO 5.6)
5. Describe the management of shoulder dystocia. (Linked to SLO 5.7)

Long-answer questions

6. Describe the stages and mechanism of normal labour and its monitoring using the partograph. (Linked to SLO 5.1, SLO 5.2)
7. Describe the causes and management of abnormal and operative labour. (Linked to SLO 5.4)
8. Describe immediate newborn care, resuscitation, and assessment. (Linked to SLO 5.5, SLO 5.6)
9. Describe the causes and management of postpartum haemorrhage. (Linked to SLO 5.7)

10. Describe the recognition and management of shoulder dystocia, cord prolapse, and eclampsia. (Linked to SLO 5.7)

Answers to Concept Check Questions [Series 5]

Objective questions

11. Active.
12. Action.
13. Iron.
14. Ventilation.
15. 500.

Short-answer questions

16. Uterotonic administration, controlled cord traction, and cord clamping substantially reduce the risk of postpartum haemorrhage compared with expectant management.
17. Induction artificially initiates labour before spontaneous onset, while augmentation increases contraction strength in already established labour.
18. Most resuscitation failures reflect inadequate execution of ventilation rather than a genuine need for more advanced interventions.
19. Heart rate, respiratory effort, muscle tone, reflex irritability, and colour, each scored zero to two at one and five minutes.
20. The McRoberts manoeuvre and suprapubic pressure first, progressing to internal manoeuvres such as delivery of the posterior arm if needed.

Long-answer questions

21. **Basic response:** Labour has three stages with a defined mechanism of foetal descent, monitored using the partograph, with active management recommended for the third stage.

Value-added response: The alert and action lines on the partograph provide structured thresholds for escalating concern and intervention during labour.

22. **Basic response:** Abnormal labour includes prolonged and obstructed labour, managed with induction, augmentation, or instrumental or operative delivery as indicated.

Value-added response: Untreated obstructed labour carries serious risk of uterine rupture and fistula, underscoring the importance of early recognition and escalation.

23. **Basic response:** Immediate newborn care prioritises warmth and assessment, with resuscitation following a stepwise algorithm and Apgar scoring assessing condition.

Value-added response: Effective ventilation is the single most important resuscitation step, and delayed cord clamping and skin-to-skin contact are both recommended for healthy babies.

Answers to Pilot Questions [Series 5]

Part 5.1

1. First stage (onset to full dilatation), second stage (full dilatation to delivery), and third stage (delivery of baby to placenta).
2. Engagement, descent, flexion, internal rotation, extension, restitution and external rotation, and delivery of the shoulders and body.
3. A graphical tool plotting cervical dilatation against time alongside maternal and foetal observations to monitor labour progress.
4. The alert line prompts closer observation, and the action line prompts active intervention such as augmentation or expedited delivery.
5. Uterotonic administration, controlled cord traction, and cord clamping, reducing postpartum haemorrhage risk compared with expectant management.

Part 5.2

6. Prolonged labour progresses more slowly than expected; obstructed labour involves genuine mechanical obstruction preventing further descent.
7. Uterine rupture, obstetric fistula, and foetal death, particularly in settings with limited access to timely emergency obstetric care.

8. Indicated when continuing pregnancy risk outweighs delivery risk; methods include membrane sweeping, prostaglandins, and amniotomy with oxytocin.
9. Augmentation increases contraction strength in already established labour, while induction artificially initiates labour before spontaneous onset.
10. Full cervical dilatation, known favourable foetal position, and an experienced operator are required prerequisites.

Part 5.3

11. Warmth, assessment of breathing and tone, and early skin-to-skin contact for healthy term babies.
12. Improved iron stores in infancy from placental transfusion of blood to the newborn.
13. Drying, stimulation, and airway positioning, progressing to ventilation, then compressions and medication if needed.
14. Most resuscitation failures reflect inadequate ventilation technique rather than a genuine need for more advanced steps.
15. Apgar score assesses heart rate, respiratory effort, tone, reflex irritability, and colour; the routine examination assesses all major body systems.

Part 5.4

1. Tone (uterine atony, most common), tissue (retained placenta), trauma (laceration), and thrombin (coagulation disorder).
2. Resuscitation, uterine massage and uterotonics, examination and repair or evacuation, then tamponade, surgery, or hysterectomy if bleeding continues.
3. McRoberts manoeuvre and suprapubic pressure first, then internal manoeuvres such as delivery of the posterior arm if needed.
4. Manual elevation of the presenting part, maternal repositioning, and immediate expedited delivery, almost always by emergency caesarean section.
5. Uterine rupture presents with sudden pain and shock, requiring laparotomy; eclampsia is managed with magnesium sulphate and expedited delivery.

References and Attributions [Series 5]

Textual References

1. Cunningham, F. G., Leveno, K. J., Dashe, J. S. et al. (2022). Williams Obstetrics (26th ed.). McGraw Hill.
2. World Health Organization (2018). WHO Recommendations: Intrapartum Care for a Positive Childbirth Experience. WHO Press.
3. Royal College of Obstetricians and Gynaecologists (2012). Green-top Guideline No. 42: Shoulder Dystocia. RCOG Press.
4. International Liaison Committee on Resuscitation (2020). Neonatal Life Support: 2020 International Consensus on Cardiopulmonary Resuscitation Science. Circulation, 142(16_suppl_1), S185 to S221.

Figures, Plates, Tables, and Boxes

1. Figure 5.1: Mechanism of normal labour and the partograph alert and action lines. AI-generated using the prompt: "Create a professional medical diagram titled Mechanism of Normal Labour, showing the sequential foetal head movements and a sample partograph with alert and action lines. Clean clinical educational diagram style."
2. Table 5.2: Comparison of prolonged labour, obstructed labour, induction, and augmentation. AI-generated using the prompt: "Create a clean reference table titled Prolonged Labour, Obstructed Labour, Induction, and Augmentation, comparing definitions, causes, and management. Simple clinical reference table style with outside border."
3. Box 5.3: Neonatal resuscitation algorithm and Apgar score parameters. AI-generated using the prompt: "Create a simple single-column reference box with an outside border titled Neonatal Resuscitation and Apgar Score, listing the resuscitation steps and Apgar parameters. Clinical reference box style."
4. Figure 5.4: Recognition and management of the major obstetric emergencies. AI-generated using the prompt: "Create a professional medical diagram titled Obstetric Emergencies, showing four panels for PPH, shoulder dystocia, cord prolapse, and eclampsia with key management steps. Clean clinical educational diagram style."