Acute Fever

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Objectives   After completing this article, readers should be able to:

1. Describe the pathophysiology of acute fever.
2. Explain the role of antipyretic therapy in the management of acute fever.
3. Discuss the management of acute fever in children of varying ages.
4. List the normal range of body temperatures.

Introduction

Fever is a common, yet frightening, physiologic response that has been the source of great consternation throughout the history of medicine. Hippocrates believed that illness was caused by imbalance of the four humors (blood, phlegm, black bile, and yellow bile) and that fever "cooked" the excess humor, thereby bringing the body back to normal homeostasis. Fever has been respected by many physicians, including Thomas Sydenham, who wrote in the 1600s, "Fever is a mighty engine which Nature brings into the world for conquest of her enemies." (1) In recent times, fever has become a product of disease that is feared by parents and clinicians alike. (2)(3)(4)

Whether embraced or feared, fever plays an important role in the physiologic response during illness. In fact, the ability to mount a febrile response to infection has been shown to increase survival rates in many animal species. Even many cold-blooded animals show an innate ability to increase body temperature in response to infection. For example, to raise body temperature during certain illnesses, lizards may remain in the sun and fish tend to swim in warmer water. It is difficult to believe that this primitive, almost universal, response would have survived millions of years of evolution if it did not present some overall benefit in fighting disease. In fact, fever may have a positive effect on host leukocyte mobility and activity, activation of T lymphocytes, and production of interferon. Fever also may inhibit bacterial and viral function. However, these theoretical advantages come at the cost of hypermetabolism, increased insensible fluid loss, and general discomfort. Thus, fever is just one of many acute-phase responses to infection, and although the advantages of fever are well founded in animal models in terms of survival, its role in humans should be considered in the context of the individual patient and not on the basis of survival of the species. For example, although some elevation of body temperature likely is beneficial in children whose host responses are normal, severe elevation of temperature or any fever in children who have immunologic deficits may be detrimental.

Maintenance of Body Temperature

An intricate interaction among autonomic, endocrine, and behavioral mechanisms allows normal body temperature to remain relatively constant despite large variations in several factors, including ambient temperature and physical activity. The center of the temperature control system lies in the thermoregulatory center of the hypothalamus. This specialized group of neurons maintains the body's temperature "set point" by acting as a central thermostat. As a result of input from both peripheral receptors and the temperature of blood

Abbreviations

FUO:	fever of unknown origin
GI:	gastrointestinal
Hib:	*Haemophilus influenzae* type b
NSAID:	nonsteroidal anti-inflammatory drug
UTI:	urinary tract infection

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around the hypothalamus, the thermoregulatory center modulates various body mechanisms to maintain the physiologic set point.

Body temperature elevates primarily through heat generation and heat conservation. Heat production occurs at the cellular level by increased cellular metabolism that liberates energy during the splitting of adenosine triphosphate. This process occurs in various organ systems, including the skeletal muscles, brown adipose tissue, and the gastrointestinal (GI) tract. Due to the large amount of skeletal muscle, increased activity, usually due to involuntary shivering, can generate a significant amount of body heat in a relatively short time.

In addition to heat production, autonomic responses such as vasoconstriction of the blood vessels closest to the skin surface as well as behavioral responses such as seeking a warmer environment (eg, putting on more clothes or curling up into a fetal position) assist in heat conservation and, thereby, raise body temperature. Conversely, reduction of body temperature occurs through mechanisms that increase heat loss, such as obligate heat loss through the skin and lungs, peripheral vasodilatation, increased evaporative loss through sweating, and cold preference behavior.

Changes in the thermoregulatory set point involve a complex set of cytokine-mediated responses and production of acute-phase reactants. Pyrogens, substances that produce fever, may be toxins or products of viral or bacterial metabolism (eg, bacterial lipopolysaccharide, a cell wall product of gram-negative bacteria). In addition, various internal mediators, such as antigen-antibody complexes and complement components, may act as pyrogens. Such pyrogens stimulate host monocytes, macrophages, and other inflammatory cells to release pyrogenic cytokines (eg, interleukin-1-alpha, interleukin-1-beta, tumor necrosis factor, and interferon) into the circulatory system. Because many of these cytokines do not cross the blood-brain barrier readily, it is not clear whether they act directly or indirectly on the preoptic area of the hypothalamus.

