

## FEVER IN INFANTS AND CHILDREN

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### SUMMARY

Fever is a common complaint of childhood, and can be defined as an oral temperature higher than 37.5 °C or a rectal temperature higher than 38 °C. It occurs in response to infection or trauma and should be differentiated from hyperthermia. Diagnosis of fever is different according to the age group of children. It can be difficult under three months of age, because of immature thermoregulatory responses and these infants are at greater risk of serious infections than are children over three months of age with the same temperature. In the evaluation of fever a careful history and physical examination and appropriate laboratory studies such as a complete blood count, urine analysis, and a lumbar puncture may be necessary. Acetaminophen is the first choice as an antipyretic drug in the treatment. An overall evaluation and prompt diagnosis of the underlying illness will decrease morbidity and mortality.

**Key Words:** Clinical judgement, fever, infant, children

### INTRODUCTION

Fever in the young child is the source of great consternation for parent and physician alike. It is one of the most common complaints that brings a family to seek medical care for their child and is usually due to self-limited viral processes or bacterial infections amenable to specific antibacterial therapy (1). It is the duty of the Pediatrician and the Family Physician to diagnose the cause of the fever and give the necessary treatment as quickly as possible and to keep in mind that febrile children may not have the classic symptoms and signs of serious illness (2-8). The purpose of this article is to review mechanisms, causes and treatment of fever including the assessment of the febrile child.

### PATHOGENESIS

Fever may be defined as an oral temperature higher than 37.5 °C or a rectal temperature (obtained in children younger than 5 years) higher than 38 °C (2,3). The majority of children who present with fever are less than three years of age. Both minor and life-threatening infectious diseases, including respiratory

infections, occult bacteremia and meningitis are common in this age group (9).

Body temperature is determined by a thermostatic mechanism in the preoptic nucleus of the anterior hypothalamus (3,10). This thermostat allows modification of heat loss and heat production so that the body temperature is maintained in its normal range. Most evidence indicates that exogenous pyrogens (eg. bacterial endotoxins, viruses, antigen-antibody complexes etc.) cause the release of an endogenous pyrogen (EP), a small molecular weight protein from macrophages. EP travels through the circulation to the brain, where in the anterior hypothalamus it causes a rise in the "set-point", presumably by causing an increase in the prostoglandine E2 (11). Cytokines such as interleukin, 1, 2, 6, 8, tumor necrosis factor  $\alpha$ , interferons etc. are believed to act as EP's, thus raising the "set-point" (11). The pathophysiology of fever is illustrated in Figure 1.

Fever which occurs in response to infection or trauma, should be differentiated from "hyperthermia". During fever the host behaves as if the set-point is elevated. Heat conserving mechanisms, such as shivering, peripheral vasoconstriction and behavioral adaptations eg. wearing heavier clothing are operative until the body temperature reaches the new set point. During hyperthermia, the core body temperature is above the set point and the individual uses physiological and behavioral means to lower body temperature. Hyperthermia may be due to increased metabolic heat eg. thyrotoxicosis, excessive environmental temperature eg. heat stroke or vigorous exercise (3, 11).

### MANAGEMENT

Fever is often accompanied by symptoms and signs suggesting a diagnosis or pointing to an organ system; such as headache, cough, diarrhea, urinary frequency, or burning. This enables the physician to focus on the likely source of fever and proceed with the necessary diagnostic evaluation and management. Some 5 to 20% of febrile children will not have any suggestive signs or symptoms, at least at the initial visit (2, 7, 12, 13). Children less than three months of age lack sensitization to exogeneous pyrogens and have immature thermoregulatory responses. Thus, they are unable to give a febrile

response like that of older children (2,3). At birth, the capacity of the immune system to defend against infectious pathogens is not fully developed. The capacity increases during the early months and years of life, with this evolution most pronounced during the first three months (14). A temperature of 38 °C or above is significant for infants under three months of age (3,14). These children are at significantly greater risk of serious infections, such as sepsis, meningitis and pneumonia, than are children over three months of age with the same temperature (3). Fever in the infant under three months is a cause of alarm and calls for immediate investigation whether the child appears ill or not. Diagnostic studies should include a complete blood count, examination of the cerebrospinal fluid, blood urine, and stool cultures, and a chest radiograph (3,14). Most authorities recommend prompt hospitalization and parenteral antibiotic therapy (5), serious bacterial diseases are present in 10-15 % of febrile infants less than three months old. These infections include pyogenic meningitis, urinary tract infections, gastroenteritis, facial cellulitis, osteomyelitis and septic arthritis (5,14). Bacteremia is present in 3 to 5% of these infants (5,13). The most common organisms cultured are *S. Pneumonia* and *H. Influenzae* (2). Patients with a temperature greater than 39.4 °C, a total white blood cell count of less than 5000 per mm<sup>3</sup> or more than 15000 per mm<sup>3</sup>, and or an abnormal observational score as described by McCarthy (Table I) are at a greater risk for occult bacteremia (3,5). It is extremely important to remember that infants from birth to three months of age are not a homogenous group (3). Some authorities point out that observation scales are not reliable on judging the severity of illness in infants younger than two months (15). History, physical examination, and laboratory findings should support the diagnosis. Clinical judgement is very important for evaluating these infants.

