Obstetrics Algorithms

in Clinical Practice

2nd Edition



Alok Sharma

Foreword
Bhaskar Pal

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CHAPTER 11

H1N1 Infection in Pregnancy

Suparna Grover, Ajay Chhabra

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INTRODUCTION

Influenza is a viral infection of the respiratory tract that commonly presents as a seasonal epidemic and every few decades as a pandemic.

Pregnant women are not only at more risk of being infected by influenza virus but they are—four to five times more prone to suffering significant morbidity as well.[1,2] For the fetus also, adverse pregnancy outcomes such as abortions, preterm labor, and fetal distress are more common in those suffering from severe influenza infection during pregnancy.[1,3]

EPIDEMIOLOGY OF H1N1 INFECTION

Influenza viruses are mainly of three types based on their M capsid protein and the nucleoprotein. Among them, type A and type B are the ones responsible for most of the influenza epidemics in human population while type C is less common in humans and only causes sporadic cases of mild respiratory infection. Type A influenza viruses are further classified in many subtypes based on the surface glycoproteins hemagglutinin [H] and neuraminidase [N], and they tend to undergo mutations.

The last pandemic in 2009 was caused by H1N1 virus and was called swine flu because the virus was believed to have originated in pigs containing genes from different avian, swine, and human influenza strains causing a genetic re-assortment that created a new virus to which human population had no preexistent immunity. This virus attacked younger population and had the potential to cause serious lower respiratory infection although a mild-to-moderate respiratory infection was the most common manifestation. The pandemic was declared over in 2010 and presently this virus persists globally as a causative agent for seasonal epidemics as well as sporadic cases. In India, annual cases have ranged between 8,000 and 21,000 in last 3 years, most frequently from Tamil Nadu, Delhi, Maharashtra, Karnataka, Kerala. The Indian Council of Medical Research (ICMR)-National Institute of Virology (NIV) Pune located National Influenza center reported in 2022 that in India, H1N1 pdm09 was the predominant virus identified in 64.3% infections followed distantly by H3N2 in 29.3%.[4]

The H1N1 infection in pregnancy is significant as epidemiological evidence gathered during pandemics has established that there is significantly higher morbidity as well as mortality in pregnant women infected by this virus, more so in the third trimester.[2,3] This can be attributed to physiologically suppressed T Helper 1 mediated immune response and decreased tidal volume in pregnancy. Pregnancies complicated by severe infection are also associated with a higher incidence of adverse pregnancy outcomes.[2,3] The epidemiologic characteristics of influenza virus are described in **Table 1**.

RISK FACTORS IN PREGNANCY

- Third trimester[2]
- Maternal smoking
- Chronic lung diseases such as asthma, chronic obstructive pulmonary disease (COPD), cystic fibrosis
- Immunodeficiency disorders, hemoglobinopathies
- Diabetes mellitus, renal disease, malignancy.

PATHOLOGY

Both influenza strains, i.e., type A and type B, have two surface glycoproteins—hemagglutinin and neuraminidase—that play a critical role in its pathogenesis

TABLE 1: Epidemiology of influenza infection.

Causative agent: Orthomyxoviridae influenza virus	Type A	• Infects man, pigs, and birds • Serotypes based on hemagglutinin [H] and neuraminidase [N] • Undergoes mutations frequently • *Antigenic drift:* Mutation within genome leading to new seasonal strain • *Antigenic shift:* Reassortment among genetic material of different subtypes leading to a new virus capable of causing pandemic
	Type B	• Infects humans • No serotypes • Infrequent mutations • Causes epidemics and seasonal influenza
	Type C	• Mild respiratory disease • No mutations
Transmission		• Droplets from infected person • Fomites • Close contact like hand shaking
Incubation period		• 1–4 days
Communicability		• From onset of clinical disease up to 7 days • Children and immunocompromised patients may spread the virus longer
Seasonality		• *Tropics/subtropics:* Rainy season • *Temperate zones:* Winters

(Fig. 1). The former attaches the virus to sialic acid receptors on host cell membrane and has a tropism for cells lining the respiratory tract and the latter has a role in viral penetration as well as in the release of virus from infected cells once the virus has utilized cell machinery for replication of its genetic material.