Regardless of the precise mechanism, this activity results in an increased production of prostaglandin of the E series that eventually raises the thermoregulatory set point. Although the increase in the set point varies with factors dependent on both the host and the inciting organism, the upper threshold of temperature appears to be limited. It is likely that the mechanisms that lead to an elevated set point have some negative feedback through the production of endogenous cryogens (eg, arginine vasopressin and alpha-melanocyte-simulating hormone).

These cryogens limit temperature height during fever in otherwise healthy hosts.

An important caveat to thermoregulation is that neonates and children afflicted with diseases of the central nervous system may have immature or abnormal thermoregulatory centers or mediator responses and, therefore, not manifest fever in response to certain infections.

Fever occurs when an increase in the thermoregulatory set point eventually results in an increase in deep body temperature. This process begins when the increase in the set point causes the existing body temperature to be lower than the new set point. At this point, the previously described mechanisms lead to increased heat production. Clinically, the child begins to shiver, feel cold, and develop cool extremities due to vasoconstriction and seeks a warm environment (eg, under blankets). During this "chill" phase of the febrile response, heart rate and respiratory rate increase, functional changes occur in the GI tract, and appetite is lost. The "chill" happens as the body temperature begins to rise toward the set point and, thus, normally precedes the actual rise in body temperature. With time, the body temperature increases to be in balance with the new set point. Fever resolution begins with the lowering of the set point back toward normal body temperature, usually due to resolution of the illness or administration of an antipyretic. As the set point lowers, the body temperature is left higher than the new set point. The physiologic mechanisms that lead to heat loss are manifested clinically with skin warmth due to vasodilatation, sweating, and the seeking of a cooler environment until the new equilibrium is reached. This often is referred to as the "flush" phase. A summary of the phases of the febrile response is shown in the Figure.

Normal Body Temperature and Measurement

Until the advent of modern clinical thermometry, measurement of body temperature consisted primarily of using the hand to detect differences in skin temperature. There was no consensus as to baseline normal body temperature until 1868, when Carl Wunderlich reported that 98.6°F (37.0°C) was the mean adult temperature, based on his report of 1 million temperature readings in more than 25,000 patients via a foot-long thermometer used in the axilla. (5) Although the temperature recordings ranged from 97.2°F (36.2°C) to 99.5°F (37.5°C), the number 98.6°F (37.0°C) eventually became synonymous with normal body temperature, at least until more refined measurements and oral thermometry were used.