An alternative to hospitalization recommended by some authorities is outpatient management of previously healthy low risk febrile infants up to three months having no focal infection on physical examination with blood, urine cultures and a lumbar puncture obtained with an intramuscular injection of ceftriaxone. Infants should be rechecked in 18 to 24

hours, at which a second injection of ceftriaxone could be given (9,16). Another alternative is outpatient observation without antimicrobial therapy. Children managed in this manner should have a urine culture but do not necessarily need blood cultures or a lumbar puncture. They should be reevaluated within 24 hours. Infants in this age group with otitis media also can be treated in this manner (Fig. 2).

Evaluation of children aged three months to three years with temperatures above 39 °C may also prove to be difficult. Many of these children have nonspecific signs and symptoms of infection or they have no definite localizing signs at all. They may have an occult bacterial infection and seem nontoxic. Proper management of this child include optimal observational assessment, careful history and physical examination, and appropriate laboratory studies. Recent studies have demonstrated that appearance influences the positive predictive value of abnormal physical examination findings for serious illness (6). This of course by no means indicates that positive examination findings in the well-appearing child should be ignored. The occurrence of serious illness in well-appearing children is 2-3% and rises to 25% when abnormal physical examination findings are present (6,9). Medical decision making should be based on appreciation of the complex interaction of the many sources of data available to the physician. Appreciation of risk factors i.e. age and temperature alone, may indicate the need for laboratory evaluation (7,12).

McCarthy (3,6,7,12) recommends that all children under two years old with a temperature of 40 °C or above have a complete blood count and determination of erythrocyte sedimentation rate. A total white blood cell count over 15000 per mm<sup>3</sup> or erythrocyte sedimentation rate greater than 30 mm per hour points a marked increase in the incidence of bacteremia and should have a blood culture (3,9). Peripheral blood smears are also very useful as the presence of vacuolization or toxic granulation in the white blood cells is shown to be a very good indicator of serious bacterial infection (3). An algorithm for the assessment of the febrile child between three months to three years is shown in Figure 3.

