MEASUREMENT and ASSESSMENT of FEVER

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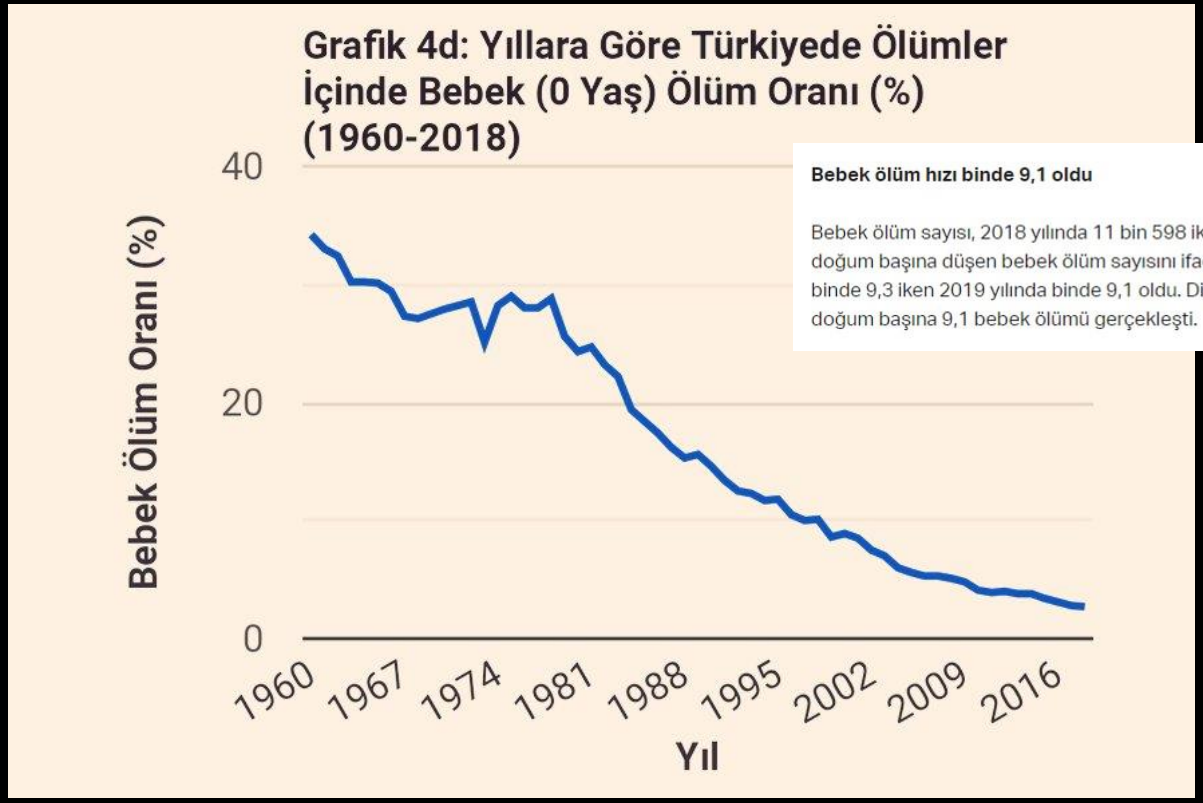
FEVER
Introduction

- We live on a planet with different temperatures.
- On this planet, our body temperature is tried to be kept within a very limited range.
- Traditionally, body temperature fluctuates in a defined normal range (36.6-37.9°C rectally), highest point is reached in early evening and the lowest point is reached in the morning.
- From time to time, our body temperature rises above normal. We call it fever.

FEVER
Introduction

- Fever is a very frightening symptom for families.

FEVER
Introduction



Bebek ölüm hızı binde 9,1 oldu

Bebek ölüm sayısı, 2018 yılında 11 bin 598 iken 2019 yılında 10 bin 770 oldu. Bin canlı doğum başına düşen bebek ölüm sayısını ifade eden bebek ölüm hızı, 2018 yılında binde 9,3 iken 2019 yılında binde 9,1 oldu. Diğer bir ifade ile 2019 yılında bin canlı doğum başına 9,1 bebek ölümü gerçekleşti.

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DEDICATED TO THE HEALTH OF ALL CHILDREN

AAP News

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Fighting 'fever phobia'

Fever, in and of itself, is not known to endanger a generally healthy child and actually may be beneficial. Still, many caregivers panic when they see the number on the thermometer rise past 98.6 degrees and rush to give their child acetaminophen or ibuprofen.

A new AAP clinical report addresses the state of knowledge about antipyretic usage in children, including common concerns, indications, treatment goals, single or combination therapy, and instructions for caregivers. It also highlights the need to educate patients and families about fever and "fever phobia."

