

MODULE 5

# Management of Prevalent Infections in Children Following a Disaster

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## INTRODUCTION

The 2009-2010 H1N1 Influenza worldwide pandemic as well as the disaster that followed Hurricane Katrina has focused attention on the need for local, state, and federal disaster preparedness planning to consider common childhood infections. This module reviews the pathogenesis, epidemiology, and management of Influenza infections that are relevant to preparedness planning. In addition, it is important to recognize that the morbidity and mortality related to common childhood infections in a emergency situation may increase due to crowded living conditions; displacement to areas with higher disease prevalence; and compromised personal hygiene resulting from inadequate water supplies, contaminated water, and poor sanitation. The pre-existing immunization rates of children, as well as the pre-existing primary care infrastructure and the degree of damage caused by the disaster, also affect childhood morbidity and mortality after a disaster.



# INFLUENZA INFECTIONS

### OBJECTIVES

- Understand the influenza virus pathogenesis and epidemiology.
- Describe clinical symptoms of influenza and diagnostic and treatment options.
- Evaluate treatment and prevention methodologies for influenza and incorporate them into preparedness plans.

### What is Influenza?

Influenza is a segmented, single-stranded enveloped RNA virus classified into influenza A, B and C based on antigenic differences. Influenza A is a potentially severe illness, causes epidemics and pandemics, is rapidly changing, and infects birds, swine, horses, seals, and humans. Influenza B is more uniform, causes epidemics and only infects humans. Influenza C is of minimal public health impact and infects humans and swine. Further subtyping of influenza A virus is based on the neuraminidase and hemagglutinin proteins on the viral surface. There are 16 different hemagglutinins and 9 different neuraminidase subtypes. Hemagglutinin proteins allow the virus to stick to cells by binding to a specific receptor. The neuraminidase protein helps newly formed viral particles get released from the cell surface so that they have the potential to infect other cells. Only H1N1, H2N2, H3N2 subtypes are associated with widespread epidemics in human. Since 1997, rare but severe infections in humans with

influenza A subtype H5N1 viruses have been identified in Asia, Africa, Europe, and the Middle East where these viruses are present in domestic or wild birds.

Repeated seasonal influenza epidemics persist because the type A and type B viruses undergo constant and rapid change due to antigenic drift. Antigenic drift refers to a gradual change in the virus that occurs through a slow series of amino acids changes in the hemagglutinin or neuraminidase surface antigens. Occurring only after a particular viral strain has become established in humans, antigenic drift represents an adaptation to the development of host antibodies. Newly developed antigenic strains of influenza then prevail for a period of 2 to 5 years, only to be replaced by the next emerging strain. This new strain can then trigger a new epidemic, since it is now unfamiliar to the antibody repertoire of the population. The development of yet another set of host antibodies eventually protects the population—at the same time it puts pressure on the virus to drift yet again. Ongoing change caused by antigenic drift requires ongoing reformulation of influenza vaccines usually on an annual basis. The World Health Organization and the Centers for Disease Control and Prevention continually track these changes to better recommend strains to be contained in the next seasonal influenza vaccine.

In contrast to the gradual evolution of strains subject to antigenic drift, antigenic



shift occurs as soon as a type A influenza virus with a completely novel hemagglutinin or neuraminidase moves into humans from another host species. The primary source is birds, certain species of which carry a reservoir of 15 influenza A subtypes. These subtypes either genetically reassort themselves with circulating human influenza virus or are transmitted directly into humans, typically via intermediate hosts such as swine. Antigenic shift of type A influenza viruses occurs less frequently than antigenic drift, but with more dramatic impact that can lead to a pandemic. A pandemic is defined by the emergence and global spread of a new influenza A virus subtype to which the population has little or no immunity and that spreads rapidly from human to human. Pandemics, therefore, can cause increased morbidity and mortality rates compared with seasonal influenza. During the 20th century, there have been four influenza pandemics, in 1918 (H1N1), 1957 (H2N2), 1968 (H3N2), and 2009-10 (H1N1). The recent influenza pandemics of 2009 H1N1 ("swine flu") was caused by genetic reassortment between human, two avian and one swine influenza viruses. Avian influenza (H5N1) continues to cause outbreaks among poultry and wild birds worldwide but has caused relatively few cases of human H5N1 infection although case fatality rates are greater than 50 percent.

### **Epidemiology**

Influenza is spread from person to person primarily by respiratory droplets created by coughing or sneezing. Contact with

respiratory droplet-contaminated surfaces or fomites is another possible mode of transmission. During community outbreaks of influenza, the highest attack rates occur among school-aged children. Secondary spread to adults and other children within a family is common. Incidence and disease severity depend, in part, on immunity developed as a result of previous experience (by natural disease) or recent influenza immunization with the circulating strain or a related strain. In temperate climates, seasonal epidemics usually occur during winter months. Peak influenza activity in the United States can occur anytime from November to May but most commonly occurs in January and February. Community outbreaks can last 4 to 8 weeks or longer. Circulation of 2 or 3 influenza virus strains in a community may be associated with a prolonged influenza season of 3 months or more and bimodal peaks in activity. Influenza is highly contagious, especially among semi enclosed institutionalized populations.

Attack rates in healthy children generally have been found to be 10% to 40% each year, but illness rates as low as 3% also have been reported. Children younger than 5 years of age visit clinics or emergency departments for influenza illness at the rate of 1 to 2 children per 100 annually. Influenza and its complications have been reported to result in a 10% to 30% increase in the number of courses of antimicrobial agents prescribed to children during the influenza season. These medical care encounters for children with influenza result in considerable costs and



likely are an important cause of inappropriate antimicrobial use.

### **Influenza Pathogenesis and Symptoms**

Influenza in adults typically begins with the sudden onset of fever, often accompanied by chills or rigors, headache, malaise, diffuse myalgia, and nonproductive cough. Subsequently, respiratory tract signs including sore throat, nasal congestion, rhinitis, and cough become more prominent. Conjunctival injection, abdominal pain, nausea, vomiting, and diarrhea are less commonly associated with influenza illness. Influenza symptoms may be different among different age populations with older children and adolescents having more classic adult influenza like symptoms. Neonates may present with fever and a sepsis like picture and toddlers may have few respiratory signs but have vomiting and diarrhea as their predominant symptom. The usual incubation period between the time someone is exposed and infected with influenza virus to the time that they experience symptoms of illness ranges from 18 hours to 5 or more days with an average of 2-3 days. Once infected with influenza the principal site of replication is the columnar epithelium in the back of the throat. Viral shedding in respiratory secretions occurs for 1 day before illness and 5-10 days after illness onset. Viral titers are generally higher in young children with shedding lasting 10 days or longer. Peak shedding of virus generally occurs during the first 3 days of ill-

ness and correlates with the presence of fever.

### **Complications of Influenza**

Post influenza complications are common. Influenza is an important cause of otitis media. Acute myositis characterized by calf tenderness and refusal to walk has been described especially with influenza type B. In infants, influenza can produce a sepsis-like picture and occasionally can cause croup, bronchiolitis, or pneumonia. Although the large majority of children with influenza recover fully after 3 to 7 days, previously healthy children can have severe symptoms and complications. Neurologic complications associated with influenza range from febrile seizures to severe encephalopathy and encephalitis with status epilepticus, with resulting neurologic sequelae or death. Reye syndrome has been associated with influenza infection and salicylate exposure. Death from influenza-associated myocarditis has been reported. Invasive secondary infections or coinfections with group A streptococcus, *Staphylococcus aureus* (including methicillin-resistant *S. aureus* [MRSA]), *Streptococcus pneumoniae*, or other bacterial pathogens can result in severe disease and death.

Hospitalization rates among children younger than 2 years of age are similar to hospitalization rates among people 65 years of age and older. Children younger than 24 months of age consistently are at substantially higher risk of hospitalization than are older children, and the risk of hospitalization attributable to influenza infection is highest in the youngest chil-

dren. Rates of hospitalization and morbidity attributable to complications, such as bronchitis and pneumonia, are even greater in children with high-risk conditions, including hemoglobinopathies, bronchopulmonary dysplasia, asthma, cystic fibrosis, malignancy, diabetes mellitus, chronic renal disease, and congenital heart disease. Influenza virus infection in neonates also has been associated with considerable morbidity, including a sepsis-like syndrome, apnea, and lower respiratory tract disease. Fatal outcomes, including sudden death, have been reported in both chronically ill and previously healthy children. All influenza-associated pediatric deaths are nationally notifiable and should be reported to the CDC through state health departments.

### Diagnostic Tests

Specimens for viral culture, immunofluorescent, or rapid diagnostic tests should be obtained if possible during the first 72 hours of illness, because the quantity of virus shed decreases rapidly as illness progresses beyond that point. Rapid enzyme immunoassay diagnostic tests for identification of influenza A and B antigens in respiratory tract specimens are available commercially, although their reported sensitivity (44%–97%) and specificity (76%–100%) compared with viral culture are variable and differ by test and specimen type. Additionally positive and negative predictive values of these influenza screening tests is influenced by the prevalence of circulating influenza viruses resulting in an

increased likelihood of false-positive results during periods of low influenza activity. Direct fluorescent antibody (DFA) and indirect immunofluorescent antibody (IFA) staining for detection of influenza A and B antigens in nasopharyngeal or nasal specimens are available at most hospital-based laboratories and can yield results in 3 to 4 hours. Reverse transcriptase-polymerase chain reaction (RT-PCR) testing of respiratory tract specimens may be available at some institutions and offers potential for high sensitivity and specificity in particular with the 2009-2010 H1N1 pandemic strain.