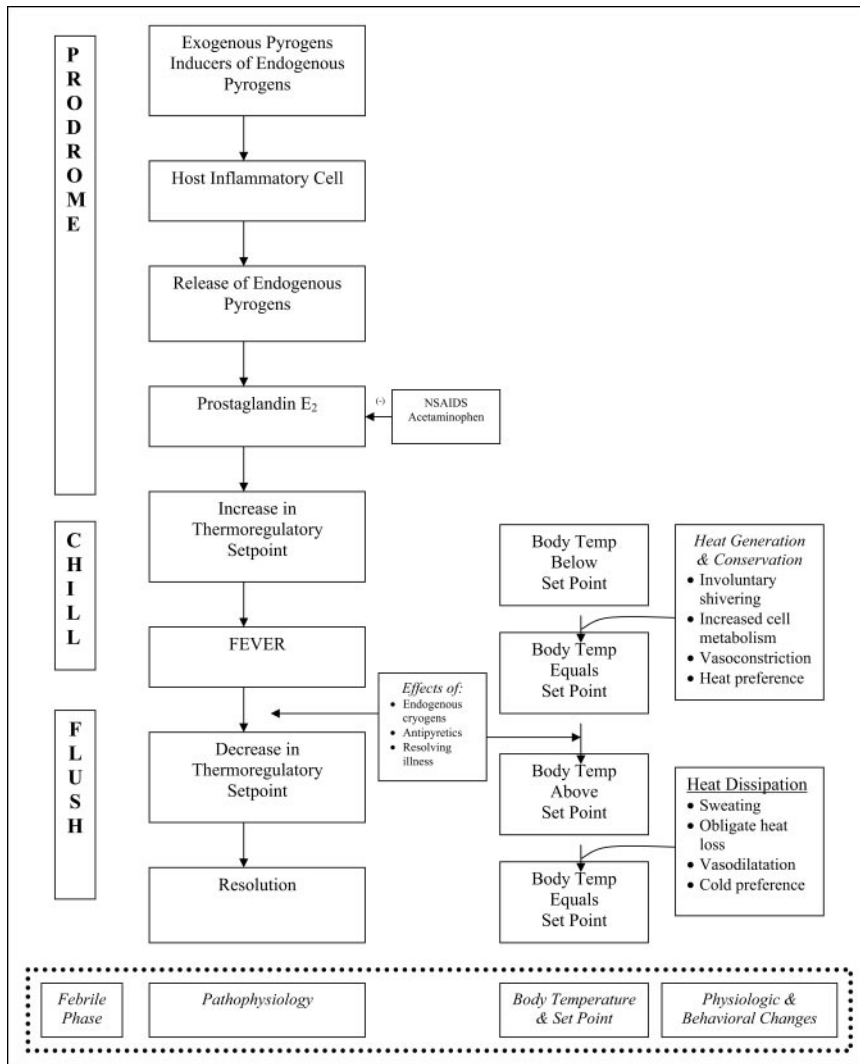A normal diurnal variation in body temperature is

Figure. The febrile response.

maintained even during the febrile response. Under normal circumstances, body temperature varies as much as 0.5°C from the mean, being lowest in the morning (between 4:00 AM and 8:00 AM) and peaking in the early evening (4:00 PM to 6:00 PM). (6) Body temperature also can vary somewhat with a variety of specific individual and environmental factors, including age (slightly higher in young infants), sex, physical activity, and ambient air temperature. Thus, it is clear that there can be no single value for normal body temperature.

Temperature measurement also varies with anatomic site. Core body temperature is measured most accurately at the pulmonary artery, but close approximation can be determined at other deep tissue locations such as the lower esophagus or the nasopharynx. Because these lo-

cations are difficult to access, more peripheral locations generally are used because they are easier to access, are safe, and are comfortable for the child. However, such indirect measurements are more prone to artifact and have some associated lag time relative to the core temperature.

The axilla was one of the first locations used for temperature measurement, although skin temperature lags behind changes in core temperature, especially during the early phase of the febrile response when vasoconstriction cools the skin while simultaneously raising core body temperature. In addition, skin cooling from sweating and evaporation can affect accuracy. Thus, axillary temperature has low sensitivity and often is inaccurate and imprecise. (7)

The oral method, in which the thermometer is placed in the sublingual pocket, is safe and comfortable for children older than 5 years of age. Oral measurement has less lag time and is more accurate than axillary measurement but may be affected by the temperature of recently consumed fluids or the evaporative effects of mouth breathing and tachypnea. Rectal temperature long has been accepted as the gold standard of indirect measurement because there is less deviation by environmental factors. However, this technique often is uncomfortable for children and can be associated with cross-contamination if standard precautions are not followed rigorously.