Once the new virions leave the host cells, it leads to apoptosis of the host cell as well as an innate inflammatory response in order to check the spread of virus. This inflammatory response may be so exaggerated that it itself leads to damage of host cells lining the respiratory tract as well as widespread endothelial damage. Widespread alveolar damage, pulmonary edema, and acute respiratory distress syndrome are the pathological findings in those suffering the most severe disease **(Fig. 2)**. In mild-to-moderate cases, there may be mild bronchiolitis and alveolitis that start healing once the virus is cleared by

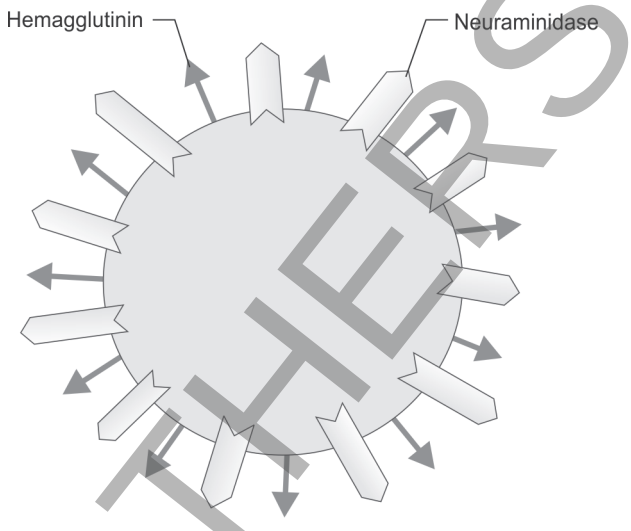

Fig. 1: Structure of H1N1 virus.

innate and humoral immune response but during this recovery period, the respiratory tract remains prone to secondary bacterial infections.

CAUSES OF DEATH

- Respiratory failure
- Refractory shock
- Multiple organ dysfunction

CLINICAL PRESENTATION

The characteristic feature of influenza virus is the rapid, almost sudden onset of symptoms **(Table 2)**.[1]

CATEGORIZATION OF INFLUENZA[5]

Pregnant state automatically categorizes the patient into category B or above, i.e., category C **(Table 3)**.

INVESTIGATIONS

- *Routine investigations:* Biochemical, hematological, microbiological and radiological tests as dictated by the patient's general condition.
- *Confirmation:*
  - Real-time reverse transcription polymerase chain reaction (RT-PCR) or
  - Isolation in a viral culture, or
  - Four times increase in virus-specific antibodies
- *Clinical specimens:* Respiratory secretions such as throat swab, nasopharyngeal swab, and tracheal secretions (in patients who are intubated). The

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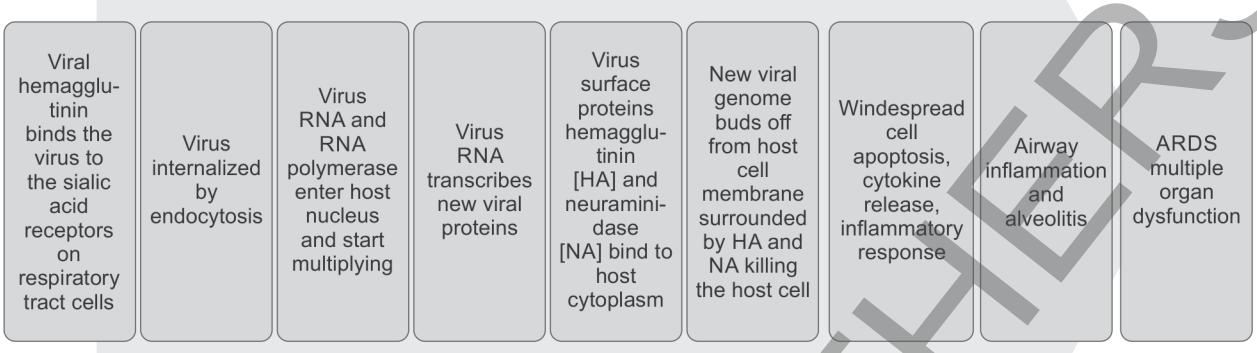