### Treatment of Influenza

Treatment is mostly supportive with rest, fluids, and antipyretics such as acetaminophen or ibuprofen. Aspirin and other salicylate-containing products should be avoided as it is associated with a rare severe complication called Reye Syndrome. Antivirals administered within 2 days of illness onset may have the greatest benefit to reduce the duration of uncomplicated influenza illness and should be considered for those who are at increased risk of severe or complicated influenza infection. Other candidates for antiviral therapy include healthy children with moderate to severe illness and people with special environmental, family, or social situations where ongoing influenza illness would be detrimental. Antiviral treatment should be continued for 5 days and be discontinued approximately 24 to 48 hours after symptoms resolve. Children with severe influenza



should be evaluated carefully for possible coinfection with bacterial pathogens, such as *Staphylococcus aureus*, that might require antimicrobial therapy.

In the United States, two classes of antiviral medications are available for treatment or prophylaxis of influenza infections: neuraminidase inhibitors (oseltamivir and zanamivir) and adamantanes (amantadine and rimantadine). Treatment has been shown to decrease the duration of flu-related symptoms by 1 to 1.5 days. Oseltamivir has been approved for chemoprophylaxis and treatment of patients older than one year old. Zanamivir has been approved for treatment in patients 7 years and older and chemoprophylaxis of patients age 5 years and older.

Influenza B viruses intrinsically are resistant to adamantanes and since 2005 all H3N2 strains in the United States have been resistant to adamantanes. During the 2008–2009 influenza season, virtually all H1N1 influenza strains were resistant to oseltamivir but remained susceptible to zanamivir, amantadine, and rimantadine. The most recent pandemic 2009–2010 H1N1 strain was once again susceptible to oseltamivir.

These resistance patterns among circulating influenza A virus strains present challenges in selecting antiviral medications for treatment and chemoprophylaxis of influenza and provide additional reasons for clinicians to test patients for influenza virus infection and to consult surveillance data in their community when evaluating people with acute respiratory tract illnesses during the influenza

season. Specific drug recommendations for treatment and chemoprophylaxis may vary by season, geographic location, and level of circulating viral resistance. The CDC website provides current recommendations for treatment and chemoprophylaxis of influenza: [www.cdc.gov/flu/professionals/antivirals/index.htm](http://www.cdc.gov/flu/professionals/antivirals/index.htm).

Zanamivir (Relenza®) is available as a dry powder administered via oral inhalation with a plastic device. The dose is two breath-activated inhalations (one 5 mg blister per inhalation = 10 mg) bid for 5 days. Zanamivir is not recommended for use in patients with underlying airway disease including asthma or COPD, because of a lack of safety and efficacy data in these patients. Oseltamivir (Tamiflu®) is available as pills or liquid and is given twice daily for 5 days, with dose adjustments required in renal impairment. Pediatric dosing of oseltamivir for 1 – 12 years is 2 mg/Kg/dose bid x 5 days (max. dose = 75 mg) and for 13 years and older: 75 mg bid x 5 days.

## Chemoprophylaxis

Chemoprophylaxis or prolonged administration of antiviral medications during the periods of highest risk for transmission is an adjunct for control and prevention of influenza in specific situations and is not a substitute for immunization. Chemoprophylaxis should be considered for protection of children at increased risk of severe infection or complications who are unable to receive influenza vaccine due to contraindications and for immunocompromised children who may not respond to

vaccine. Other considerations include the protection of unimmunized high-risk children or children who were immunized less than two weeks before influenza circulation and who may not have developed an adequate immune response, protection of unimmunized close contacts of high-risk children, protection of immunized high-risk children if the circulating influenza strain is a poor match to the strain in the vaccine and for the control of influenza outbreaks in some institutional closed settings.

### **Prevention of Influenza**

Good infection control maintenance is a well known cornerstone of disease management and needs to be the focus of general practice management of all respiratory outbreaks including seasonal and pandemic influenza. Infection control refers to all policies, procedures and activities that aim to prevent or minimize the risk of transmission of infectious diseases. This includes simple measures such as adequate hand hygiene by hand washing or hand rubs, and cough etiquette to more involved measures such as personal protective equipment (PPE).

Hospitalized patients with influenza should be placed on droplet precautions (mask, gown and glove). Respiratory hygiene/cough etiquette (placing masks on patients with a cough when outside of their room) should be incorporated into infection control practices. Visitors who have any respiratory illness symptoms should be discouraged from visiting patients. Health

care workers who are ill should be restricted from working until they are healthy.

The primary measure to prevent influenza is vaccination of both patients and families, and healthcare workers. The rapid evolution of new strains of influenza necessitates annual reformulation of the vaccine strains and annual vaccination of vaccine recipients to maintain immunity to current influenza strains. All currently available inactivated and live attenuated influenza vaccines are trivalent, meaning they contain 3 strains that represent the most recent circulating wild-type strains in a given year: A (H3N2), A (H1N1), and B. Initiation of influenza vaccination programs should start as soon as influenza vaccine is available from manufacturers and should be continued throughout the influenza season.

### **Surveillance and Surge Planning**

During the pre-pandemic intervals, healthcare providers and healthcare facilities play an essential role in surveillance for suspected cases of infection with novel strains of influenza and should be on the alert for such cases. Novel strains may include avian or animal influenza strains that can infect humans such as avian influenza A H5N1 or novel influenza A H1N1 and new or re-emergent human viruses that cause cases or clusters of human disease. For detection of cases during the Pre-Pandemic and Pandemic Intervals, hospitals should have predetermined thresholds for activating pandemic influenza surveillance plans.



Influenza pandemics are different from many of the threats for which public health and the healthcare system are currently planning. The pandemic will last much longer than most other emergency events and may include “waves” of influenza activity separated by months (in 20th century pandemics, a second wave of influenza activity occurred 3 to 12 months after the first wave). The numbers of healthcare workers and first responders available to work can be expected to be reduced; they will be at high risk of illness through exposure in the community and in healthcare settings, and some may have to miss work to care for ill family members. It is reasonable to assume that absenteeism may exceed 25%. Resources in many locations could be limited because of how widespread an influenza pandemic would be.

The goal of a pandemic surge plan for an emergency department or other outpatient setting is to provide safe and effective care in the event of an influenza pandemic or similar event, and to optimize resources and mitigate throughput issues in order to provide for maximum surge capacity for pediatric patients presenting to the emergency department for care. Utilizing the all-hazards approach to develop plans for epidemic and pandemic respiratory illness is based on the concept that most disaster-response functions are common to all disaster types, and unified planning provides the strongest basis for effective response.

Critical components of comprehensive plans must address the following: 1)

Screening, surveillance, and tracking of exposed individuals; 2) controlled access to the healthcare facility; 3) prevention strategies (isolation and cohorting, PPE use, vaccination, antiviral prophylaxis, modification of environmental controls (i.e., separate areas for ill and non ill patients); 4) disease-specific admission criteria, treatment, and triage algorithms; and 5) enabling the continuity of limited clinical operations.

In all healthcare settings, patients with symptoms of influenza or influenza like illness (ILI) should be segregated from non-influenza patients as rapidly as possible, especially in a triage setting. When possible, consider having different teams of staff should care for influenza and non-influenza patients. In acute care settings, triage non ILI patients promptly to specific non ILI waiting and examining areas, physically separate from the ILI assessment area to prevent their exposure to ILI if possible. Additionally separate entrances and exits should be established for those who believe they may have been exposed to ILI or those that are in need of other types of medical attention if feasible.

Admission policies and testing and treatment algorithms should also be created for determining if a patient needs to be admitted to the hospital or if an alternate care facility may be more appropriate if altered standards of care are being used. If possible, hospitals triage protocols for phone triage may help to educate patients and families and provide help with illness management without access-

ing the clinic, emergency department or hospital setting. The diagnosis and treatment algorithms used at the Children's Hospital Colorado can be found in this module appendix.

### **Special Issues in Developing Countries**

Several factors may be involved in the high mortality rates pandemics cause in developing countries. These include lack of access to adequate medical care, weak public health infrastructures, social factors such as housing conditions and population density, and host factors such as nutritional status and co-existing medical conditions. Core interventions to control or mitigate the effects of an influenza pandemic include pharmaceutical interventions such as vaccines and antiviral agents, and nonpharmaceutical interventions such as quarantine, isolation, social distancing, and personal hygiene.

Antiviral agents are particularly useful in the early stages of a pandemic when there is shortage of vaccines. Stockpiling of neuraminidase inhibitors is part of many industrialized countries pandemic preparedness plans however stockpiles of antiviral agents available in developing countries is small and limited. The most critical limiting factor for stockpiling neuraminidase inhibitors in developing countries is their high cost and allocating scarce resources to stockpile sufficient quantities of oseltamivir for an unpredictable influenza pandemic. Because only a limited number of vaccines will be ini-

tially available, particularly in the early stages of a pandemic, and most of them would likely be supplied to industrialized countries, developing countries will need to focus initially on nonpharmaceutical interventions. Maintaining a balance between pharmaceutical and nonpharmaceutical interventions is necessary to achieve the best use of limited resources.