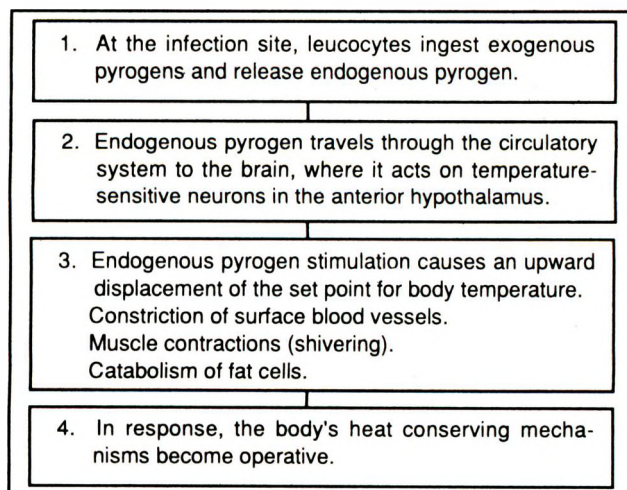
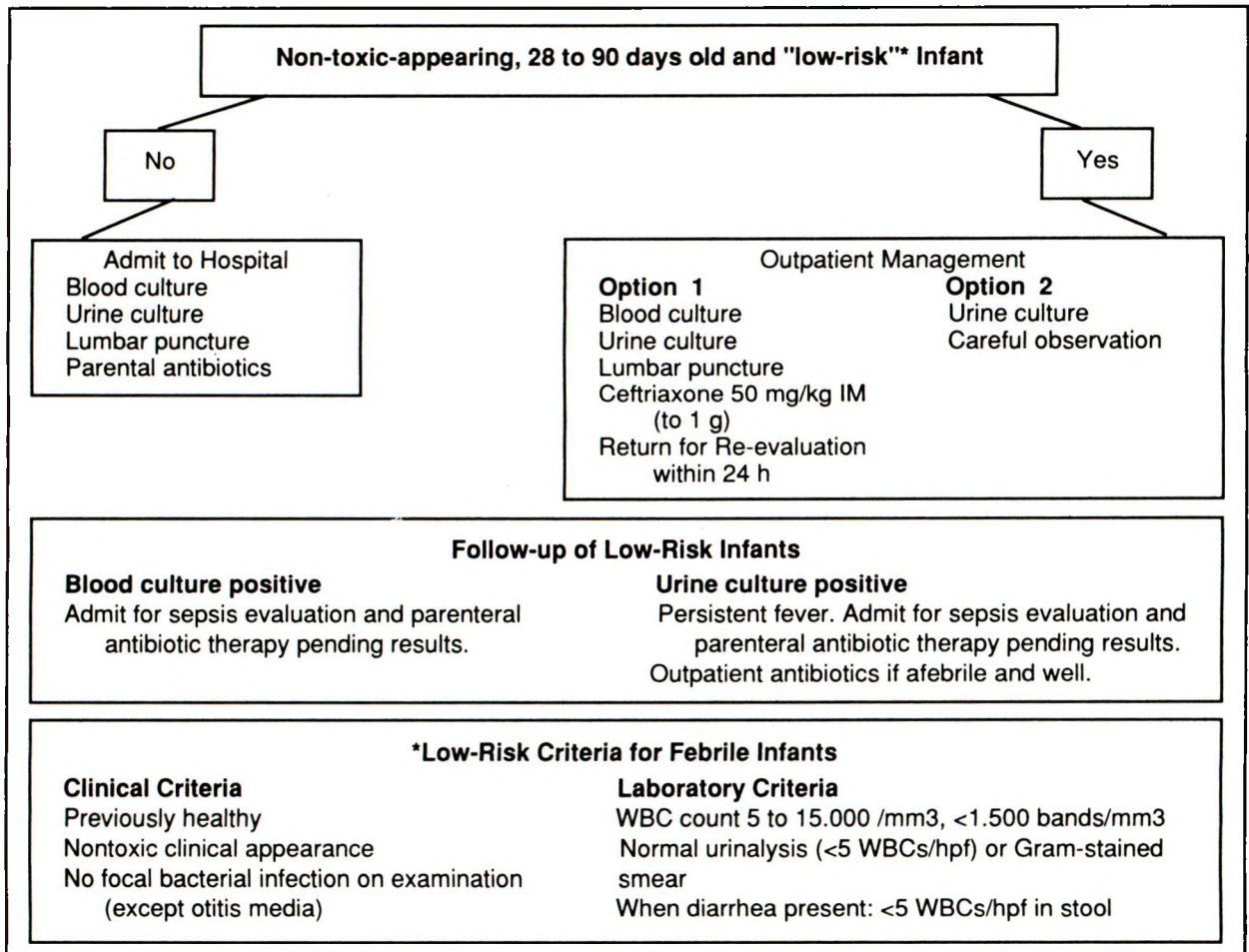


Fig 1. Pathophysiology of fever.