Fig. 2: Pathogenesis of H1N1 virus.

TABLE 2: Symptoms of influenza virus.

Influenza-like illness (ILI)	*Gastrointestinal symptoms*	*Severe respiratory disease*
• Fever • Cough • Sore throat • Coryza • Myalgia • Headache	• Vomiting • Diarrhea	• Breathlessness • Chest pain • Tachypnea • Sputum mixed with blood • Drowsiness • Hypotension • Cyanosis

TABLE 3: Categorization of H1N1 infection.[5]

Category A	*Category B*	*Category C*
Mild fever plus cough/ sore throat with or without bodyache, headache, diarrhea, and vomiting	• Signs and symptoms mentioned under Category-A plus high-grade fever and severe sore throat • Signs and symptoms mentioned under Category-A individuals having one or more of the following high-risk conditions – Children less than 5 years – Children with predisposing risk factors – Age ≥65 years – Pregnant women including up to 2 weeks postpartum – Persons aged 65 years or older – Patients with lung diseases, heart disease, liver disease, kidney disease, blood disorders, diabetes, neurological disorders, cancer and HIV/AIDS – Patients on long-term cortisone therapy, posttransplant patients	• Signs and symptoms mentioned under Category-A and B plus any of the following: – Breathlessness, chest pain, drowsiness, fall in blood pressure, sputum mixed with blood, bluish discoloration of nails – Children with influenza like illness who had a severe disease as manifested by the red flag signs (Somnolence, high and persistent fever, inability to feed well, convulsions, shortness of breath, difficulty in breathing, etc.) – Worsening of underlying chronic conditions

(AIDS: acquired immunodeficiency syndrome; HIV: human immunodeficiency virus)

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specimen should be collected by technically trained personnel only and transported to central laboratories assigned by government with proper clinical record of the patient.

MANAGEMENT OF INFLUENZA IN PREGNANCY

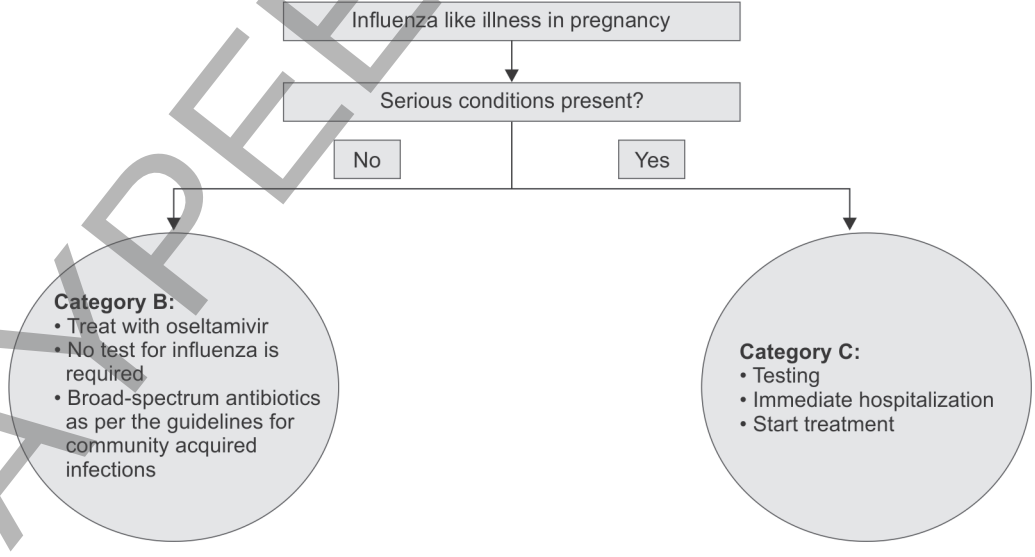
There are three important aspects in the management of influenza in pregnancy: prevention, timely diagnosis, and management **(Algorithm 1)**.