During an influenza pandemic, additional essential medical supplies such as gloves, masks, syringes, antipyretics, and antimicrobial agents will also be required. These supplies are insufficient in health-care facilities in developing countries, even in nonemergency situations. Lack of these supplies may hamper provision of adequate medical care for patients with pandemic influenza. Basic PPE such as disposable gloves and surgical masks are needed for protecting healthcare workers. Anti-microbial agents are expected to be effective for secondary bacterial pneumonia, which can be a major cause of death for patients with pandemic influenza.

Providing better medical care during a pandemic is essential to reduce the health consequences of the pandemic including death. Since the availability of pharmaceutical interventions in developing countries is less likely, nonpharmaceutical interventions such as social distancing and personal hygiene may be the only available interventions. Essential medical supplies such as masks, gloves, and antimicrobial agents should be available in hospitals and clinics. The stockpiles of these basic supplies can be more cost-effective in developing

countries than stockpiles of more expensive antiviral agents. Healthcare personnel should be trained for infection control measures, especially hand hygiene and use of personal protective equipment. The overarching goal is to maintain the current healthcare and public health systems need to minimize the impact of a pandemic. The link to PAHO's Pandemic Influenza A (H1N1) 2009 manuals that describe preparedness planning, infection prevention and control, nonpharmaceutical strategies and IMCI diagnosis, treatment and management protocols in Spanish, English, Portuguese and French is [http://new.paho.org/hq/index.php?option=com\\_content&task=view&id=2914&Itemid=1084&lang=en](http://new.paho.org/hq/index.php?option=com_content&task=view&id=2914&Itemid=1084&lang=en).

### **Lessons Learned from 2009-2010 H1N1 Pandemic**

The WHO plans to continue to strengthen influenza surveillance and the early warning system, build capacity to cope with a pandemic, and further coordinate global scientific research and development activities. The current novel influenza A (H1N1) pandemic confirms the need for preparedness plans that focus on both nonpharmaceutical strategies (social distancing, infection control and quarantine), and pharmaceutical strategies (antiviral drugs use for the treatment and prophylaxis of influenza, and the use of influenza vaccines) to miti-

gate the effect of the pandemic. The importance of building human surge capacity allows the allocation of health resources including the provision of essential health services and determination of the roles each institution plays in the response. Infection prevention and control activities have been critical to protect healthcare workers and to prevent the nosocomial spread of influenza infections.

Additionally, there is an urgent need to have better detection methods for influenza viruses, including the creation or strengthening and scaling-up of laboratory capacity for influenza diagnosis in most settings (low-, middle-, and high-income countries), through international networks of collaboration, technology transfer, and capacity-building efforts. Pharmacologic interventions including the use of antiviral drugs and medical interventions such as antimicrobials to treat secondary bacterial pneumonias, along with the use of supportive medical care such as oxygen, anti-inflammatory drugs, and antipyretics, have also shown to be a critical component of the overall response activities during the current influenza pandemic. Finally, all countries should develop pandemic influenza vaccine deployment or antiviral deployment plans, regardless of the current absence of availability of pandemic influenza vaccine or adequate supplies of antiviral medications.



# INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS (IMCI)

### OBJECTIVES

- Describe the rationale for the WHO evidence-based syndromic approach to case management as described in the IMCI.
- List the clinical illnesses included in the IMCI program and their relevance in situations associated with disasters.
- Assess and classify the condition of a child to determine its severity and establish the relationship between this classification and the subsequent management.
- List the danger signs that should be routinely checked in all children.

### What is IMCI?

The strategy for the IMCI was designed by PAHO and WHO to enhance children's health and reduce the mortality and morbidity due to the most prevalent diseases in developing countries. The principles and approach of IMCI may become very useful in disaster situations in developed countries, when the primary care capacity has been degraded and there is an increase in morbidity of common childhood infections related to conditions caused by the disaster.

### CASE I.

A 15-month-old boy presents at the emergency department with a fever. He had been healthy until 3 days ago, when he developed symptoms of upper respiratory airway infection. His mother reports giving ibuprofen to her son the day before, because of the fever. The child continues to be febrile with reduced food and fluid intake, urine output, and activity level. There is no history of vomiting, diarrhea, cough, or rash. He is not receiving any medication. You note fatigue and irritability when the child is stimulated during the physical examination. Respiratory rate is 50 breaths/min, pulse rate 162 beats/min, blood pressure 92/70 mm Hg, and axillary temperature 38.9°C. He has dry lips but wet oral mucosa without lesions. His neck is flexible. Lung and heart examination are unremarkable with no significant findings. A few isolated petechiae are noted over the abdomen and lower limbs. Peripheral pulse is normal and capillary refill time is 3 seconds.

- **What is your global clinical impression for this boy?**
- **What is the most probable diagnosis?**
- **What treatment strategies should you adopt initially?**

This strategy includes the early diagnosis, treatment and timely referral of children under 5 years of age with the most common diseases. It also contributes to improving parental skills and practices associated with the home care of children. A community-based approach is essential for childhood health, because it promotes healthy habits in the family, adequate care of children (feeding, clothing, stimulation, etc.), disease prevention, and prompt seeking of medical care when alarming signs and symptoms are noted. The IMCI strategy also helps healthcare professionals take advantage of opportunities for prevention, promote childhood development, and encourage the rational use of drugs and medications. This strategy is not meant for chronic or less frequent diseases or acute emergencies. As a complement to ambulatory care, this strategy includes procedures and practices at different referral levels and types of hospitals.

The IMCI strategy is based on the importance of simple clinical signs and symptoms, the proper classification of the disease, timely treatment, and interventions for prevention and follow-up. It is particularly useful in the first level of care, i.e., camps, medical offices, health care centers or hospital primary care departments. It includes a series of procedural algorithms and standardized forms to record the patients' care. **Figure 1** shows the algorithm describing the care processes.

### IMCI Guidelines

The practical IMCI guidelines are based on the following principles:

- All sick children must be assessed for

general danger signs, which indicate the need for immediate referral or admission to a hospital.

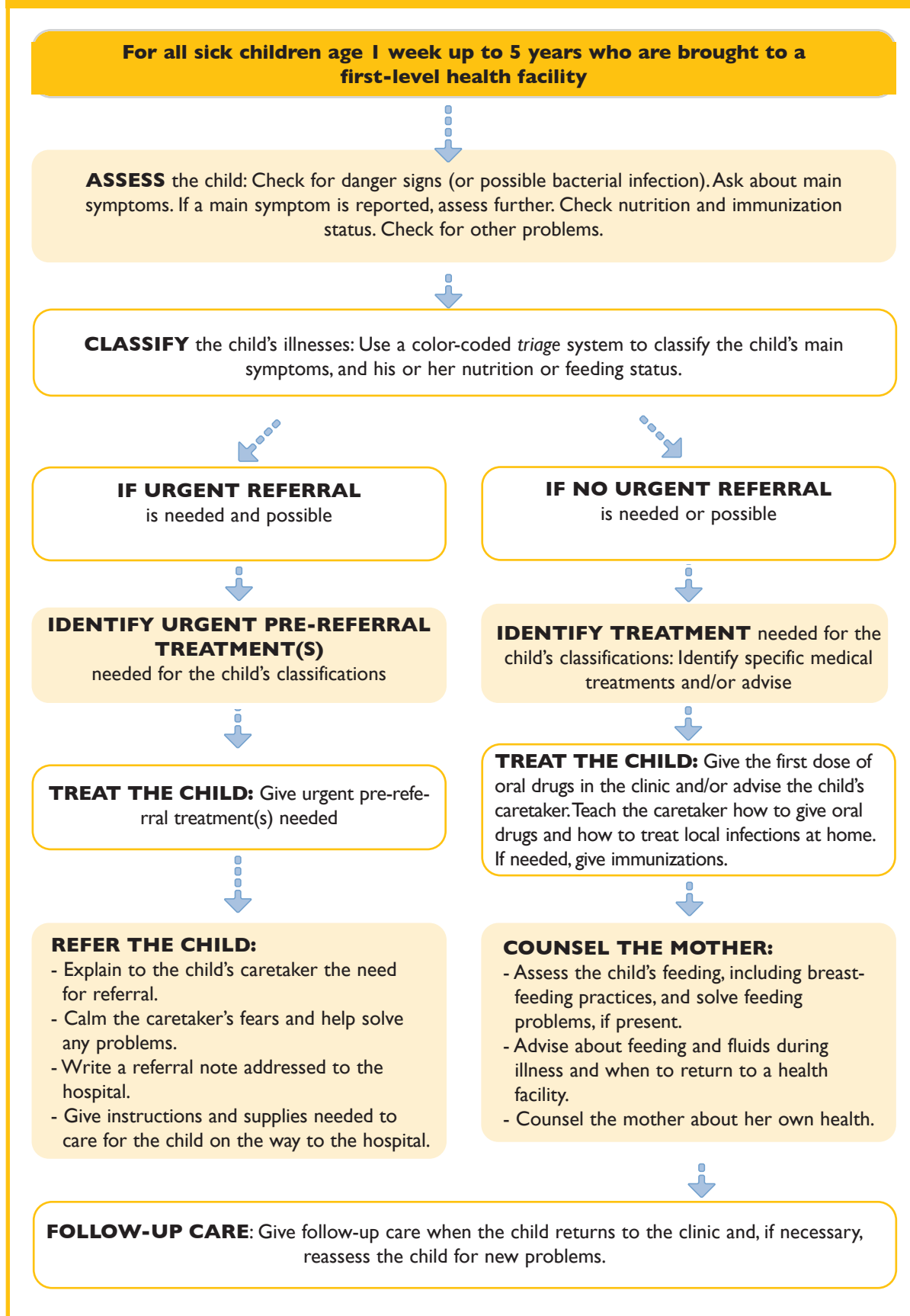
- All sick children must be routinely assessed for major symptoms (for children from 2 months to 5 years old: cough or difficult breathing, diarrhea, fever, ear problems; for infants age 1 week to 2 months: bacterial infection and diarrhea). They must also be assessed for nutritional and immunization status, feeding disorders, and other potential problems.
- Only a limited number of carefully selected clinical signs are used, based on evidence of their sensitivity and specificity to detect diseases. These signs were selected also considering the available resources in first-level healthcare facilities.