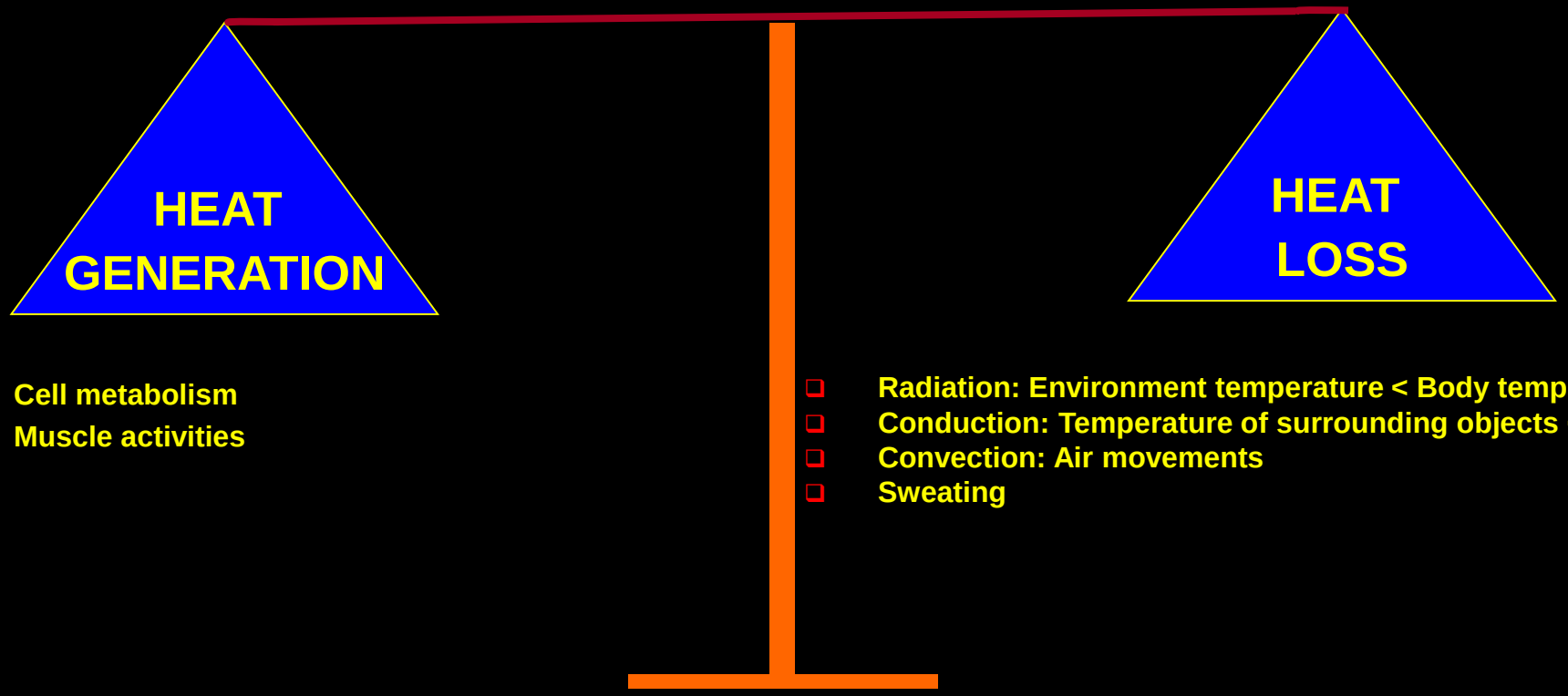
See story on page 8.

FEVER
Introduction

- Fever is an increase in body temperature in a controlled manner.

FEVER
Thermoregulation

- It is keeping the body internal temperature stable in a balanced way.