Prevention

Considering the serious risk to both maternal and fetal well-being, the role of prevention, especially during seasonal outbreak or pandemic, cannot be overstressed.

- *Vaccination:* Quadrivalent inactivated seasonal influenza vaccine is universally recommended for all pregnant women, irrespective of the period of gestation, as it provides protection not only to the women during pregnancy but also to their newborns up to 6 months. The Indian Government recommended the same influenza vaccine as recommended by World Health Organization (WHO) for 2025–26:[6]
  - an A/Victoria/4897/2022 (H1N1) pdm09-like virus;
  - an A/Croatia/10136RV/2023 (H3N2)-like virus; and
  - a B/Austria/1359417/2021 (B/Victoria lineage)-like virus.
  - *a B/Phuket/3073/2013 (B/Yamagata lineage)-like virus.*
- *Timing of vaccination:*
  - 1 month before the start of the influenza season.
  - The usual season of influenza in most parts of India is the monsoon season. In Central and Northern India, the peak incidence is in winter months (January to March).
- *General measures:* Even after adequate matching, vaccine efficacy is not >80%[6] and considering the risk involved, all pregnant women should take the following precautions:
  - Pregnant women should practice social distancing. They should avoid:
    - Crowded places, especially during community epidemics
    - Providing care for those with suspected influenza infection
    - Touching mouth and nose.
  - Washing hands with water and soap or alcohol-based hand sanitizer frequently.
  - Soiled surfaces should be cleaned/disinfected to keep the environment free from the virus.

Algorithm 1: Management during pregnancy.[7]