Over the past decade, infrared tympanic membrane thermometry has gained popularity because it is quick, comfortable, and cost effective and has few infection control issues. Because the blood supply of the tympanic membrane is similar to that of the hypothalamus, the measurement is believed to be closer to the core body temperature. Yet, despite numerous studies, the accuracy of tympanic thermometry remains debatable, especially when there is difficulty aiming the thermometer at the tympanic membrane, when there is cerumen impaction or otitis media, and when the clinician struggles with

properly positioning the thermometer in infants younger than 2 months of age. (8) It is important for the practitioner to appreciate that body temperatures vary: (9)

- Axillary: 97.5°F (36.4°C) (range, 94.5° to 99.1°F [34.7° to 37.3°C])
- Oral: 97.9°F (36.6°C) (range, 95.9° to 99.5°F [35.5° to 37.5°C])
- Rectal: 98.6°F (37.0°C) (range, 97.9° to 100.2°F [36.6° to 37.9°C])
- Infrared tympanic: 97.9°F (36.6°C) (range, 96.3° to 99.5°F [35.7° to 37.5°C])

Therefore, it is best to use a consistent form of measurement and make the measurement at the same site to monitor changes in body temperature.

Although a measured temperature is preferred for reliability and accuracy, parents often bring a child for evaluation because the child "feels warm to the touch." Parental assessment of fever, based on the tactile temperature of the child's skin, is subjective because it may vary with environmental factors as well as with the part of the body the parent is touching. The sensitivity of this technique when used by parents ranges from 71% to 89%, but the specificity and positive predictive value are less than 50%; the accuracy when used by medical staff is only slightly better. (10)(11) Therefore, parental report of fever to touch has limited validity and is, perhaps, more useful to exclude, rather than confirm, the presence of fever.

Fever as a Predictor of Illness

In most cases, fever is associated with an infectious illness. The organism (eg, virus, bacteria) invades the host and may seed various tissues and organs, causing focal infection or sepsis. In response, host defense mechanisms attempt to contain and eliminate the organism. The clinical and laboratory signs associated with infection (eg, fever, increased white blood cell count, increased C-reactive protein) reflect the activity of the host defense system and, therefore, may be useful for monitoring outcome. In this context, the presence of fever signifies ongoing infection for most infectious illnesses; as the infection is contained, the fever usually begins to resolve. Thus, the presence or absence of fever is a very useful guide to the course of illness.

Debate has surrounded whether the height of the fever is associated with increased morbidity and whether it predicts more serious illness. As the body temperature rises, there is an associated increase in heat stress because physiologically, children have higher metabolic rates and

are more prone to radiant heat loss compared with adults. In addition to increased catabolism, there is an increase in both heart rate (10 to 15 beats/min per degree C) and respiratory rate (3 to 5 breaths/min per degree C).

Most healthy children can accommodate such stresses. However, children who may not be able to buffer the increased metabolic demand (such as those who have a chronic illness, cardiovascular or pulmonary disease, immature or suppressed immune systems, or underlying anatomic abnormalities) are at risk for developing more systemic effects. Furthermore, in the 2% to 4% of children who develop febrile seizures, the height of the temperature has been shown to be an independent risk factor for such seizures. (12) Still, brain damage, a common concern of parents and practitioners, has not been shown to be caused by fever (even a temperature as high as 107.6°F [42°C]) associated with infection; it is the underlying illness rather than the fever itself that is responsible for most morbidity. (13)

Similarly, the validity of the height of the fever as a predictor of serious illness remains unclear. Although the presence of pneumococcal bacteremia, especially in the toddler age group, has been shown to be related to the height of the fever, the increased incidence is small. Furthermore, with the widespread use of conjugated pneumococcal vaccination, this association may no longer be germane for prognostic relevance. (14) Some studies show that hyperpyrexia (temperature >106.0°F [41.1°C]) is associated with a higher incidence of serious illness, but no useful symptoms or screening laboratory tests (eg, white blood cell count) predict bacterial rather than viral infection. (14) However, almost all children who have life-threatening illness in these studies had predisposing underlying medical conditions or were clinically assessed to be ill-appearing. (4)(14) Thus, clinical appearance rather than the height of fever is a more powerful predictor of serious illness. Accordingly, rather than focusing on the height of the fever, the clinician should use the overall impression of the child's clinical state determined by a thorough history and physical examination, in combination with the reliability of the parents and likelihood of good follow-up, to guide management.