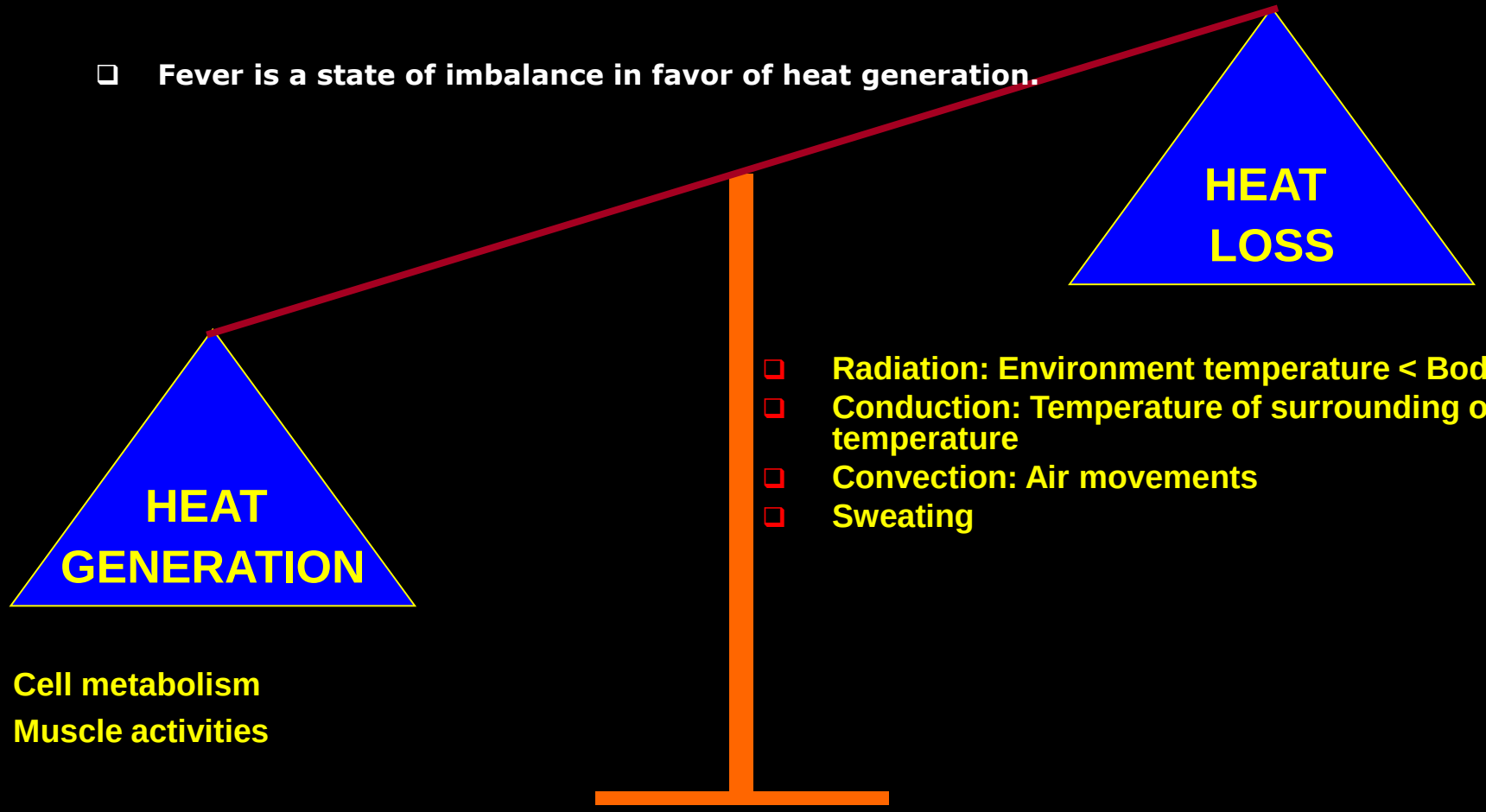


- Cell metabolism
- Muscle activities

- Radiation: Environment temperature < Body temperature
- Conduction: Temperature of surrounding objects < Body temperature
- Convection: Air movements
- Sweating

FEVER
Thermoregulation

- Fever is a state of imbalance in favor of heat generation.