The combination of individual signs leads to a child's classification rather than a diagnosis. This classification indicates the severity of the condition and calls for specific actions based on whether the child (a) should be urgently referred to a higher level of care, (b) requires specific treatments, or (c) can be safely managed at home. The classification is color-coded: red requires hospital referral or admission; yellow indicates the need to initiate treatment; and green indicates home management.

The IMCI strategy addresses most, but not all, of the major reasons why a sick child is brought to a clinic. A child with a chronic condition or a less common illness may require special care. The guidelines do not describe the management of



The IMCI strategy also helps healthcare professionals take advantage of opportunities for prevention, promote childhood development, and encourage the rational use of drugs and medications.

**FIGURE I.** Summary of the process of integral care of children

trauma or other acute emergencies due to accidents or injuries. IMCI management strategy uses a limited number of essential drugs and encourages the active participation of caregivers in the treatment of children. A basic component of the IMCI strategy is the counselling of caretakers about home management issues, such as feeding, fluids, and when to return to a health facility (**Box 1**).

### Assessment of Sick Children

The assessment procedure for this age group includes a number of important steps that must be taken by the healthcare provider: (1) Take a history and talk with the caregiver about the child's problem; (2) check for general danger signs; (3) assess major symptoms;

(4) evaluate nutritional status; (5) assess the child's feeding; (6) check immunization status; and (7) look for other problems.

### Danger Signs that should be Routinely Checked in all Children

*Seizures during the current illness.* Seizures may result from fever. Febrile seizures do little harm beyond frightening the parents. But seizures may also be associated with meningitis, cerebral malaria, or other life-threatening conditions. All children with seizures during the current illness should be considered seriously ill.

*Unconsciousness or lethargy.* An unconscious child is likely to be seriously ill. A lethargic child who is awake but does not take any notice of his/her surroundings or does not respond normally to sounds or movement may also be very sick. These signs can be associated with many conditions, including severe dehydration, severe hypoxia, sepsis, or meningitis.

*Inability to drink or breast-feed.* An infant may be unable to drink if he/she is too weak or cannot swallow. Observe the child while the mother breast-feeds or gives him/her something to drink.

*Persistent vomiting.* Vomiting itself may be a sign of serious illness. This symptom may also prevent the child from taking medications or fluids for rehydration.

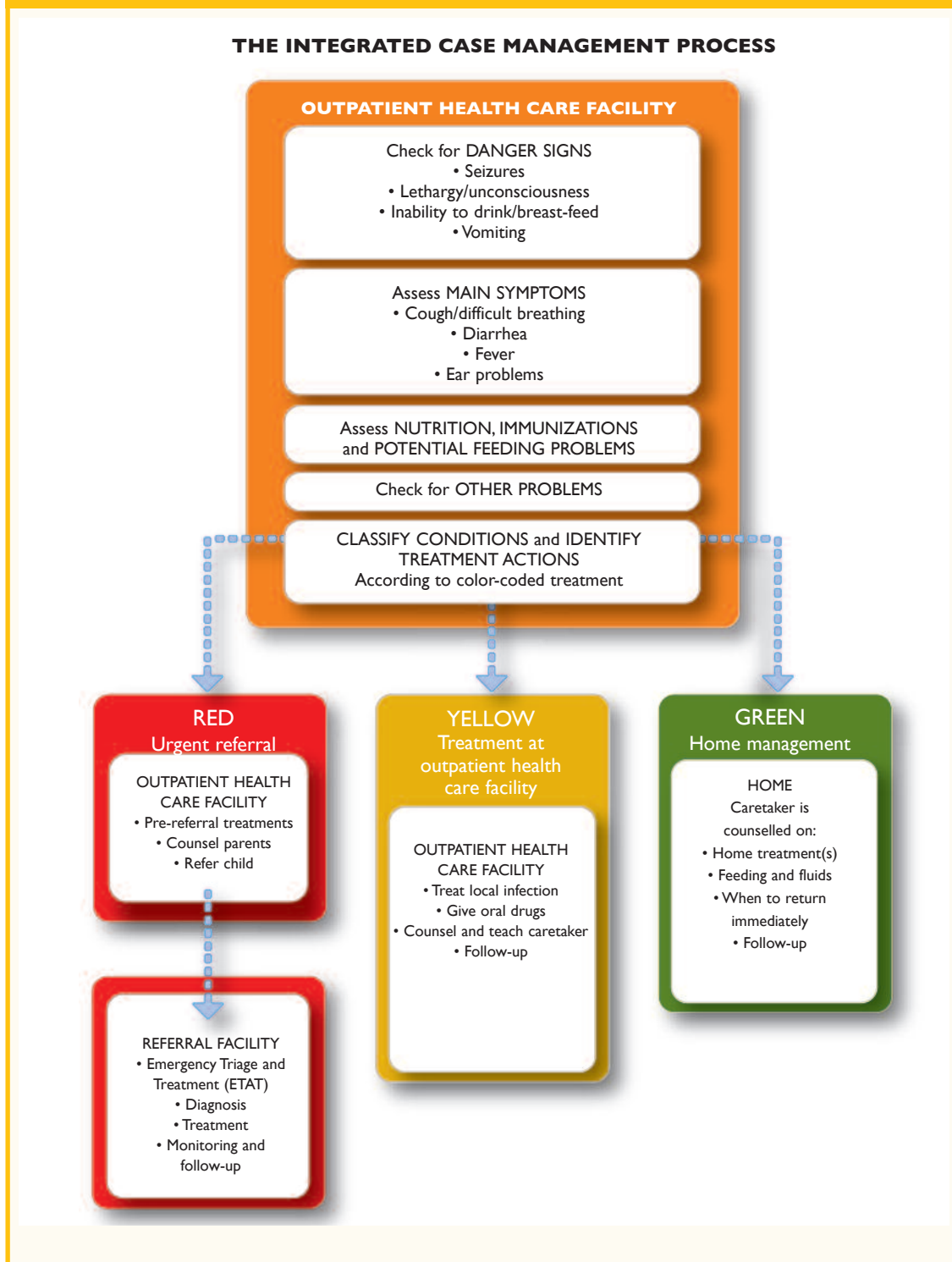
A child with *one or more* of these signs must be considered seriously ill and will require hospital referral. In order to start treatment for severe illnesses without delay, quickly assess the child for the most

## 1

### BOX 1. Key aspects of the IMCI strategy

- Evaluates general danger signs
- Assesses major symptoms
- Assesses nutritional status, immunization status, feeding disorders, and other potential problems
- Includes a limited number of carefully selected clinical signs
- Combines clinical signs to define the classification for the evaluated child
- Addresses most, but not all, of the major reasons why a sick child is brought to a clinic
- Uses a limited number of essential drugs
- Encourages active involvement of adult caretakers in the children's management
- Offers counselling to caretakers

**FIGURE 2.** IMCI strategy for case management in the outpatient healthcare facility, first-level referral service, and at home for the sick child from age 2 months to 5 years





important causes of serious illness and death, including acute respiratory infection (ARI), diarrhea and dehydration, sepsis, malaria, and measles. A rapid assessment of nutritional status is also crucial, as malnu-

trition contributes to developing an overwhelming infection and death, and is in itself a main cause of death. **Figure 2** gives an overview of IMCI case management strategies.



## SECTION III / ACUTE RESPIRATORY INFECTIONS

# ACUTE RESPIRATORY INFECTIONS

### OBJECTIVES

- Know the 3 key clinical signs used to assess a child with cough or difficult breathing and based on these signs classify acute respiratory clinical illness into 3 categories.
- Diagnose and develop a treatment plan (medications, supportive care and monitoring) using available resources for patients with:
  - Severe pneumonia
  - Pneumonia
  - Upper respiratory infection
  - Ear problem without pneumonia

### Acute Respiratory Infections: The Patient with Cough or Difficult Breathing

All types of respiratory infections are more common among people living in overcrowded conditions. Most cases of acute respiratory infections (ARI) are viral upper respiratory tract infections that should not be managed with antibiotics. The IMCI strategy uses 3 key clinical signs to assess children with cough or difficult breathing:

- Respiratory rate (RR) distinguishes the presence or absence of pneumonia.
- Lower chest wall indrawing indicates severe pneumonia.