Fever Without a Source and Prolonged Fever

Most febrile illnesses last for fewer than 3 to 5 days. During this time, either a specific cause is identified and treated or the fever resolves spontaneously. The initial treatment of febrile children who do not have an identi-

fiable source of infection or localizing signs on physical examination has been a subject of much uncertainty over the past decade. In some cases, fever remains an important sign for identifying children who need immediate evaluation and treatment. Although the majority have benign, self-limited illness, those who have serious bacterial illness often are difficult to diagnose and have high morbidity. Children who have a specific chronic illness or immunosuppressive conditions are at higher risk of developing serious illness and sepsis. Because of this concern, some screening laboratory and radiologic studies frequently are recommended, and empiric antibiotics may be advised.

Similarly, the febrile infant younger than 2 months of age has immature immune responses and may not be able to contain certain infections. In fact, as many as 10% of febrile infants in this age group have serious bacterial illness, including almost 3% who have bacteremia or bacterial meningitis. (15) Because infants younger than 1 month of age have a high risk of bacteremia and have yet to develop many clinical signs (eg, social smile) necessary to judge clinical appearance, most management strategies recommend routine hospitalization and empiric antibiotic treatment pending the results of blood, urine, and cerebrospinal fluid cultures. (15)(16)

For infants 1 to 2 months of age, management often depends on risk stratification using the peripheral white blood cell count, urinalysis, and often cerebrospinal fluid studies to determine if the febrile infant needs hospitalization and empiric antibiotic treatment or if the child can be treated as an outpatient with or without empiric antibiotics.

Febrile illness is most common in the 3- to 36-month age group and usually is of relatively benign viral origin that needs no more than reassurance and careful follow-up. In other cases, the child has a recognizable bacterial source of infection on physical examination and can be treated accordingly. Nevertheless, the identification of "occult" or unsuspected bacteremia in well-appearing febrile toddlers prompted the development of various managements designed to identify a subset of children more likely to have bacteremia. Because some children who have bacteremia subsequently develop serious bacterial illness such as meningitis, many guidelines recommend empiric antibiotic treatment pending the result of a blood culture. (16)

However, a major change has occurred in both the incidence and epidemiology of occult bacteremia in the past decade. In the early 1980s, about 3% of well-appearing febrile toddlers had occult bacteremia. Infec-

tion with *Streptococcus pneumoniae*, which accounted for almost 75% of cases, usually resolved spontaneously without antibiotics. On the other hand, *Haemophilus influenzae* type b (Hib) infection had a 10% to 20% progression to meningitis. With the near eradication of Hib disease after immunization, the incidence of occult bacteremia has declined to about 1.5%. More recently, widespread use of the heptavalent pneumococcal vaccine has had a profound impact on the risk of occult bacteremia by reducing the incidence of pneumococcal bacteremia to less than 0.2% and the overall incidence of bacteremia to less than 0.7% in vaccinated children. (17)(18) At this low rate of bacteremia, the utility of routine blood cultures and complete blood count is diminished in the evaluation of otherwise healthy, well-appearing, febrile 3- to 36-month-old children who have received pneumococcal vaccine. (17)(18)(19) However, the presence of occult urinary tract infection (UTI) in febrile children who have no source of infection remains a concern because the prevalence ranges from 2.1% to 8.7%, being highest in girls younger than 1 year of age and lowest in circumcised boys older than 6 months of age. (20) Other factors that increase the likelihood of a UTI include prior UTIs, lack of circumcision, abdominal pain, back pain, dysuria, and suprapubic pain. (20) If a UTI is suspected, a catheterized urine specimen should be obtained to decrease the chance of a contaminated culture.

The definition of fever of unknown origin (FUO) often was applied to any febrile illness that persisted at a temperature of at least 101.3°F (38.5°C) for 3 or more weeks. However, with the use of more sophisticated diagnostic techniques, many investigators have shortened the minimum duration of fever to 7 to 9 days with the following caveats: fever is present every or almost every day, and there have been repeated evaluations by a clinician that included a history, physical examination, and selected laboratory tests. It also is important to differentiate true FUO from two separate shorter febrile illnesses that occur within a short time interval, giving the false impression of one longer febrile episode.