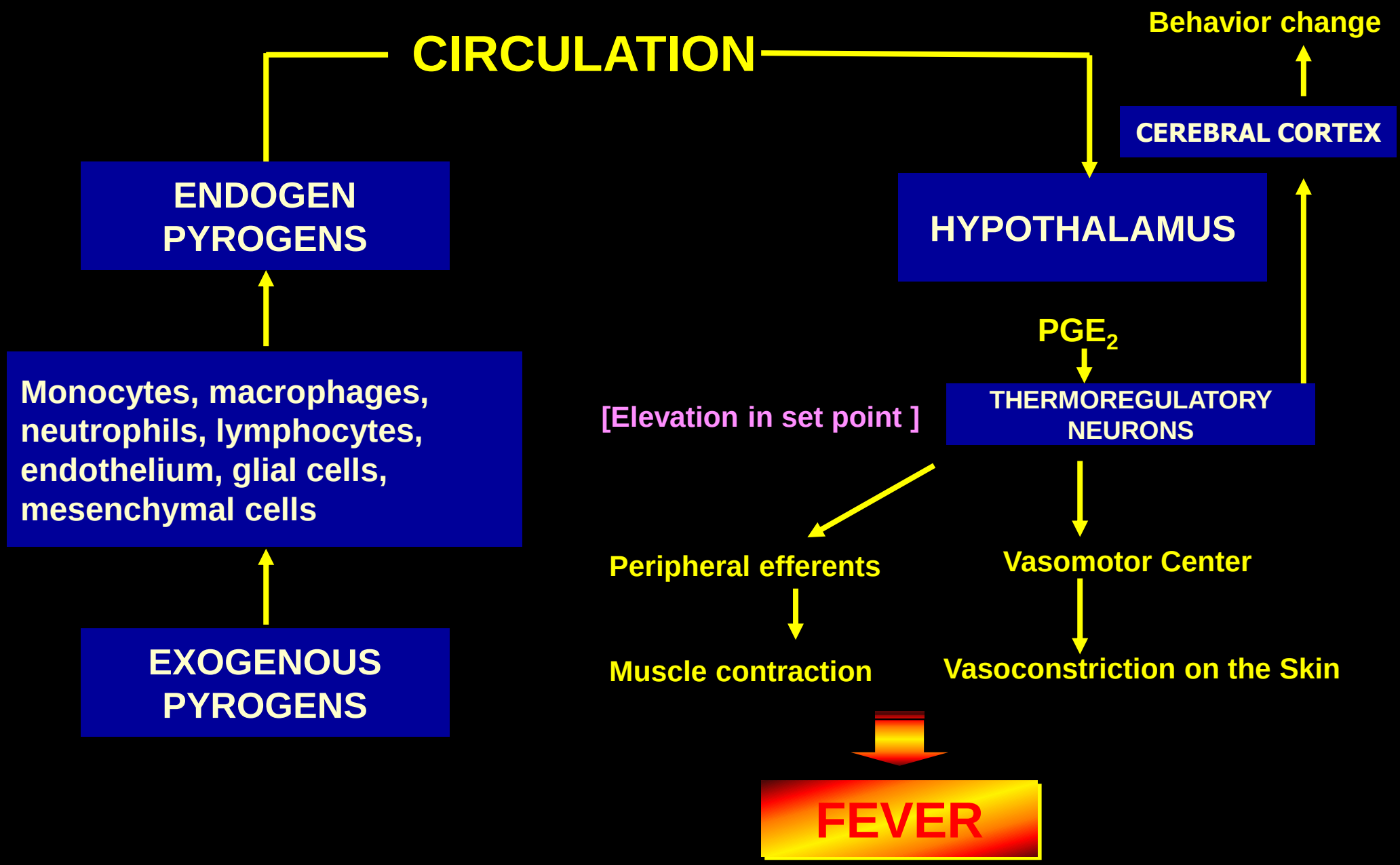


- Radiation: Environment temperature < Body temperature
- Conduction: Temperature of surrounding objects < Body temperature
- Convection: Air movements
- Sweating

- Cell metabolism
- Muscle activities

FEVER
Thermoregulation

- Three different mechanisms can produce fever:
  - Pyrogens
    - Endogenous pyrogens (Interleukin (IL)-1, IL-6, TNF-α, IFN-β and IFN-γ)
    - Exogenous pyrogens (Microbes, microbial toxins, or other products of microbes, drugs)
  - Heat production exceeding heat loss
  - Defective heat loss


CIRCULATION
ENDOGEN PYROGENS
Monocytes, macrophages, neutrophils, lymphocytes, endothelium, glial cells, mesenchymal cells
EXOGENOUS PYROGENS
HYPOTHALAMUS
Behavior change
CEREBRAL CORTEX
PGE2
THERMOREGULATORY NEURONS
[Elevation in set point]
Peripheral efferents
Muscle contraction
Vasomotor Center
Vasoconstriction on the Skin
FEVER

FEVER
Measurement of Body Temperature

- **Body temperature is measured with a thermometer.**

THERMOMETERS
Digital Thermometers

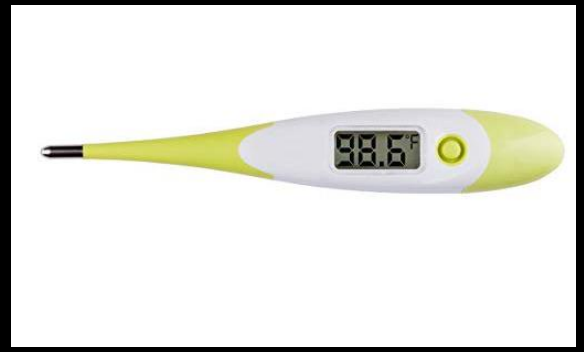
- Mercury thermometers
- Digital Thermometers
  - Digital multi-use thermometer
  - Temporal artery thermometer
  - Tympanic thermometer
- Plastic Strip Thermometers
- Wearable Thermometers

THERMOMETERS
Mercury Thermometers

- It was invented by physicist Daniel Gabriel Fahrenheit in Amsterdam (1714).
- Measures rectal, oral or axillary temperature.
- It can be dangerous if the glass breaks and the mercury is not cleaned up properly.
- The mercury will evaporate and can contaminate the surrounding air and become toxic to humans.
- Mercury-in-glass thermometers are banned in many countries due to mercury exposure concerns.

THERMOMETERS
Digital Multi-use Thermometer

- Measures temperature in child’s bottom (rectal), mouth (oral) or armpit (axillary).
- Oral use is not recommended until a child is age 4 or older.
- Reads body temperature when the sensor located on the tip of the thermometer touches that part of the body.
- It's important to label the thermometer "oral" or "rectal" so it is not used in both places.



