Problems in Family Practice

The Febrile Infant

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While 46 percent of febrile children, aged 3 months to 24 months, will be well without treatment within 24 to 48 hours, and another 12 percent well within 72 to 96 hours, approximately 6 percent will have serious bacterial infections. The incidence of such infections tends to increase with decreasing age and increasing degree of fever. Physicians, who make specific observations of the child's color, hydration, social response, consolability, and degree of alertness after the child has been made comfortable, can identify about two thirds of those with benign illness and the one tenth who require inpatient evaluation. Of the remaining patients, those with serious illness can be further identified if their white blood count is greater than 15,000/μL, neutrophils are greater than 10,000/μL, band cells are greater than 500/μL, or sedimentation rate is more than 30 mm/h. Children with these laboratory findings should then have a chest film and blood culture and, if the former is negative, should be considered for a lumbar puncture and urine culture. Whether further observation or treatment at this point can be done as an outpatient depends on physician judgment.

The outpatient evaluation and management of febrile children continues to be a commonly encountered and perplexing problem for primary care physicians. Fever in children aged less than 10 years stimulated 15 to 20 percent of after-hour physician contacts, most of those children being less than two years old.[1-3] While the majority of these febrile illnesses represent self-limited, benign diseases,[4] it is estimated from 4 to 10 percent have bacteremia or other serious bacterial infections.[5] Bacteremia, especially that caused by Streptococcus pneumoniae, frequently presents in the febrile child as a minor illness such as upper respiratory tract infection, fever without apparent cause, or otitis media.[2]

In the past five years, there have been six studies reported to the Ambulatory Pediatric Association at national meetings,[6] and the pediatric literature has published numerous articles in recent years attempting to document practical guidelines for detecting these more seriously ill patients, but they frequently contradict each other. At least one study suggested that after-hour evaluation of febrile infants differed substantially from guidelines in the literature.[1] A practical approach is needed to the common problem of fever in infants and young children. This paper presents such an approach based on the current literature on the subject.

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Variables Affecting Approach to Fever

Age

The incidence of fever greater than 38.3°C (101° F) is uncommon in infants aged less than 8 weeks but increases dramatically with each month of age. In a large series of emergency room visits, fever greater than 38.3° C in infants aged less than 8 weeks equaled 0.1 percent of all visits, while they represented 3.1 percent of all admissions.[7] In the past it was generally agreed that temperature increase in this age group more often represented more serious disease. Children aged less than 3 months with temperatures more than 38.3° C were reported to have 21.5 times the risk of serious underlying infection as infants more than 3 months old with the same temperature.[9] Some recent studies challenge this thinking, pointing out experience indicated that the incidence of bacteremia in less than 8-week-old infants was the same as[8] or less than[9] that in older infants, and that they might be safely managed as outpatients with close follow-up.[8]

Surveys of actual practice show that infants seen in a physician's office are four times less likely to have a lumbar puncture as those seen in a university setting,[7] suggesting less intensive investigation, and that infants aged less than 3 months were not treated differently by residents in a family practice training program than those aged over 3 months.[1] Other experienced investigators continue to feel that in infants younger than 3 months significant disease is easily overlooked and in most cases the infants deserve inpatient management.[6] Accepting the latter position, the remainder of this article deals with those children aged 3 to 24 months. Within this age group, children 3 to 9 months old have twice the rate of meningitis as older children, with 7-month-old children having four times as much meningitis as children aged more than 24 months.[7] Bacteremia is also most common in the 7- to 12-month age group.[9]

Degree of Fever

A number of studies have demonstrated a clear relationship between the degree of fever and the incidence of bacterial infection. McCarthy[2] reported 264 consecutive children, aged less than 24 months, seen in an emergency room setting with temperatures of 40.5° to 41° C (104° to 105.8° F); 13 percent had bacteremia. If the temperature was over 41° C, 23 percent were bacteremic and 10 percent had meningitis. He further reported that 18 percent of 1,169 consecutive emergency room visits of febrile children had temperatures greater than 40° C, making it a common problem. Table 1 summarizes similar data from Sheinfield.[10]

Table 1. Incidence of Serious Bacterial Infection Related to Degree of Patient's Temperature

Temperature	Bacteremia (%)	Meningitis (%)
38.9°C (102°F)	4	
40°C (104°F)	8	
40.5°C (105°F)	13	8
41.1°C (106°F)	26	19

Source: Scheinfield H: Managing fever in the very young, called doctor's dilemma. Pediatr News 1982; 16(9): 15

In a study of 146 middle-class private patients, all cases of bacteremia occurred in those patients with temperatures greater than 39.5° C (103° F); 10.5 percent had bacteremia.[11]

Other Variables

If the child is otherwise healthy, other history variables, such as income or race, do not seem to play a remarkable role in determining the cause of fever.