Parents of a child who has FUO are often frustrated and anxious due to the prolonged nature of the fever and the inability to find the underlying cause. In an effort to make a diagnosis, multiple laboratory and radiologic studies often are obtained, which may be confusing to interpret due to false-positive and false-negative results. Therefore, a focused approach, beginning with a history and physical examination, is essential. Further investigation should proceed stepwise, with consideration of the duration of the fever, age of the child, exposures, and clinical appearance.

In general, children who have FUO have lower mortality and more self-limited disease compared with adults. (21) Almost 50% of the cases of FUO are due to infectious diseases (usually respiratory infections, followed by infections of the urinary tract, skeleton, and central nervous system). (21) The incidence of infectious causes (eg, tuberculosis, parasitic infection) also may vary with local epidemiology. Generally, as the duration of the fever increases, the cause is less likely to be infectious. Of the remaining cases of FUO, 10% to 20% are due to rheumatologic diseases, 8% due to malignancy, and 10% to 20% remain undiagnosed. (22)

Management of Fever

As discussed, fever is just one of many nonspecific acute-phase responses to infection. Although fever may have some beneficial effects in terms of shortening the duration of illness by creating an unfavorable host environment for the infecting microbe, this effect usually is outweighed by the associated increased metabolic demand and discomfort for the child. Parents should not focus solely on the height of fever, but if the child becomes uncomfortable or cannot be assessed clinically, fever should be treated.

Because fever increases metabolic demand, its management should begin with restoring the nutrients and water lost during the onset of the febrile phase. This is accomplished best by proper hydration as well as by creating a comfortable environment by adjusting the child's activity level and amount of clothing. Sponging or bathing with tepid water provides only marginal temperature reduction and often is accompanied by discomfort and shivering. Cold water or rubbing alcohol should not be used because it leads to vasoconstriction rather than to the vasodilatation that is needed for heat dissipation; alcohol also can be absorbed through the skin and lead to toxicity. For low-grade fever, nonpharmacologic methods often are all that are needed. However, as the temperature increases, antipyretics frequently are required to reduce the body temperature and make the child more comfortable during the illness. Antipyretic therapy is not, however, without potential disadvantages, including the elimination of fever as a valuable diagnostic clue, the occurrence of allergic or idiosyncratic reactions, the possibility of toxicity when dosed incorrectly, and the elimination of fever's effects on the immune system.

The most common antipyretics, acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs), work by inhibiting the enzyme cyclo-oxygenase, which converts arachidonic acid to prostaglandin. Although the interleukin-mediated steps of the febrile response continue to increase the hypothalamic set point, the effects of the reduced production and release of prostaglandin work to override that response. Thus, antipyretics serve to lower the set point. This effect is present only in the febrile state; antipyretics do not reduce normal body temperature.

Both the efficacy of the type of antipyretic used and whether the antipyretics should be used in combination have been debated. Acetaminophen has a long history of both safety and efficacy in doses of 10 to 15 mg/kg. Multiple preparations are available, and most forms are palatable, are well tolerated, and cause few allergic reactions. Ibuprofen is the most common NSAID used as an antipyretic. The recommended dose of 5 to 10 mg/kg is palatable, efficacious, and safe, despite theoretical concerns about interstitial nephritis, when used for a limited time as an antipyretic in children older than 6 months of age. Both drugs are absorbed in the GI tract, metabolized in the liver, and excreted in the urine. Table 1 compares their pharmacodynamics. A review of several studies comparing acetaminophen and ibuprofen showed similar safety and analgesic effects for moderate and severe pain, but ibuprofen was a more effective antipyretic and provided a longer duration of antipyresis. (25)