THERMOMETERS
Temporal Artery Thermometer

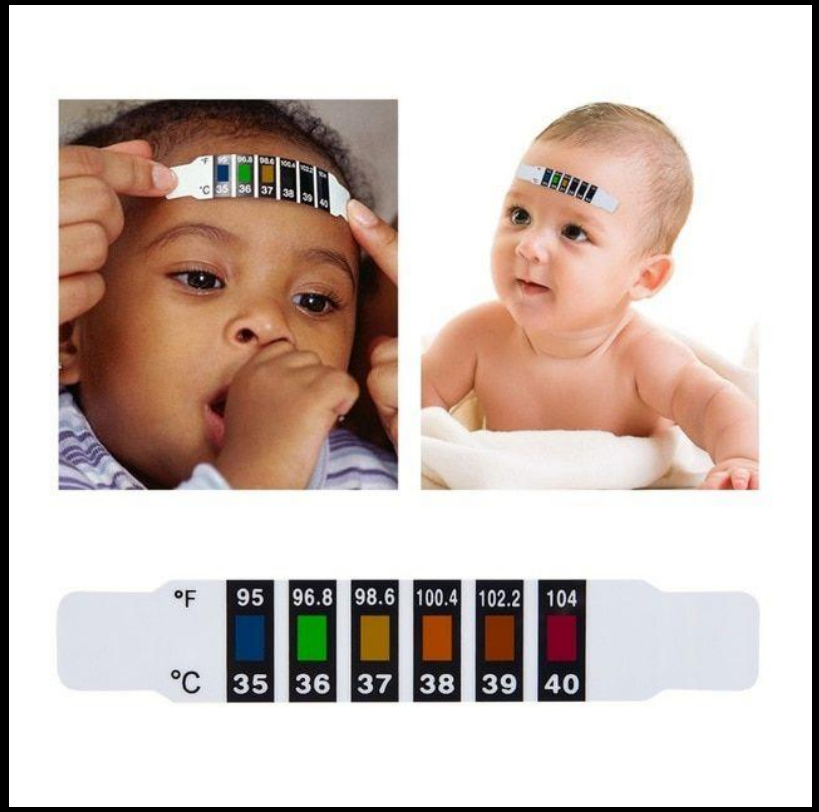
- Measures infrared heat waves coming off the blood vessel that runs across the forehead just below the skin.
- Can be used for all ages.
- Temperature is taken on the side and front of the forehead, depending on whether it is a non-contact or "no-touch" model. Check the instructions to find out how close to the forehead and other tips before using.
- Non-contact models may help reduce the risk of passing germs.
- Direct sunlight and cold temperatures after being outside may affect reading.

THERMOMETERS
Tympanic Thermometer

- Measures temperature in a child's ear by reading infrared heat waves from the eardrum.
- Can be used on children age 6 months and older. Not reliable for younger babies, whose ear canals are too narrow.
- It needs to be placed correctly in your child's ear canal to be accurate.
- Cold temperatures after being outside can affect reading

THERMOMETERS
Plastic Strip Thermometers

- Plastic strip thermometers that are laid on the forehead are popular with parents as they are cheap and easy to use, especially with sleeping or uncooperative children.
- But they are not as accurate as thermometers.



THERMOMETERS
Wearable Thermometers

- They can be used continuously and do not require waking or disturbing the child.
- Their ability to track the fever across time can be helpful.

MEASUREMENT OF FEVER
Rectal Temperature

- Taking a rectal temperature gives the best reading, especially for infants under 3 months of age.
- Put a small amount of lubricant, such as petroleum jelly, on the end of the thermometer and on the child's bottom.
- Place your child belly down across your lap or on a firm surface. Another way is on the back with the legs pulled up to the chest. Turn the thermometer on and slide it 1 cm (for babies less than 6 months old) to 2-2.5 cm into the anus. Be gentle. There should not be any resistance. If there is, stop. Hold your child still. Leave the thermometer in place until it beeps. Then remove and check the digital reading.
- Thermometers should be disinfected before and after use with disinfecting soap and water or disinfecting alcohol swab.
- Label the rectal thermometer so it is not accidentally used in the mouth.

MEASUREMENT OF FEVER
Oral Temperature

- Once the child is 4 years old, you can take a temperature by mouth.
- If the child has had a hot or cold drink, wait 30 minutes.
- Turn the thermometer on and place the tip under one side of the child's tongue toward the back of the mouth.
- Have the child hold the thermometer with their lips and fingers.
- Do not use the teeth to keep in place.
- Keep the lips sealed over the thermometer until it beeps.
- Check the digital reading.