Patient Assessment

Classical history and physical findings are often not diagnostic when evaluating the febrile child.[2] Physicians often rely on "instinctive observations" more than history and physical examination to help identify the seriously ill child from those with benign febrile illness.[12] Attempts have been made to identify these "instinctive observations,"[5,8,12-14] and include such variables as alertness, response to parental stimulation, how easily the child arouses from sleep, and the ability to feed. State of hydration, color, and consolability are considered three key observations by McCarthy

Table 2. Observations That Help Predict Severity of Illness

	Quality of Cry	Reaction to Stimulation by Parent	State Variation	Color	Hydration	Response to Social Overtones (smile, talk)
Normal	Strong with normal tone or content; not crying	Cries briefly then stops *or* not crying	If awake, stays awake, *or* if sleeping, awakens quickly to stimulation	Pink	Skin normal; eyes normal; mucous membranes moist	Smiles or alert (< 2 mo)
Moderate impairment	Whimpering	Cries off and on	Eyes close briefly→awake *or* awakes with prolonged stimulation	Pale extremities *or* acrocyanosis	Skin, eyes normal *and* mouth slightly dry	Brief smile *or* alerts briefly (< 2 mo)
Severe impairment	Weak *or* moaning *or* high pitched	Continual cry *or* hardly responds	Falls to sleep *or* will not respond	Pale *or* cyanotic *or* mottled *or* ashen	Skin doughy *or* tented *and* dry mucous membranes *and/or* sunken eyes	No smile face anxious, dull, expressionless, *or* no alerting (< 2 mo)

Adapted from McCarthy PL, Sharpe M, Spiesel S, et al: Observation scales to identify serious illness in febrile children. Pediatrics 1982; 70:806

and colleagues.[13] The child's response to social overtures (smile or talk) was impaired in 100 percent of seriously ill children, and no child who smiled normally had serious illness in his study. However, less than 20 percent who did not smile normally had serious illness.[12]

Variables such as playfulness, consolability, and alertness are difficult to quantitate. McCarthy et al[12] found that only 57 percent of seriously ill children were judged so by their attending physician, so that reliance on instinctive judgment was not a sufficiently sensitive clinical tool, but they later demonstrated that using well-defined scales for each variable increased the ability to identify serious illness.[13] Table 2 is adapted from the predictive model they devised. Each observation is scored from 1 to 5. When the total score was less than 10, only 2.7 percent had serious illness; when it was more than 16, 92.3 percent had serious illness. When the score was 11 to 15, 26.2 percent had serious illness. With this model, he identified 77 percent of seriously ill febrile children.

Nelson[14] devised a similar Severity Index Scoring System (Table 3) to be used as a screening tool by physicians and nurses to triage patients in an emergency room setting. The scale rates respiratory effort, color, activity, temperature, and pulse on a scale from 0 to 2, similar to the Apgar scale, with a total of 10 equaling "no illness," 8 and 9 "moderate illness," and 7 or less "serious illness." Using this scoring system, 98.7 percent of nonsevere illnesses were identified with a false-negative rate 1.3 percent and a false-positive rate of 15.8 percent.

In making these observations, the physician must try to provide an optimal environment. McCarthy[2] notes, "Perhaps the most serious error the physician can make is to bring the child into an exam room hastily and before the child is comfortable and the fever is controlled, begin the examination. The presence of the physician, a cold exam table, and fever may all result in a persistently irritable, inconsolable child. Rather, evaluate the child when the temperature is controlled and the child is comfortable on the mother's lap."

In a study of 165 febrile patients aged 3 to 24 months, 66 percent appeared well and were managed as outpatients with observation only (only 2.7 percent of these had serious illness), 8 percent appeared seriously ill and required inpatient management, and 26 percent occupied middle ground.[13] It is the latter group that presents the greatest challenge to physicians. Waskerwitz and Berkelhamer[5] feel that the physician's assessment

Table 3. Severity Index Scoring System

Variable	Point Value 0	1	2
Respiratory effort	Labored or absent	Some distress	No distress
Color	Cyanotic	Pale Flushed Mottled	Normal
Activity	Delirium Stupor Coma	Lethargy	Normal
Temperature	< 97.4° or > 104°F	101.1° - 104°F	97.4° - 101°F
Play	Refuses to play	Decreased	Normal