The use of a combination of acetaminophen and ibuprofen, in a variety of alternating regimens, has become a popular practice of both parents and practitioners. When surveyed, 67% of parents responded that they alternated antipyretics, (26) and 50% of pediatricians advocated such practice. (27) Yet, no conclusive proof indicates that alternating antipyretics is either safe or more efficacious than single-drug therapy. The only study that suggested an advantage of alternating therapy used subtherapeutic doses of antipyretics and inappropriate dosing intervals in the monotherapy groups. (23)(26) Furthermore, alternating antipyretics may be

Table 1. **Pharmacodynamics of Antipyretics** (23)(24)

	Acetaminophen	Ibuprofen
Dose	10 to 15 mg/kg	5 to 10 mg/kg
Dosing Interval	4 to 6 hours	6 to 8 hours
Time to Peak Plasma Concentration	30 minutes	60 minutes
Time to Maximum Temperature Reduction	2 hours	3 hours
Duration of Action	4 to 6 hours	4 to 8 hours

confusing to parents and has the potential for incorrect dosing and increased risk of toxicity. Specifically, ibuprofen inhibits production of glutathione that, in the presence of increased acetaminophen concentrations, can lead to hepatic or renal toxicity, especially in a febrile child who has hypovolemia. (27)(28) Therefore, in the absence of additional data, parents should be cautioned about using this approach; rather, practitioners should reinforce monotherapy with the correct antipyretic dosage and dosing interval for the individual child.

The response of fever to antipyretic therapy should not be used as a prognostic factor for determining whether the child has a less serious illness. Several prospective studies suggest that fevers due to serious infection (such as bacteremia) are as responsive to antipyretic therapy as less serious infection and, therefore, do not distinguish between infectious outcomes. (29) However, because it often is difficult to assess the febrile child due to the discomfort associated with fever, the reduction of fever may allow better assessment of the child's underlying well-being. A child who has a serious illness often continues to look ill even after fever reduction, whereas the appearance of a child whose illness is benign usually improves.

Vigorous attention to antipyretic therapy has been advocated for children who have a history of a simple febrile seizure. Yet, in the few controlled studies to date, no reduction in the recurrence of febrile seizures was documented with antipyretic therapy. (29) Therefore, it is more appropriate to focus on the excellent long-term outcome of febrile seizures to reduce parental anxiety, rather than on undue attention to fever control.

Parental Beliefs and Fever Phobia

As many as 30% of acute-care visits in pediatrics are related to the complaint of fever. Many of these visits are due to parental confusion about the significance of fever and the resultant anxiety about potential harmful effects of fever. These mistaken beliefs and undue concerns about fever were described in the early 1980s by Schmitt, (13) when he coined the term "fever phobia" to describe excessive concern by parents about low-grade fever. This phenomenon has been replicated in several studies, confirming that many parents remain confused or misinformed about what is normal temperature, what temperature constitutes a fever, how a temperature should be taken, and the use and dosing of antipyretics. (13)(30)

Concern about brain damage, febrile seizures, and death from mild-to-moderate fever exists across the spectrum of parental education and socioeconomic status. (30) In a sense, most parents still view fever as a "disease" rather than a "symptom." This perspective may be due, in part, to practitioners who may present mixed messages to parents about fever and fail to address parental concerns about fever during all types of pediatric visits. (3) Parents may be taught to "control" the fever rather than understand fever as a sign of an underlying illness that will persist until the illness is resolved.

These misconceptions by parents and practitioners have potential for a negative psychosocial impact on the physician-parent-child relationship during the evaluation of a simple febrile illness. Parents who are very worried about fever are more likely to perceive their doctors as being very worried about fever, more likely to bring the child for medical evaluation, and more likely to have blood tests performed on their children. (2) Whether the increased testing is due to parental pressure or practitioner anxiety is not known, but the result is that the parent may believe that blood tests are necessary for the evaluation of fever. This misperception leads to more fever phobia, more medical evaluations for febrile illness, more testing, and perpetuation of the anxiety.