MEASUREMENT OF FEVER
Axillary Temperature

- The axillary temperature method is usually used to check for fever in newborns and young children.
- It is frequently used in our hospital and in our country.
- Place the tip of the thermometer in the centre of the armpit
- Tuck the child's arm snugly (closely) against their body.
- Leave the thermometer in place for about 1 minute, until you hear the "beep" (Keep the baby's arm against his or her side for 4 to 5 minutes for mercury thermometers).
- Remove the thermometer and read the temperature.

MEASUREMENT OF FEVER
Forehead Temperature

- Temporal artery (forehead) thermometers can be used on children of any age.
- Follow the instructions on the package to know how and where to slide or aim the sensor across the forehead to get the most accurate measurement. The sensor measures the heat waves coming off the temporal artery. This blood vessel runs across the forehead just below the skin.
- Read the child's temperature on the display screen.

MEASUREMENT OF FEVER
Ear Temperature

- Tympanic (ear) thermometers can be used on children 6 months of age and older, as young infants have narrow ear canals.
- Follow the instructions on the package. A correct temperature depends on pulling the ear back. Pull the ear back and up if the child is over 1 year old. Then put the tip of the ear probe to the ear canal.
- Being outdoors on a cold day may cause a low reading. Wait 15 minutes after coming indoors to take the temperature.

MEASUREMENT OF FEVER
Border of Fever

- Which body temperature is accepted as fever?
  - Axillary > 37.2ºC
  - Oral > 37.8ºC
  - Rectal ≥ 38ºC
  - Tympanic > 38ºC (Rectal mode) >37.5ºC (Oral mode)
  - Forehead > 38ºC

MEASUREMENT OF FEVER

Celsius to Fahrenheit Conversion Formula

$$°C = (°F - 32) \times 5 / 9$$

$$°F = (°C \times 9 / 5) + 32$$

MEASUREMENT OF FEVER

Celsius to Fahrenheit Conversion Formula

- You measured a child's temperature of 37°C. His mother asked if he was above 100°F. Tell the mother how much degrees Fahrenheit is the body temperature of her child.
- Solution:
  - The temperature in Celcius = 37°C (given)
  - Convert 37°C temperature of the body into °F.
  - Using C to F Formula, °F = (°C x 9 / 5) + 32
  - Put the values,
  - °F = (37 x 9 / 5) + 32
  - °F = (333 / 5) + 32
  - °F = (66.6) + 32
  - °F = 98.6
- Answer: The temperature in Fahrenheit is 98.6°F.

MEASUREMENT OF FEVER
Positive Consequences of Fever

- Fever is an adaptive response that the body develops against harmful agents.
- Briefly, when the body temperature increases:
  - Inflammation system works better
  - Microbial growth rate decreases

- Fever, usually, works for the benefit of us.

MEASUREMENT OF FEVER
Negative Consequences of Fever

- Increase in metabolic rate
- Increase in oxygen consumption
- Increase in carbon dioxide production
- Increased cardiac output
- Increased respiratory workload
- Decline in convulsion threshold

TREATMENT OF FEVER
Supportive Treatment

- Fever with temperatures <39°C in healthy children generally does not require treatment.
- Encouraging good hydration is the 1st step to replace fluids that are lost related to the increased metabolic demands and insensible losses of fever.
- Physical measures such as tepid baths and cooling blankets are not considered effective to reduce fever.

TREATMENT OF FEVER
Antipyretic Drug Treatment

- Antipyretic therapy is beneficial in high-risk patients and patients with discomfort.
  - Paracetamol 10-15 mg/kg/dose, every 4-6 hours
  - Ibuprofen 5-10 mg/kg/dose, every 6-8 hours (in children >6 months old)

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AAP News

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Fever! Fever! Fever!

Clinical report addresses educating parents to reduce 'fever phobia'

by Hank Farrar, M.D., FAAP, and Janice E. Sullivan, M.D., FAAP

AAP Clinical Report

It is 3 a.m. and you get your third call of the night about a child with fever. A parent asks about giving antipyretics prior to routine immunizations. You are educating first-time parents about fever prior to discharge of their infant from the newborn nursery. These scenarios are common in everyday practice.

Fever accounts for one-third of all presenting conditions in children. What guidance is available to pediatricians and pediatric health care providers regarding fever treatment or prophylaxis and education for parents/caregivers?

A new AAP clinical report, *Fever and Antipyretic Use in Children*, summarizes recommendations and controversies related to the use of antipyretics in pediatrics (*Pediatrics.* 2011;127:580-587). The report, from the AAP Section on Clinical Pharmacology and Therapeutics and the Committee on Drugs, addresses the state of knowledge about antipyretic usage in pediatric patients, including common concerns, indications, treatment goals, single or combination therapy, and instructions for caregivers. Limited evidence-based information is available regarding antipyretic therapy, combination therapy and the role of fever in the natural history of an illness.