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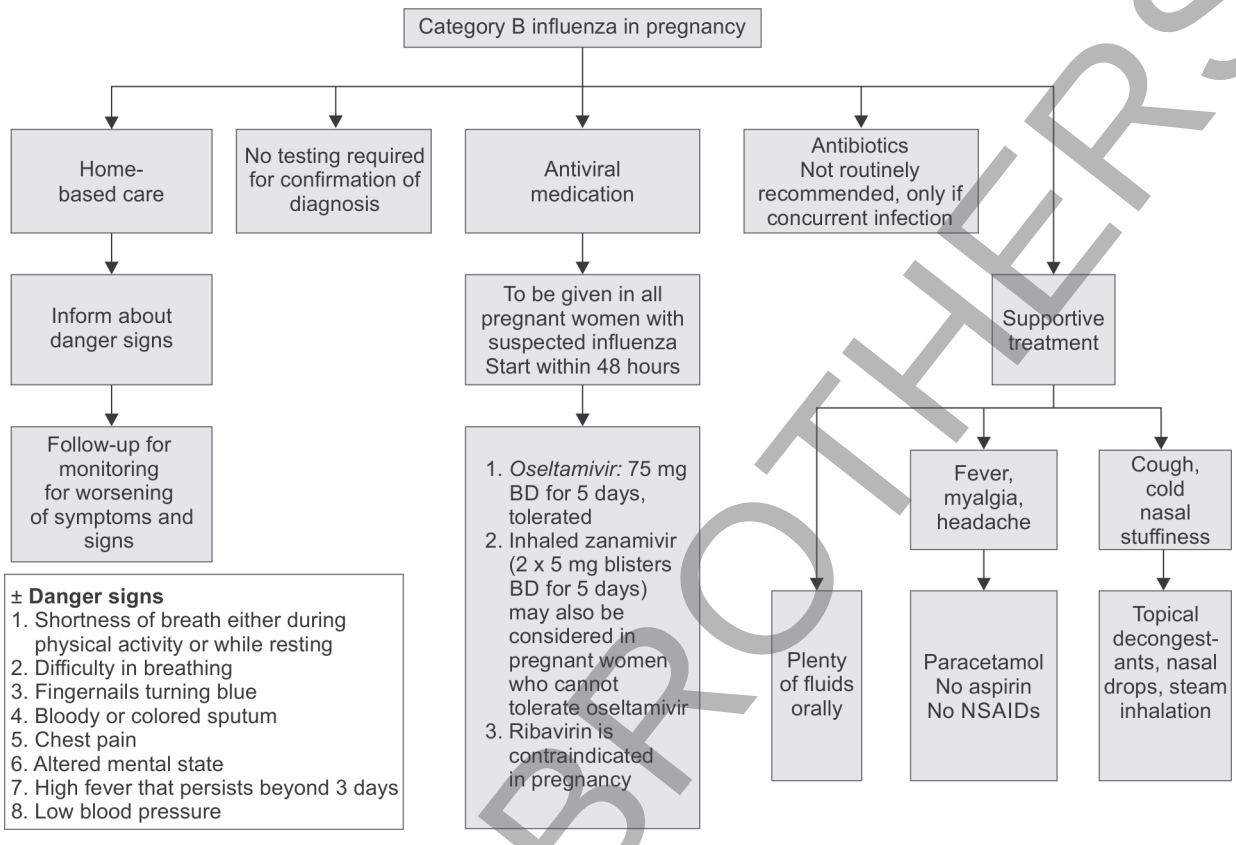
Algorithm 2: Management of category B influenza infection. (NSAIDs: Nonsteroidal anti-inflammatory drugs)



(NSAIDs: nonsteroidal anti-inflammatory drugs)

- Not involving any person with respiratory symptoms in care for a pregnant woman or a mother and newborn baby.
- Breastfeeding should be started within an hour of childbirth, and it should be done exclusively and frequently.

Timely Diagnosis, Classification, and Treatment

The clinical course and prognosis depend a lot on timely starting the pharmaceutical management on clinical suspicion without waiting for confirmatory tests.

- In the absence of symptoms of a severe disease, the patient is considered category B and oseltamivir is started in a dose of 75 mg twice a day for 5 days without confirming the diagnosis. Initiate the treatment preferably within 48 hours **(Algorithm 2)**.
- In category C cases, immediate hospitalization, starting oseltamivir and supportive therapy is required. Oseltamivir may need to be continued for longer than 5 days in these patients **(Algorithm 3)**. Many of these patients may benefit from mechanical ventilation which includes noninvasive and invasive ventilation **(Box 1)**.

If women have not been vaccinated, vaccination should be recommended soon after they have recovered, to protect them against the other strains that are circulating.[8]

Management during Labor and Prevention of Spread of Infection

Management during labor and prevention of spread of infection to newborn, healthcare providers, and community require strict adherence to infection control practices **(Table 4)**.