Reprinted with permission from Nelson KG: An index of severity for acute pediatric illness. Am J Public Health 1980; 70:804-807

is the most useful factor in predicting serious illness (predictive value 14 percent, specificity 83 percent, sensitivity 47 percent). Serial examinations may increase the sensitivity of identifying those with serious illness, or an alternative approach is laboratory screening.[12]

Laboratory Screening

Considerable research has centered around the use of laboratory screening procedures, including use of white cell counts, differential, estimated sedimentation rates, and C-reactive protein, to help identify those febrile infants with serious illness.[2,5,7,8,11,15] The only thing these studies agree on is that there is no laboratory screening procedure, taken alone, that reliably identifies serious illness. There is disagreement whether combinations of some of these tests are more valuable.

McCarthy[2] reports that a white cell count of more than 15,000/μL and an erythrocyte sedimentation rate of more than 30 mm/h has the best balance of false-positive–false-negative results and predictive value (sensitivity 64 percent, specificity 60 percent). This combination of tests identified 75 percent of children with bacteremia and 66 percent of those with serious febrile illness. Crain and Shelov[8] found that the combination of physician's impression of sepsis, a white cell count of more than 15,000/μL, and a sedimentation rate of more than 30 mm/h identified 100 percent of infants with bacteremia and excluded 82 percent of infants who did not have bacteremia. Waskerwitz and Berkelhamer,[5] on the other hand, found the white cell count to be least useful and that use of a combination of laboratory tests (not defined) did not markedly improve the sensitivity or predictive value. Todd[16] reported a total segmented neutrophil count of more than 10,000/μL or a total band count (bands) of more than 500/μL is associated with an 80 percent chance of bacterial infection. Baron and Fink[11] confirmed Todd's finding and found that combined with a white cell count of more than 15,000/μL or a total neutraphil and band count of more than 10,500/μL, 7 out of 8 bacteremic babies were identified with only 10 out of 138 being false positive. McCarthy[2] found neutrophil and band counts less sensitive and specific by themselves and did not comment on their combination with other tests.

Summary of a Practical Approach

Taking into account, then, that approximately 5 to 10 percent of febrile children between 3 and 24 months of age have significant bacterial infection and that the incidence of such infection increases with the degree of fever, the physician who knows what specific observations to make can identify approximately 66 percent of those children with benign illness and those 8 percent with significant infection who need hospitalization. The remaining children can benefit from a white cell count, differential, and sedimentation rate to further define those at high risk. These are tests easily available in the outpatient setting at reasonable cost.

Because the overwhelming majority of patients with serious illness (71/82) in his study had either pneumonia or bacteremia as a final diagnosis, McCarthy[2] recommends that those children with a white cell count of more than 15,000/μL or a sedimentation rate of more than 30 mm/h have a chest roentgenogram and blood culture done. If the chest roentgenogram is negative, the physician must then rely on his observation of the child to determine whether other laboratory workup (urinalysis and culture, lumbar puncture) is indicated, and whether the child warrants admission or observation at home. In the latter case, a repeat examination in 24 hours is necessary.

Keeping A Perspective

McCarthy's data[2] also revealed that about 40 percent of those children with a high white cell count and sedimentation rate will not have serious disease. Murray et al,[4] considering all children more than 3 months old with fever, found that without treatment, 46 percent were afebrile and completely well within 24 to 48 hours and 12 percent more were well within 72 to 96 hours. Even those who had been judged well enough to be observed at home, who subsequently had a positive blood culture, often were asymptomatic on repeat examination.[17] McCarthy[2] recommends for these children that, if the blood culture grows Hemophilus influenzae, the child be admitted for intravenous antibiotics, as this organism is so invasive to soft tissue. If the culture grows S pneumoniae, a less invasive organism, and the child is asymptomatic, repeat culture and oral antibiotics at home with good follow-up is satisfactory. Other authors[10,17] feel all children with positive blood cultures who are asymptomatic can be treated at home. Symptomatic patients with positive blood cultures, of course, require intravenous therapy.

Teele et al[17] recommend that any child 6 to 24 months old with fever more than 38.9°C (102°F) and a white cell count of more than 15,000/μL at least be treated with ampicillin or its equivalent at home. Although they demonstrated a decrease in bacteremia on 24-hour follow-up, they also demonstrated no alteration in the incidence of meningitis on such treatment, and made no comment on the cost or complication rate of the 85 to 90 percent who received unnecessary treatment. Physician judgment is still necessary for appropriate treatment.

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