Although many parents administer antipyretics to a child with minimal or no fever, this report emphasizes that the primary goal of treating the febrile child should be improvement of the child's overall comfort rather than normalization of body temperature.

Need to educate

The report highlights the need to educate patients and families about fever and "fever phobia."

Fever is a physiological mechanism that has beneficial effects in fighting infection. Fever, in and of itself, is not known to endanger

of an illness or that it causes long-term neurological complications. Possible exceptions may be children with certain underlying chronic disease (i.e., myocardial dysfunction or heart failure) or acute illness (i.e., acute myocarditis, shock, etc.) that may result in limited tolerance of the increased metabolic demands caused by a fever.

Many physicians continue to encourage the use of antipyretics, believing that most benefits result from improved comfort and the accompanying improvements in activity and feeding, less irritability, and a more reliable sense of the child's overall clinical condition.

Specific recommendations	AAP[2]	SIP[27]	South- Africa[30]	NICE[44]	NSW[47]	SA[48]	WHO[49]
Age of target population	Not specified	0–18 years	Not specified	<5 years	1 month –5 years	<3 years	<5 years
Indications and treatment goals							
Antipyretics are indicated to improve overall comfort of the febrile child	✔	✔	✔	✔	✔	✔	✔
Antipyretics should not be used with the aim of reducing body temperature	✔	✔	✔	✔	✔	nr	✔
Fever response to antipyretics is not a predictor of serious illness	nr	✔	✔	✔	✔	nr	nr
Antipyretics do not prevent febrile convulsions	✔	✔	✔	✔	nr	✔	nr
Antipyretics are not indicated to prevent vaccine reaction	✔	✔	✔	nr	nr	nr	nr
Antipyretics are not indicated to treat vaccine reaction	nr	nr	✔	nr	nr	nr	nr
Physical management							
The use of physical devices is not recommended	nr	✔	nr	nr	✘*	nr	✘†
Children with fever should not be under-dressed or over-wrapped	nr	✔	✔	✔	✘*	nr	✘†
The use of alcoholic baths is not an appropriate cooling method	✔	✔	nr	nr	✔	nr	nr
Tepid sponging is not recommended for the treatment of fever	✔	✔	✔	✔	✔	nr	nr
Pharmacological management							
Consider using either paracetamol or ibuprofen in children with fever who appear distressed	✔	✔	✔	✔	✔	✔	✔
Paracetamol from the age of	3 months‡	Birth§	3 months	nr	Birth	Birth§	2 months
Ibuprofen from the age of	6 months	nr	3 months	nr	6 months		2 months
Combination of paracetamol/ibuprofen is not recommended	✘¶	✔	✔	✔	nr	✔	nr
Alternating paracetamol/ibuprofen is not recommended	✘¶	✔	✔	✘**	✔	✘**	nr
Oral administration of paracetamol is preferred to rectal	nr	✔	nr	nr	nr	nr	nr
Rectal administration is allowed only if the oral is not feasible	nr	✔	nr	nr	nr	nr	nr

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NICE
National Institute for Health and Care Excellence