**Table I-** Observational Assessment of the Febrile Child

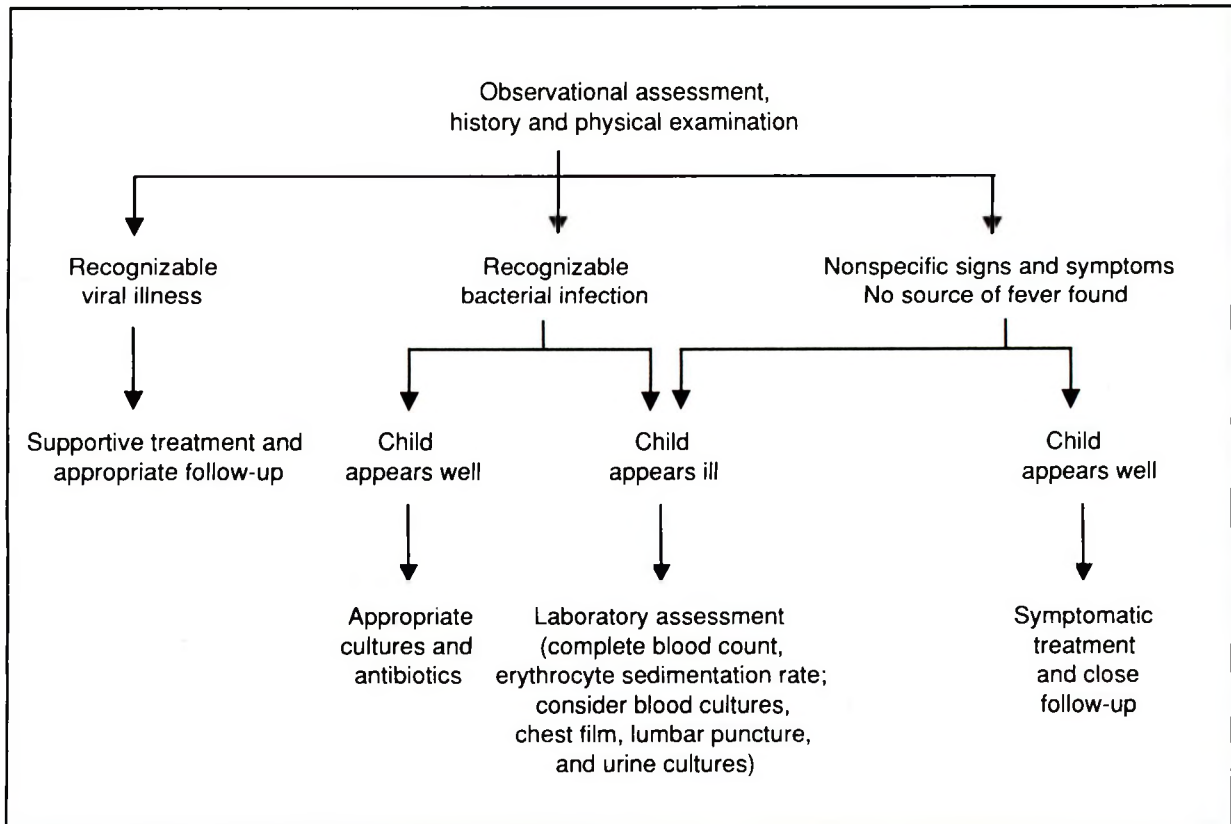
Observation item	Normal = 1	Moderate impairment = 3	Severe impairment = 5
Quality of cry	Strong cry with normal tone, or contented and not crying	Whimpering or sobbing	Weak cry, moaning or high-pitched cry
Reaction to parental stimulation	Cries briefly and then stops, or is contented and not crying	Cries off and on	Cries continually or hardly responds
State variation	If awake, stays awake, or if asleep and then stimulated, awakens quickly	Closes eyes briefly when awake, or awakens with prolonged stimulation	Falls asleep or will not rouse
Color	Pink	Pale extremities or acrocyanosis	Pale, cyanotic, mottled or ashen
Hydration	Normal skin and eyes, moist mucous membranes	Normal skin and eyes, slightly dry mouth	Doughy or dented skin, dry mucous membranes and/or sunken eyes
Response (talk, smile) to social overtures ( $\leq 2$ months)	Smiles or is alert ( $\leq 2$ months)	Smiles briefly or is briefly alert ( $\leq 2$ months)	No smile, anxious face, dull expression or not alert ( $\leq 2$ months)

From McCarthy PL, Sharpe MR, Spiesel Z, et al. Observation scales to identify serious illness in febrile children. Pediatrics 1982;70:802-9.



From Baraff LJ, Bass JW, Fleisher GR, Klein JO, McCracken GH, Powell Kr. Practice Guideline for the Management of Infants and Children 0 to 36 Months of Age With fever Without Source. Pediatrics. 1993;92(1):1-12.

**Fig 2.** Algorithm for the management of a previously healthy infant 0 to 90 days of age with fever without source  $\geq 38.0$  ° C.



**Fig 3.** Algorithm for the evaluation of the child aged three to 24 months with a temperature greater than 39°C. Note that all children with a temperature over 41.1°C should have a complete laboratory assessment.  
From Kruse J. Fever in children. *American Family Physician*. 1988;37(2):127-135.

## TREATMENT

The treatment of fever is much argued about. Some authorities believe that fever is the adaptive response of the host and point to the fact that fever is associated with an increase of survival in animals (11,17). However fever renders the febrile patients more susceptible to dehydration, is accompanied with chills, anorexia, myalgias, arthralgia and fatigue. Treatment of fever reduces these symptoms, probably because of the analgesic effects of antipyretic medications. Also preventions of febrile seizures which occur with rapidly rising temperatures or at a threshold temperature that differs for each patient (3,17) is another good cause for treatment of fever. The most commonly used antipyretics are aspirin and acetaminophen. However aspirin use in children with a viral illness has been associated with the development of Reye's Syndrome (3,17). Acetaminophen is relatively free of adverse effects and is considered first-line pharmacologic therapy.

Ibuprofen should be considered as second-line antipyretic therapy. Combination of acetaminophen and aspirin may be considered if the patient fails to respond to other therapies; however this may result in increased drug toxicity and adverse reactions (3,17).

## CONCLUSION

Fever remains the most prevalent of the potentially serious symptoms occurring in childhood and commonly brought to primary physicians. Knowledge of the optimal diagnostic and therapeutic approach to febrile infants is incomplete, but expanding rapidly. Such studies increase our ability to make decisions about the care of febrile infants.

An "overall" evaluation by an experienced observer and prompt diagnosis of the underlying illness will decrease morbidity and mortality for this vulnerable group of patients.

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