—Stridor in a calm child indicates severe upper airway obstruction and the need for hospital admission.

### Respiratory Rate

No single clinical sign has a better combination of sensitivity and specificity to detect pneumonia in children under 5 years than RR. Even auscultation by an expert is less sensitive as single sign. Cutoff rates for fast breathing (tachypnea) depend on the child's age. Normal RR is higher in children aged 2 to 12 months than in children from 12 months to 5 years ([Table 1](#)).

The specificity of RR for detecting pneumonia depends on the prevalence of bacterial pneumonia among the population. In areas with high levels of viral pneumonia, RR has relatively modest specificity. Nevertheless, even if the use of RR leads to some over-treatment, this will still be small compared with the use of antibiotics among all children with an ARI, as frequently occurs.

### Lower Chest Wall Indrawing

Lower chest indrawing is defined as the inward movement of the bony structure of the chest wall with inspiration. It is a useful marker of severe pneumonia. It is more specific than "intercostal indrawing," which includes the soft tissue between the ribs without affecting the bony structure of the

**TABLE 1.** Respiratory rate

Child's age	Cutoff rate for fast breathing (tachypnea)
2 months to 12 months	50 breaths per minute or more
12 months to 5 years	40 breaths per minute or more



No single clinical sign has a better combination of sensitivity and specificity to detect pneumonia in children under 5 year than respiratory rate.

chest wall. Chest indrawing should only be considered present if it persists in a calm child. Agitation, a blocked nose, or breast-feeding can all cause temporary chest indrawing.

### Stridor

Stridor is a harsh noise made when the child inhales. Children who present with stridor when calm are at substantial risk of upper airway obstruction and should be referred. Some children with mild croup manifest stridor only when they are crying or agitated.

### Wheezing

Sometimes a wheezing noise is heard at exhalation. Wheezing is usually associated with asthma or viral bronchiolitis. With fast breathing, no distinction is made between children with bronchiolitis and those with pneumonia.

In some cases, especially when a child has wheezing at exhalation, the final decision on presence or absence of fast breathing can be made after a test with a rapid-acting bronchodilator (if available). Experience suggests that even where asthma rates are high, mortality from asthma is relatively uncommon.

### Classification of Children with Cough or Difficult Breathing

Based on a combination of the aforementioned clinical signs, children presenting with cough or difficult breathing can be classified into 3 categories: those who require referral for possible severe pneumonia or very severe disease, those who require antibiotics as outpatients, and those who do not require antibiotic treatment (**Box 2**).

**2**

#### **BOX 2.** Classification of children with cough or difficult breathing according to clinical signs

Very severe respiratory disease or pneumonia (**RED**)

- Any general danger sign
- Chest indrawing
- Stridor in a calm child

Pneumonia (**YELLOW**)

- Fast breathing

Cough without pneumonia (**GREEN**)

- No signs of pneumonia or other severe disease

The group requiring referral for possible very severe disease includes children with any general danger sign, lower chest indrawing, or stridor when calm. Children with severe pneumonia or very severe disease are more likely to have life-threatening invasive bacterial infections. This indicates the need to use injectable antibiotics.

Give outpatient antibiotics to children with a fast RR for their age to treat bacterial pneumonia when they do not have additional danger or severe signs. Fast breathing, as defined by WHO, detects about 80% of children with pneumonia who need antibiotic treatment. Treatment based on this classification has been shown to reduce mortality.

Patients with cough and no signs sug-

gesting pneumonia or severe disease do not require antibiotics. Such children may require a safe agent to relieve cough. A child with cough will normally improve in 1 to 2 weeks. However, a child with chronic cough (more than 30 days) needs to be further assessed (and, if needed, referred) to rule out tuberculosis, asthma, whooping cough, or another respiratory problem (Mulholland et al., 1992).

### **Antibiotics**

First-line oral antibiotic for suspected pneumonia will typically be amoxicillin. Intramuscular (IM) antibiotics used to treat severe pneumonia or very severe disease include ceftriaxone when admission and IV antibiotics are not possible.



## SECTION IV / OTHER CASES THAT REQUIRE ATTENTION

# OTHER CASES THAT REQUIRE ATTENTION AT THE SCENE OF THE DISASTER

### OBJECTIVES

- Distinguish other clinical entities that can present at the scene of the disaster, such as tuberculosis.
- Consider meningitis in emergency settings and assess the clinical findings.

### Tuberculosis

Even though tuberculosis (TB) is the leading infectious cause of death in some parts of the developing world, TB treatment and control programs are not part of an emergency relief response. TB is a chronic infection and effective treatment is very resource-intensive. Treatment programs need to include resources to identify and monitor true cases by sputum smears exam, a stable population for at least 6 months (to complete short-course therapy), enough available drugs to treat all cases, and enough personnel to supervise all therapy in the first 2-3 months. Administration of anti-TB drugs to per-



Even though tuberculosis (TB) is the leading infectious cause of death in some parts of the developing world, TB treatment and control programs are not part of an emergency relief response.

### CASE 2.

A 3-month-old infant presents with fever, restlessness, and poor food intake. He is irritable and it is difficult to soothe him. He is breathing normally. His vital signs include respiratory rate 36 breaths/min, heart rate 120 beats/min, blood pressure 90/58 mm Hg, temperature 102°F (39.2°C), and oxygen saturation 98%. The fontanelle looks full and the neck is flexible. Capillary refill time is 2 seconds.

- **Which of these findings are consistent with the diagnosis of meningitis?**
- **Which is the most important therapeutic measure to be implemented?**
- **Which complications could possibly occur?**



sons who will not adhere to or complete treatment is likely to contribute to drug resistance in the community.

## Meningitis

Meningitis is the inflammation of the membranes (meninges) that surround the brain and spinal cord. Encephalitis is the inflammation of the cerebral cortex. Meningoencephalitis involves both the meninges and the cerebral cortex.

Meningitis may be due to viral, bacterial, or fungal infections. Approximately two-thirds of diagnosed cases are viral and one-third are bacterial. The most common viral infections are caused by enteroviruses and herpes simplex virus.

The most common bacterial pathogens that cause meningitis during the first 3 months of life include group B *Streptococcus* (GBS), *Escherichia coli*, *Listeria monocytogenes*, enterococci, *Staphylococcus aureus*, and Gram-negative enteric organisms. The viral pathogens in this age group are herpes simplex virus, enterovirus, and cytomegalovirus.

Pathogens infecting infants more than 3 months of age and children are most often *Streptococcus pneumoniae*, *Haemophilus influenzae* type b (Hib) and *Neisseria meningitidis*. Other organisms such as *M. tuberculosis*, *Salmonella*, and *Mycoplasma pneumoniae* are rare.

The frequency of *Haemophilus* infection has dramatically decreased with immunization. However, in areas of the world where conjugate Hib vaccine is not administered, this organism remains a common cause of meningitis. Viral pathogens most prevalent

in this age group include enterovirus, arbovirus, herpes simplex virus, herpes virus, influenza, and Epstein-Barr virus.

## Clinical Findings of Meningitis

Look for changes in mental status and level of activity, including irritability, changes in feeding and sleeping patterns, unresponsiveness, and seizures.

Check for signs of meningeal irritation: nuchal rigidity, bulging fontanelle, paradoxical irritability, and Brudzinski and Kernig signs.

Evaluate hydration status and signs of shock, such as mottled skin, slow capillary refill, increased pulse, and decreased blood pressure. Perform a neurologic examination and document focal neurologic signs, paresis, or ataxia. Measure the head circumference and look for exanthem, purpura or petechiae, or soft-tissue, bone, or joint infections.

Signs associated to central nervous system complications include focal neurologic findings, prolonged seizures, persistent changes in mental status, enlarging head circumferences, or ataxia. Complications include subdural effusion or empyema, cerebral edema, cerebral abscess, cerebral infarction, or hydrocephalus.

## Treatment of Meningitis

Suspected cases of severe sepsis or meningitis need to be treated promptly with the best available drugs. Report such cases to health authorities and make attempts to obtain appropriate samples for identification of the causative agent.

Identification of *Neisseria meningitidis* is

particularly important because of its epidemic potential and the fact that a reasonably effective vaccine is available. During confirmed *N. meningitidis* outbreaks, implement vaccination and chemoprophylaxis of household contacts.

*N. meningitidis* remains susceptible to penicillin all over the world. Treat newborn infants with ampicillin and an aminoglycoside (gentamicin) or cefotaxime. Ampicillin is needed to cover *Listeria* and enterococci. Treat infants 1 to 3 months of age with ampicillin and ceftriaxone, or cefotaxime to cover enterococcus, *Listeria*, and *H. influenzae*. Treat older children with vancomycin and ceftriaxone if the rate of penicillin-resistant *S. pneumoniae* in the area is high.

When non-susceptible organisms are identified, consider the recommended high doses of cefotaxime and ceftriaxone, and add rifampin when the minimum inhibitory concentration (MIC) of the non-suscepti-

ble pneumococci is  $>2.0 \mu\text{g/mL}$ . If possible, obtain serum creatinine levels before giving vancomycin, and repeat weekly during treatment because vancomycin excretion depends on glomerular filtration.

Use penicillin G, ampicillin, cefotaxime, or ceftriaxone for *N. meningitidis*. The duration of IV therapy varies with the pathogen. Treat Gram-negative enteric organisms for 21 days; *S. pneumoniae* for 10 to 14 days; *H. influenzae* for 7 to 10 days, and *N. meningitidis* for 4 to 7 days.