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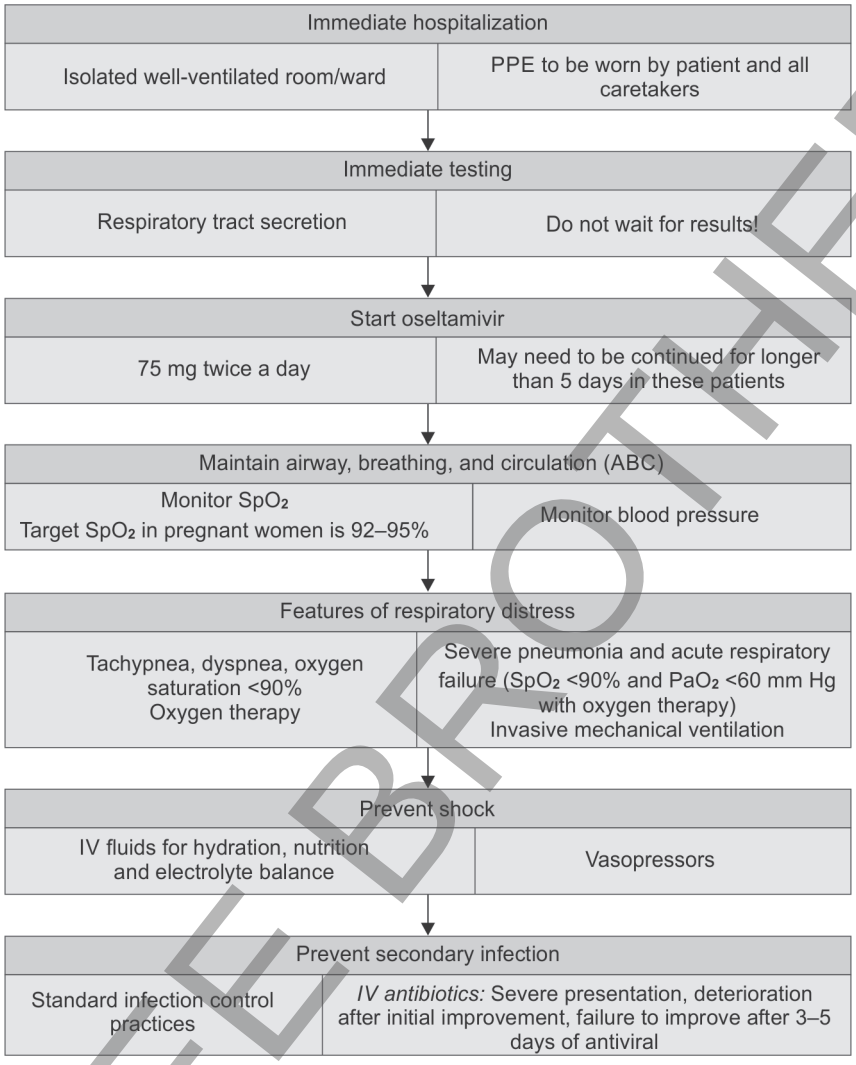
Algorithm 3: Management of category C infection.



(PPE: personal protective equipment)

BOX 1: Guide to mechanical ventilation.

- ARDS severity to be assessed as per Berlin criteria
- Mild ARDS—early NIV
- Moderate-to-severe ARDS—invasive ventilation
- Severe ARDS—failure to achieve SaO_2 ≥90% or pO_2 of ≥60 mm Hg on an FiO_2 <0.6

Ventilator settings:

- Pressure controlled
- Low tidal volume (6–7 mL/kg ideal body weight)
- Titrate PEEP to keep lungs recruited to target FiO_2 <0.5 and SaO_2 >90% or PaO_2 >60 mm Hg
- Plateau pressure <30–35 mm Hg.
- Recruitment maneuvers and prone ventilations can be considered

(ARDS: acute respiratory distress syndrome; NIV: noninvasive ventilation; PEEP: positive end-expiratory pressure)

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TABLE 4: Management during labor for a pregnant woman infected with influenza.