The same situation holds true for the use of antibiotics for the febrile child. Almost 50% of pediatricians surveyed said parents always, most of the time, or often pressure them to prescribe unnecessary antibiotics, and about 33% of the pediatricians comply with these requests occasionally or more frequently. (31) Parents may perceive that the treatment for fever is antibiotics rather than antipyretics. Thus, practitioners must be diligent in their efforts to counteract fever phobia (Table 2) and resist the pressure and temptation to perform unnecessary testing and prescribe unnecessary antibiotics.

Table 2. **Counteracting Fever Phobia** (3)(13)(15)

- Educate about fever at a health supervision visit
- Fever is a normal response to infection
- Fever is a symptom not a disease
- Fever determination does not always need to be exact
- Parents should treat the child's comfort rather than a specific temperature
- Fever will persist until the disease process resolves
- Clinical appearance is important
- Use the term "fever therapy" rather than "fever control"

Summary

- Based on strong research evidence, there is no single value for normal body temperature; body temperature varies with a variety of specific individual and environmental factors, including age, sex, physical activity, ambient air temperature, and anatomic site of measurement. (6)(7)
- Based on some research evidence, parental report of fever to touch has limited validity and possibly is more useful to exclude rather than to confirm the presence of fever. (10)(11)
- Based on some research evidence, clinical appearance rather than the height of fever is a more powerful predictor of serious illness. (4)(14)
- Based on some research evidence as well as on consensus, the utility of routine blood cultures and complete blood count is diminished in the evaluation of otherwise healthy, well-appearing, febrile 3- to 36-month-old children who have received pneumococcal vaccine. (17)(18)(19)
- Based on strong research evidence, acetaminophen and ibuprofen have similar safety and analgesic effects for moderate and severe pain, but ibuprofen is a more effective antipyretic and provides a longer duration of antipyresis. (25)
- Based on strong research evidence, fevers due to serious infection (such as bacteremia) are as responsive to antipyretic therapy as is less serious infection. Therefore, a reduction in the height of the temperature after antipyretic therapy does not distinguish between infectious causes. However, clinical experience indicates that a child who has a serious illness often continues to appear ill after fever is reduced, whereas the appearance of a child who has a benign illness usually improves. (29)

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PIR Quiz

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1. Which of the following is a true statement regarding body temperature?

   A. Measuring the temperature of the tympanic membrane has been proven to be the most accurate method of determining body temperature.
   B. Normal body temperature is usually highest on waking in the morning.
   C. Parental reporting of tactile fever is an accurate measure of the presence of true fever.
   D. The control of body temperature is primarily regulated by the thalamus.
   E. The first phase of a febrile response often is associated with feeling cold.

2. Which of the following is *not* a known complication of fever associated with infection?

   A. Cerebral damage.
   B. Increased catabolism.
   C. Seizure.
   D. Tachycardia.
   E. Tachypnea.

3. You are evaluating a 10-month-old girl who has had a temperature to 102.0°F (38.9°C) for 2 days. Her parents deny other symptoms except a slight increase in fussiness. Her immunizations are up to date. Findings on physical examination are normal, and she appears well. Which of the following tests is *most* helpful in establishing a diagnosis in this child?

   A. Blood culture.
   B. Chest radiograph.
   C. Complete blood count.
   D. C-reactive protein.
   E. Urine culture.

4. You are taking call one night when a worried mother phones you because her 2-year-old son had a temperature of 103.0°F (39.5°C) 1 hour ago that has not resolved with a dose of acetaminophen. She reports that he is eating well and still playful, and she denies other symptoms. Of the following, which is the *most* appropriate advice?

   A. She should encourage fluids and monitor for the development of other symptoms.
   B. She should give another dose of acetaminophen immediately.
   C. She should place the boy in a cool bath until his temperature is normal.
   D. The child needs immediate attention because the lack of response to antipyretics indicates a serious bacterial infection.
   E. The height of the fever indicates a bacterial infection, so antibiotics should be given.

Acute Fever

Jeffrey R. Avner

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