When using aminoglycosides or chloramphenicol, monitor blood levels if possible (therapeutic levels for gentamicin or tobramycin are 4 to 8  $\mu\text{g/mL}$ ; for kanamycin or amikacin, 15 to 25  $\mu\text{g/mL}$ ). Adequate blood chloramphenicol levels can be achieved with oral administration. Whenever possible, avoid aminoglycosides in patients with renal disease and chloramphenicol in patients with hepatic dysfunction.



## SECTION V / VACCINATION IN DISASTER SITUATIONS

# VACCINATION IN DISASTER SITUATIONS

### OBJECTIVES

- Acknowledge the importance of measles immunization in a disaster situation.
- Recognize the characteristics of tetanus-prone injuries and wounds.
- Describe specific situations that require the use of other vaccines.

The only vaccine that may be routinely administered during immediate emergency relief efforts is measles. A routine immunization program for other vaccines should only be considered if the population is expected to stay in the area for longer than 3 months, if it is possible to keep appropriate records, and if other assistance efforts are not disrupted or compromised by the activities needed for vaccination.

### Tetanus

Tetanus immunization is not routinely recommended in disaster situations, but if the vaccine is available, it is reasonable to apply it prophylactically to individuals who have tetanus-prone wounds if the time of the last tetanus immunization is unknown or greater than 5 years, or when the child has not received the primary 3-dose vacci-

nation series. The characteristics of tetanus-prone wounds are a wound that was first cleaned more than 6 hours after its occurrence; irregular wounds; wounds from bullets, crushing, burns, or frostbite; and presence of devitalized tissue or wound contaminants.

### Specific Situations Requiring Prophylaxis

#### Pertussis

*The vaccine.* It is well established that pertussis vaccine provides clinical protection after exposure to the disease in most people. The effectiveness of the vaccine with a regimen of 3 or more doses is around 80% to 90%. Appropriately immunized children who acquire the disease have milder symptoms and fewer complications.

*Management of outbreaks.* When an increase in the number of cases is suspected, mass immunization is a priority in children under 7 years old.

*Household contacts—vaccination.* Household contacts and other close contacts of patients under 7 years old who have had at least 4 previous doses of diphtheria-tetanus-pertussis vaccine (DTP or DTaP) must receive a booster injection of DTP or DTaP, unless they have received a dose within the past 3 years. Children under 7 years old who have not been immunized or who have previously received less than 4 doses must start or continue their vaccination regimen

according to the national program. A fourth dose must be administered to children who received their third dose 6 or more months before exposure.

**Chemoprophylaxis.** All household contacts and other close contacts, regardless of their age or immune status, should receive erythromycin (40-50 mg/kg/day orally, divided in 4 doses), for 14 days because immunity after vaccination is not total and infection may not be prevented. It has been proven that erythromycin eliminates the carrier state and is effective in limiting secondary spread. For patients who are intolerant to erythromycin, clarithromycin (15 mg/kg/day orally divided in 2 doses, for 1 week) may be administered; other options are azithromycin and trimethoprim-sulfamethoxazole.

### Meningococcal Disease

Few infectious diseases cause as much concern among the general population and health workers as meningococcal infection. The estimated attack rate for household contacts is 4 cases per 1,000 exposed persons. This is 500 to 800 times higher than rates in the general population. Chemoprophylaxis is indicated for those individuals who meet the criteria for close contacts. The goal is to eradicate *N. meningitidis* carriers and prevent the occurrence of secondary cases.

- Close contacts: household members, attendees at child care centers, nursery schools, schools, universities, and members of closed communities that are in contact with any individual with meningococcal disease for more than 4 hours

daily, 5 days a week; any other person directly exposed to oral secretions of the patient (e.g., sharing tableware, drinks, kisses; sneezing or coughing).

- Secondary case: any case occurring in a close contact 24 hours or more after onset of the disease in the primary case.

Because there is a high rate of secondary disease during the 5 days following contact, give chemoprophylaxis within the first 24 hours. It is not indicated beyond 14 days. A nasopharyngeal culture to determine the need for chemoprophylaxis is not warranted. If the patient was treated with third-generation cephalosporins, chemoprophylaxis before discharge is not needed. Rifampin is the first choice agent for chemoprophylaxis in children, but there are alternatives for adults (**Table 2**). Chemoprophylaxis is indicated for household members and contacts (**Box 3**). Monitor exposed individuals and assess if they have a febrile disease.

**The vaccine:** immunogenicity and effectiveness. With unconjugated polysaccharide vaccines, protection is achieved 7 to 10 days after immunization. Bivalent A + C vaccine is safe and effective (85% to 90%) in children older than 2 years old and in adults. The A component induces an immune response from 3 months of age on, with a seroconversion rate of 88% after the second dose, applied in children between 7 and 12 months old.

**Management of outbreaks.** An outbreak of meningococcal disease is defined when

**TABLE 2.** Recommended agents for chemoprophylaxis

Agent	Age Group	Dose	Duration
Rifampin	Newborns Children Adults	5 mg/kg/dose 10 mg/kg/dose 600 mg/dose	Every 12 h for 2 days
Ceftriaxone	≤12 years >12 years Pregnant women	125 mg IM 250 mg IM 250 mg IM	Single dose
Ciprofloxacin	≥18 years	500 mg orally	Single dose

IM: Intramuscular.

**3**

### BOX 3. Indications for chemoprophylaxis

#### Contacts who should receive chemoprophylaxis

- Household members
- Individuals who often sleep or eat with the patient, and meet the definition of contact
- Contacts in child care centers and nursery schools (including staff members) for more than 4 hours during 5 days in the previous week
- Individuals who have been directly exposed to the patient's secretions through kissing, or sharing food, drinks, toothbrushes, etc.
- Individuals administering mouth-to-mouth resuscitation
- Individuals who experience unprotected contact during endotracheal intubation in the 7 days prior to the onset of the disease

#### Situations where chemoprophylaxis is NOT indicated:

- Casual contact: no direct exposure to the patient's oral secretions (classmates or co-workers)
- Indirect contact: no contact with the patient, only with a case's contact
- Healthcare workers with no direct exposure to the patient's oral secretions

the attack rate is higher than 10 cases in 100,000 persons, in a specific area, with an epidemiologic relation among cases, and with a predominating serogroup. With active epidemiologic surveillance, an outbreak is also considered when the incidence rate by age is doubled. Where can outbreaks occur? Outbreaks can occur in an institution or an organization. In this case, an outbreak is defined by 3 or more confirmed, presumptive, or probable cases occurring in a period of 3 months or less within the same institution or organization, but without close contacts (e.g., schools, universities, military organizations, jails).

Community outbreaks are defined by 3 or more confirmed, presumptive, or probable cases that occur in 3 months or less among people who live in the same area and are not close contacts (e.g., small towns, cities, countries).

## **Guidelines for Evaluation and Management of a Meningococcal Disease Outbreak**

### **1. Reinforcement of active surveillance**

In areas where surveillance for meningococcal disease is passive, case reports may be incomplete or delayed. When an outbreak is suspected, alert public health authorities and request immediate report of new cases.

### **2. Case detection and bacteriologic confirmation**

Establish the diagnosis of meningococcal disease considering confirmed, presumptive, or probable cases.

- a. Confirmed case: isolation of *N. meningitidis* from a usually sterile site (blood, CSF) in an individual with clinically consistent findings.
- b. Presumptive case: observation of Gram-negative diplococci in any usually sterile site, with negative cultures and symptoms of disease.
- c. Probable case: positive antigen test for *N. meningitidis* (latex agglutination test, immunoelectrophoresis), with negative cultures and consistent symptoms.

Information about serogroup is essential. Laboratories not performing this test routinely should forward the sample to referral laboratories of higher complexity to identify the serogroup. If possible, investigate *N. meningitidis* subtype by pulsed-field gel electrophoresis or multilocus enzyme electrophoresis to determine if the strains of a

group of cases are interrelated and whether they represent an outbreak.

### **3. Appropriate treatment of patients, according to management guidelines**

### **4. Chemoprophylaxis and careful observation of contacts**

Chemoprophylaxis and careful observation are recommended for close contacts. Chemoprophylaxis for individuals who are not close contacts is ineffective in preventing community outbreaks; therefore, it is not recommended. Exposed individuals must be carefully monitored and evaluated in case of any febrile illness.

### **5. Investigation of relationships between cases**

In addition to demographics, obtain the following information for each affected individual: history of close contact with another primary case; participation in social activities or sports; attendance at child care centers, kindergartens, schools, universities, or clubs. This information will help identify cases as co-primary or secondary, reveal relationships between cases, and define the population at risk.

### **6. Assessment of the relationship of the suspected outbreak with the community or with an institution or organization**

### **7. Definition of at-risk population**

In outbreaks related to an institution or organization, cases are linked with a shared affiliation, such as attending the same day care center, kindergarten, school, or univer-

sity or belonging to the same sports team. In such cases, the population at risk is everyone in those places. On the other hand, in community outbreaks patients do not share an affiliation, only a geographically defined location, such as a neighborhood, small town, city, or country. The risk group includes every individual living in those places.