Obstetric care	*Prevention of spread of infection*
• Delivery in an isolated, well-ventilated room • Both patient and healthcare providers to wear masks • In case of preterm labor, corticosteroids for fetal lung maturation can be given in routine doses • Tocolytics causing hypotension should be used in a very guarded manner • Risk of fetal distress and operative interference is higher • In critically ill patients, a preterm delivery or delivery by lower segment cesarean section (LSCS) may be indicated in order to help with the mechanical ventilation of the patient • Management and decision making should be multi-disciplinary (Obstetrician, Critical care specialist and neonatologist)	• Admission and delivery in an isolated room • Restricted entry in the room • Reinforce standard infection control precautions • Both patient and healthcare providers to wear masks • Triple-layer surgical masks are to be worn by all personnel involved in transport, care, and delivery of the patient. N 95 Respirator masks are required for collection of respiratory samples and for performing aerosol producing procedures such as nebulization or bronchoscopy[9] • Strict adherence to respiratory etiquette, i.e., covering their nose and mouth when sneezing and coughing. A disposable tissue paper should be preferred over cloth. Hands must be washed after disposal of tissue in a covered bin • Personal protection equipment (triple-layered masks, eye covers, gowns, gloves, head-cap, and shoe cover) should be used during delivery • Standard biomedical waste disposal protocol should be strictly adhered to • Vaccination to be provided to healthcare workers as per National guidelines • Consider antiviral chemoprophylaxis for exposed healthcare staff for 7 days following the last exposure during epidemic/outbreak situation
Prevention of the newborn	
• Rooming-in of the newborn with the mother and early and exclusive breastfeeding is recommended when all of the following criteria are met:[8] • The mother has received antiviral drugs for at least 2 days • The mother is afebrile for 24 hours without using paracetamol • The mother understands and follows respiratory hygiene	

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Obstetrics Algorithms in Clinical Practice

Key Features

This second edition arrives at a pivotal moment. The authors have meticulously updated every chapter to reflect the latest evidence-based guidelines, ensuring that practitioners have the most current protocols at their fingertips. Key enhancements include:

- *Advanced imaging and diagnostics:* Expanded sections on 3D/4D ultrasound
- *Maternal medicine:* Deeper insights into managing complex comorbidities, such as hypertension, diabetes, cardiac disease, APLA, H1N1, COVID-19, hemoglobinopathies, substance abuse, vaccination protocols, etc.
- *Global perspectives:* A thoughtful integration of obstetric challenges in diverse resource settings
- *Patient safety:* A robust focus on simulation-based training and multidisciplinary team communication provides an overview of treatment protocols and outcomes in the field of obstetrics by a unique algorithmic approach
- Designed to support rapid decision-making in the most clinically relevant situations to minimize the risks of a poor outcome based on current national guidelines and clinical evidence, the algorithms can be used as a reliable and practical resource for normal and problem cases encountered in day-to-day practice
- Divided into various sections such as maternal disorders, antenatal emergencies, labor, delivery, and the postpartum period
- Each chapter is presented as an algorithm and has been carefully structured to ensure a logical progression of thought to aid anticipation, early diagnosis, and prompt and appropriate management
- Easy-to-follow management algorithms presented in a highly visual format
- A ready reckoner for obstetricians, postgraduate students, and private practitioners practicing obstetrics and gynecology.



Alok Sharma MD DHA MICOG did his postgraduation in obstetrics and gynecology from Kamla Nehru State Hospital for Mother and Child and Indira Gandhi Medical College, Shimla, Himachal Pradesh, India, in 2010. Presently, he is working as a Consultant, Department of Obstetrics and Gynecology, Regional Hospital Kullu, Kullu, Himachal Pradesh, and working day and night for the benefit of his ailing patients. He formerly served as an Assistant Professor, Dr Rajendra Prasad Government Medical College, Kangra, Himachal Pradesh. He is Founder Secretary of the Indian Menopause Society—Shimla Chapter and Indian Fertility Society—Himachal Pradesh Chapter. He was National Coordinator of Sexual Medicine Committee, FOGSI and North Zone Coordinator of Perinatology, Safe Motherhood and Young Talent Promotion Committee, FOGSI. He is an active member of various academic and professional bodies. He has published many articles in various national and international journals. He has edited several books in the field of obstetrics and gynecology and has also contributed several chapters and articles to various books and magazines related to the field of gynecology. He is not only active clinically but also performing his duties for the upliftment of women in the society.

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