### 8. Estimation of attack rate

Attack rate can be estimated by the following formula:

$$\text{Attack rate} = \frac{\text{Number of probable and confirmed cases (over a 3-month period)} \times 100,000}{\text{Population at risk}}$$

With a global attack rate higher than 10 cases in 100,000, consider vaccination of at-risk population. Consider the incidence rates by age groups. If the incidence rate doubles in a population with adequate epidemiological surveillance, immunization may be considered.

### 9. Selection of the target group for vaccination

Consider the guidelines from public health authorities regarding the serogroup involved and the age group affected. In that case, it is necessary to have adequate vaccine supplies.



## SECTION VI / INFECTIONS IN INFANTS 0 TO 2 MONTHS OF AGE

# INFECTIONS IN INFANTS 0 TO 2 MONTHS OF AGE

### OBJECTIVES

- Identify and establish the treatment for sick infants 0 to 2 months of age.

### Assessment of the Sick Infant 0 to 2 Months of Age

As mentioned previously, newborn and infants under 2 months of age are very vulnerable to infections, with high morbidity and mortality rates associated with very severe clinical conditions including sepsis, meningitis, and pneumonia. Thus, if an infant under 2 months is suspected of having a severe neonatal illness or a possible severe bacterial infection, there is no time to lose in laboratory studies. It is extremely important to start antibiotic therapy immediately and to refer the patient to a hospital if needed resources are not available.

Infants weighing less than 2,000 g who are brought to the primary healthcare facility with a possible infection should be referred to a hospital for specialized treatment, regardless of the severity of the condition, because they are more vulnerable due to their immaturity. The assessment of the infant 0 to 2 months old should include the following questions:

- What is your baby doing?
- Is he/she feeding well or poorly?
- Has he/she vomited / Is he vomiting all he eats?
- Does he/she have diarrhea?
- Has he/she difficulty breathing?
- Has he/she have fever or hypothermia?
- Has he/she had seizures or shivering?

In addition, look for clinical signs that indicate the severity of the illness, from subtle signs such as "he doesn't look good" to neurologic signs (e.g., seizures) or difficult breathing. Assessment of body temperature, hydration status, capillary refill, and fontanelle characteristics are also important, as well as looking for other problems (congenital anomalies, surgical disorders). **Figure 2** (page 18) shows the algorithm used by the Integrated Management of Childhood Illness (IMCI) for assessment of sick infants 0 to 2 months of age.

### Classification of the Infant 0 to 2 Months of Age with Severe Illness or Possible Severe Bacterial Infection

Based on general danger signs, infants can be classified into four different categories as shown in **Table 3**. Children presenting with any sign in the upper row of **Table 3** are classified as having a severe illness or possible severe bacterial infection. In



If an infant less than 2 months is suspected of having a severe neonatal illness or a possible severe bacterial infection, there is no time to lose in laboratory studies.



It is extremely important to start antibiotic therapy immediately and to refer the patient to a hospital if needed resources are not available.

**TABLE 3.** Classification of the infant 0 to 2 months with severe illness or possible severe bacterial infection

SIGNS	CLASSIFY AS	TREATMENT
<p>(RED)</p> <p>One out of the following signs:</p> <ul style="list-style-type: none"> <li>• “Doesn’t look good”</li> <li>• Cannot be breast-fed</li> <li>• Lethargic/unconscious or flaccid</li> <li>• Vomiting</li> <li>• Seizures</li> <li>• Intense pallor</li> <li>• Weight &lt; 2,000 g</li> <li>• RR &gt; 60 or &lt; 30 per min</li> <li>• Temperature &lt; 36,5°C or &gt;37,5°C</li> <li>• Bulging fontanelle</li> <li>• Apnea</li> <li>• Nasal flaring</li> <li>• Grunting</li> <li>• Severe lower chest wall indrawing</li> <li>• Central jaundice</li> <li>• Jaundice below the umbilicus</li> <li>• Petechiae, pustules or vesicles in the skin (many or extended)</li> <li>• Pus drainage from ear</li> <li>• Umbilicus redness extending to skin</li> <li>• Poor capillary refill (&gt; 2 sec)</li> <li>• Abdominal distension</li> </ul>	<p>(RED)</p> <p><b>SEVERE ILLNESS</b></p> <p><b>OR</b></p> <p><b>POSSIBLE SEVERE BACTERIAL INFECTION</b></p>	<p>(RED)</p> <ul style="list-style-type: none"> <li>• <b>URGENTLY refer to hospital, according to the guidelines for stabilization and transportation</b></li> <li>• <b>Give the first IM dose of recommended antibiotics</b></li> <li>• <b>Prevent hypoglycemia</b></li> <li>• <b>Keep the child warm</b></li> <li>• <b>Advise the mother/ caretaker not to stop breast-feeding</b></li> <li>• <b>Clarify any doubt and give support to the mother/ caretaker</b></li> <li>• <b>Advise mother to accompany the child and how to keep the infant warm on the way to the hospital</b></li> </ul>
<p>(YELLOW)</p> <ul style="list-style-type: none"> <li>• Ocular pus discharge</li> <li>• Red umbilicus or draining pus</li> <li>• Skin pustules (few or localized)</li> </ul>	<p>(YELLOW)</p> <p><b>LOCAL BACTERIAL INFECTION</b></p>	<p>(YELLOW)</p> <ul style="list-style-type: none"> <li>• Give an appropriate oral antibiotic for 7 days</li> <li>• Teach the mother/caretaker how to treat local infections at home</li> <li>• Apply local treatment (topical antibiotic)</li> <li>• Teach the mother/caretaker to recognize signs of danger</li> <li>• Clarify doubts and give support to the mother/ caretaker</li> <li>• Follow up 2 days later</li> </ul>
<p>(GREEN)</p> <ul style="list-style-type: none"> <li>• Normal activity</li> <li>• Feeding well</li> <li>• Normal physical examination</li> <li>• White plaques in the mouth</li> </ul>	<p>(GREEN)</p> <p><b>NO BACTERIAL INFECTION</b></p>	<p>(GREEN)</p> <ul style="list-style-type: none"> <li>• Counsel the mother to continue breast-feeding</li> <li>• No additional treatment</li> <li>• Teach the mother to recognize signs of danger and to implement hygienic measures</li> <li>• Tell the mother when to come back to the clinic</li> <li>• Check immunization status</li> <li>• Clarify doubts and give support to the mother/caretaker</li> <li>• Consider applying Nistatin locally 100,000 units in the mouth, 4 times a day</li> </ul>

infants younger than 2 months old, it is difficult to distinguish between a very severe illness and a severe infection, such as sepsis or meningitis, since clinical findings are usually similar. For this reason, the classification gives both possibilities.

If the infant is suffering from a local but extensive bacterial infection, he or she should also be classified as having a possible severe bacterial infection because the local infection can disseminate and result in sepsis, due to the immaturity of the immune system. He or she needs to be referred urgently to a specialized hospital to receive different kinds of treatments, such as oxygen or parenteral antibiotics. Before transfer, administer the first dose of the adequate antibiotic. Transfer according to the guidelines for stabilization and transport. Counsel the mother or caregiver in order to clarify possible doubts and provide support.

Infants with no general danger signs but who have purulent discharge from the umbilicus or eyes, pustules in the skin (limited in number or localized), are classified as having a local bacterial infection. Children who exhibit no danger signs are classified as having no bacterial infection.

### **Treatment of Infants 0 to 2 Months of Age with Infection**

Infants 0 to 2 months old who need to be transferred to a hospital more than 5 hours away should receive an intramuscular (IM) dose of an adequate antibiotic. Possible antibiotic combinations include:

- gentamicin + ampicillin
- cefotaxime or ceftriaxone (depending on age)

Avoid oral feeding if the infant presents with altered consciousness or difficult breathing, and administer a 5% dextrose solution through nasogastric tube to prevent hypoglycemia.

If there is no incubator available for the transfer, the "mother kangaroo" technique is advisable in order to prevent hypothermia. If available, also administer supplemental oxygen during the transfer to prevent hypoxemia. Infants 0 to 2 months of age with a local bacterial infection should receive an adequate oral antibiotic as well as topical antibiotic therapy according to the site of infection.



Infants 0 to 2 months old who need to be transferred to a hospital more than 5 hours away should receive an intramuscular dose of an adequate antibiotic.

**SUMMARY**

The IMCI strategy, designed for primary care management of children and based on a number of clinical signs at presentation, is an ideal tool for the effective management of people affected by disasters, particularly in situations with limited resources, both material and human. This tool allows a quick and simple distinction between children who require referral to hospital and those with less severe illness that can be managed in a less complex setting.

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## Case resolution

### Case 1.

The child is ill-appearing, febrile, tachycardic, and tachypneic with a physical exam remarkable for scattered petechiae on the abdomen and lower extremities. The primary concern is whether this child is in shock. Tachycardia and decreased capillary refill are consistent with compensated shock.

Since the child is febrile and has a history of an upper respiratory disease, the most likely etiology of the shock is sepsis. The fever and the presence of petechiae suggest a severe bacterial infection, most likely meningococcemia. While many other conditions such as viral infection—influenza, enterovirus, adenovirus, infectious mononucleosis, or group A *Streptococcus* infection—can present with fever and petechiae, meningococcal infection is rapidly progressive and life-threatening.

Initial management begins with 100% oxygen. An IV line was placed and a blood sample was sent for complete blood count, serum electrolytes, coagulation studies, and culture. Rapid blood glucose determination was 120 mg/dL. As the child was tachypneic and had signs of shock, the lumbar puncture was deferred and IV antibiotics were administered immediately. An IV bolus of normal saline was given because of poor oral intake and decreased urine output, with no signs of cardiac or pulmonary disease.

His initial laboratory tests showed a white blood cell count of 21,000. Serum bicarbonate was 11, prothrombin time 15 seconds, and partial thromboplastin time 28 seconds.

Over the next several hours the child developed purpura, had increasing respiratory distress, and labile blood pressure. He was intubated and ventilated. His blood culture grew *N. meningitidis*.

### Case 2.

The infant is manifesting many of the classic features of an acute presentation of bacterial meningitis. The patient is irritable, febrile, and has a bulging fontanelle. The fact that the patient has a supple neck should not dissuade the examiner from the overall impression of meningitis. Children younger than 18 months frequently lack sufficient neck musculature to manifest nuchal rigidity.

Because the patient is well oxygenated and has stable vital signs, the most pressing intervention is the rapid delivery of IV antibiotics. Antibiotics should cover all possible organisms, especially *S. pneumoniae*. Treatment should begin with cefotaxime or ceftriaxone and vancomycin (if resistant *S. pneumoniae* is in the community). Possible complications of meningitis include seizures, syndrome of inappropriate antidiuretic hormone (SIADH), and intracranial hypertension.

# MODULE REVIEW

## **SECTION I- INFLUENZA**

1. What are the risk factors for having a more severe Influenza infection?
2. What methods can be used to prevent the spread of HI NI Influenza infections in the hospital and community?

## **SECTION II- INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS (IMCI)**

1. What is IMCI?
2. Which are the IMCI steps for the assessment of sick children?
3. Which are the general danger signs that must be routinely checked in all children?

## **SECTION III- ACUTE RESPIRATORY INFECTIONS**

1. Which are the clinical signs that should be assessed in children with cough or respiratory problems?
2. What are the antibiotics used for lower respiratory infections?
3. How should ear problems be assessed?

## **SECTION IV: OTHER CASES THAT REQUIRE ATTENTION AT THE SCENE OF THE DISASTER**

1. Which clinical signs raise the suspicion of meningitis?
2. What must be taken into consideration for the treatment of meningitis?

## **SECTION V-VACCINATION IN DISASTER SITUATIONS**

1. What interventions are recommended when tetanus is suspected?
2. Which are the situations that require prophylaxis?
3. How should a meningitis outbreak be evaluated and managed?

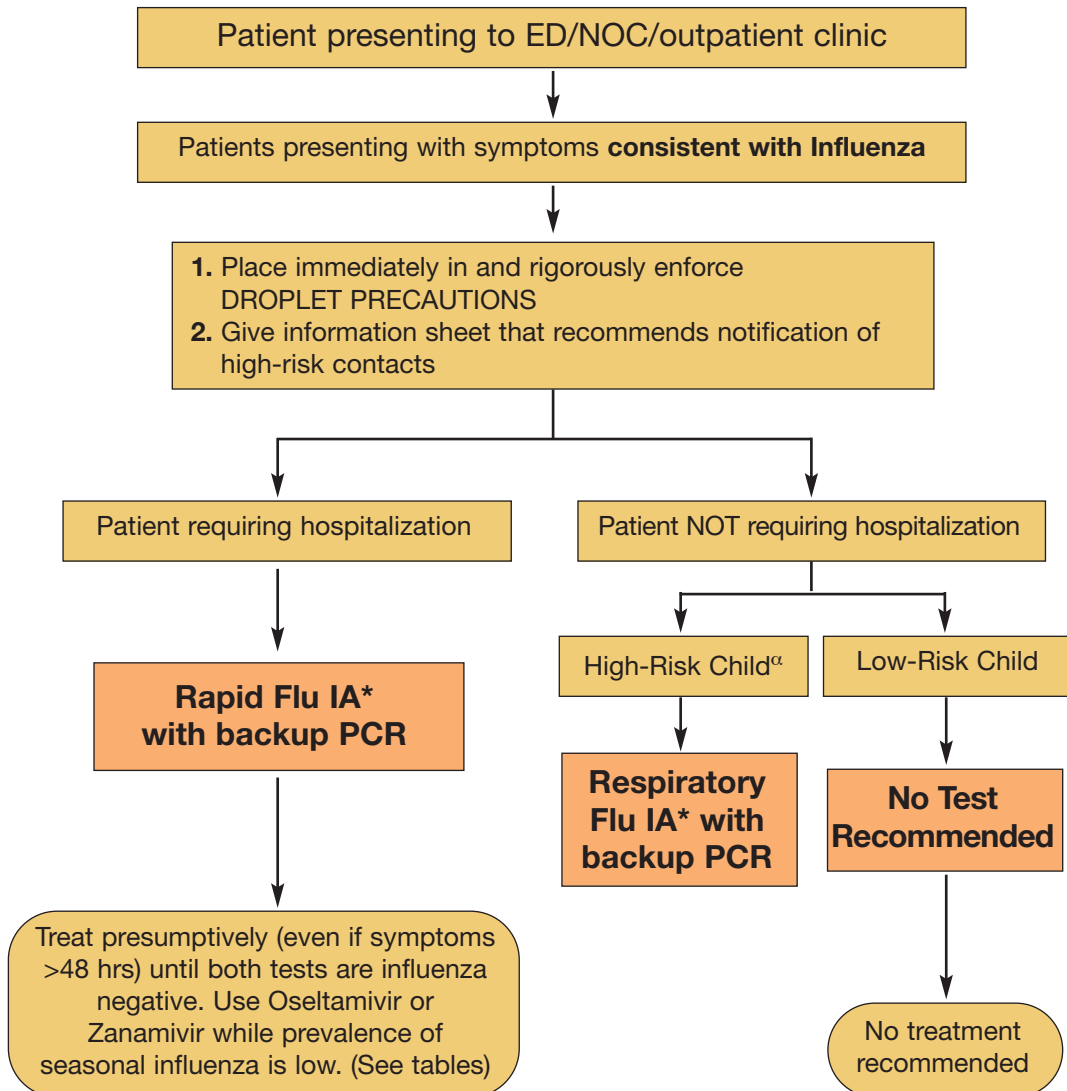
## **SECTION VI- INFECTIONS IN INFANTS 0 TO 2 MONTHS OF AGE**

1. Which are the clinical signs that suggest a severe illness in infants 0 to 2 months of age?
2. Which immediate action should be taken with an infant 0 to 2 months of age with severe illness?



## INFLUENZA ANTIVIRALS

Currently Influenza A-H1 (Swine), susceptible to oseltamivir (Tamiflu), is the only strain circulating in Colorado. Recommendations will change as strains change in the community – for most current information go to “Planettch/Quicklinks/Influenza info”



<sup>a</sup>High Risk Child per CDC suggestion = Children < 2 yrs (CDC includes those 2-5 yrs but many experts feel that is excessive); children with any of the following medical conditions: chronic pulmonary (including asthma), cardiovascular (except hypertension), renal, hepatic, hematological (including sickle cell disease), neurologic, neuromuscular, or metabolic disorder (including diabetes mellitus); immunosuppression including that caused by medications or by HIV; pregnant women; persons who are receiving long-term aspirin therapy; residents of chronic-care facilities; or children who present with a severe illness.

\*Nasopharyngeal Aspirate – Observe droplet precautions + N95 mask and eye protection. Get a good specimen – the quality of the result is directly proportional to the quality of the specimen! Immunoassay (IA) sensitivity alone = 70%.

Note to ordering physicians – Due to the increased number of samples being tested, the microbiology lab will only call physicians for respiratory virus results if positive for Influenza. It is the ordering physician’s responsibility to follow up for all other testing results.

Recommendations will change when seasonal influenza and/or RSV become more widespread in the community.

## INTERIM INFLUENZA TESTING ALGORITHM

Table 1. Influenza A-H1 (Swine) Oseltamivir dosing recommendations				
Agent, group		Treatment		Chemoprophylaxis
Adults		75-mg capsule twice per day for 5 days		75-mg capsule once per day
Children (age, 12 months or older), weight:	15 kg or less	60 mg per day divided into 2 doses		30 mg once per day
	16-23 kg	90 mg per day divided into 2 doses		45 mg once per day
	24-40 kg	120 mg per day divided into 2 doses		60 mg once per day
	>40 kg	150 mg per day divided into 2 doses		75 mg once per day

Table 2. Dosing recommendations for antiviral treatment of children younger than 1 year using oseltamivir	
Age	Recommended treatment dose for 5 days
<3 months	12 mg twice daily
3-5 months	20 mg twice daily
6-11 months	25 mg twice daily

Table 3. Summary of Antiviral Resistance, U.S. 2008-09				
Antiviral	Influenza viruses			
	A-H1 (Swine)	A-H1 (Seasonal)	A-H3 (Seasonal)	B (Seasonal)
Amantadine Rimantadine	Resistant	Susceptible	Resistant	No activity
Oseltamivir (Tamiflu)	Susceptible	Resistant	Susceptible	Susceptible
Zanamivir (Relenza)	Susceptible	Susceptible	Susceptible	Susceptible