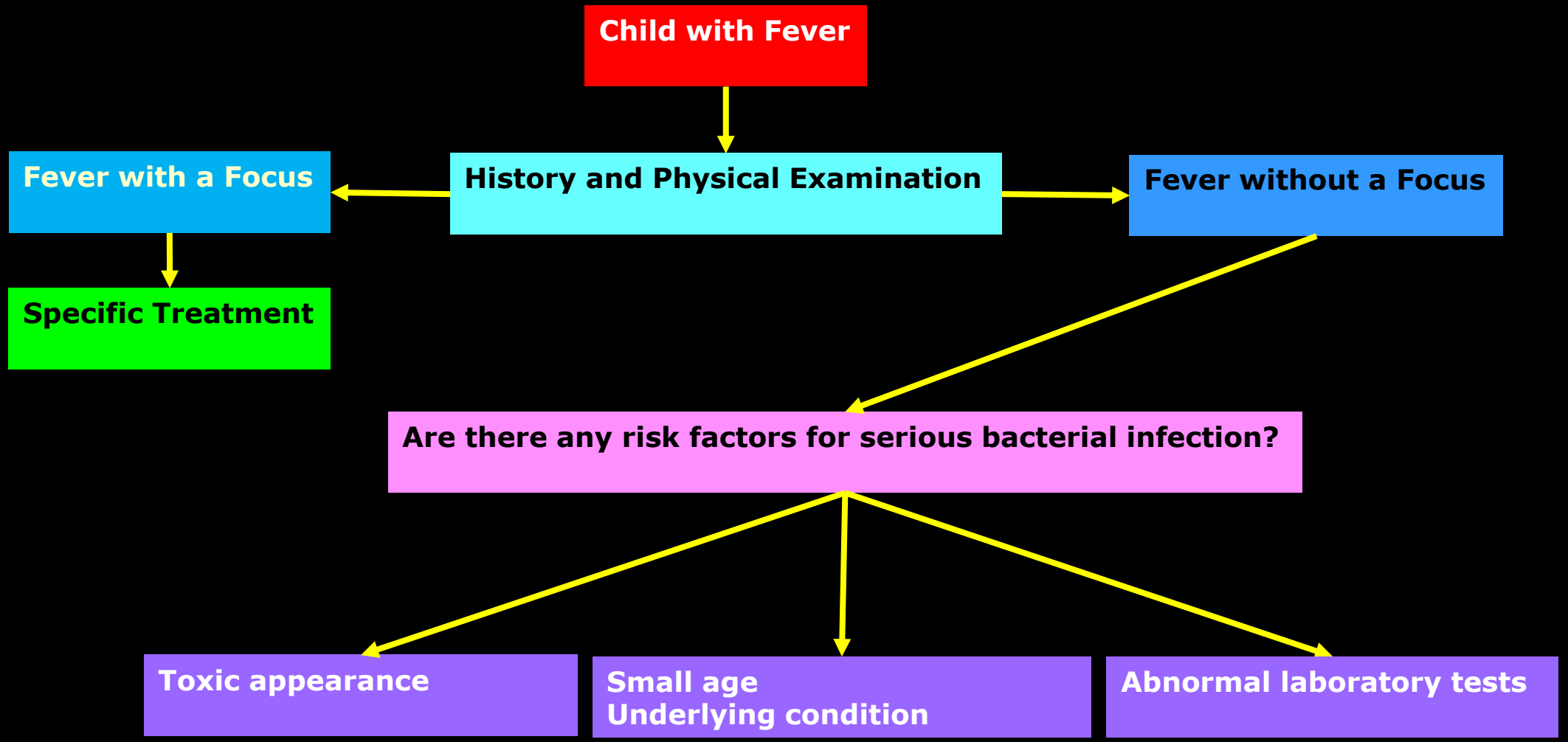
World Health Organization

Società Italiana di Pediatria

TREATMENT OF FEVER
Treatment for the Main Disease

- Treatment of infection
- Disease-specific treatment

TREATMENT OF FEVER
Treatment for the Main Disease



GROUP	MANAGEMENT
Any toxic-appearing child 0-36 mo and temperature ≥38°C (100.4°F)	Hospitalize, broad cultures plus other tests,* parenteral antibiotics
Child <1 mo and temperature ≥38°C (100.4°F)	Hospitalize, broad cultures plus other tests,* parenteral antibiotics
Child 1-3 mo and temperature ≥38°C (100.4°F)	Two-step process 1. Determine risk based on history, physical examination, and laboratory studies. Low risk: • Uncomplicated medical history • Normal physical examination • Normal laboratory studies • Urine: negative leukocyte esterase, nitrite and <10 WBC/HPF • Peripheral blood: 5,000-15,000 WBC/mm^3; <1,500 bands or band: total neutrophil ratio <0.2 • Stool studies if diarrhea (no RBC and <5 WBC/HPF) • CSF cell count (<8 WBC/μL) and negative Gram stain • Chest radiograph without infiltrate 2. If child fulfills all low-risk criteria, administer no antibiotics, ensure follow-up in 24 hr and access to emergency care if child deteriorates. Daily follow-up should occur until blood, urine, and CSF cultures are final. If any cultures are positive, child returns for further evaluation and treatment. If child does not fulfill all low-risk criteria, hospitalize and administer parenteral antibiotics until all cultures are final and definitive diagnosis determined and treated
Child 3-36 mo and temperature 38-39°C (100.4-102.2°F)	Reassurance that diagnosis is likely self-limiting viral infection, but advise return with persistence of fever, temperatures >39°C (102.2°F), and new signs and symptoms
Child 3-36 mo and temperature >39°C (102.2°F)	Two-step process: 1. Determine immunization status 2. If received conjugate pneumococcal and *Haemophilus influenzae* type b vaccines, obtain urine studies (urine WBC, leukocyte esterase, nitrite, and culture) for all girls, all boys <6 mo old, all uncircumcised boys <2 yr, all children with recurrent urinary tract infections If did not receive conjugate pneumococcal and *H. influenzae* type b vaccines, manage according to the 1993 Guidelines (see Baraff et al. *Ann Emerg Med* 22:1198-1210, 1993.)

*Other tests may include chest radiograph, stool studies, herpes simplex polymerase chain reaction.
CSF, cerebrospinal fluid; HPF, high-powered field; RBC, red blood cell; WBC, white blood cell.

FEVER OF UNKNOWN ORIGIN
Prolonged Fever of Unknown Cause

- For the first time, in 1961, researchers named Petersdorf and Beeson described.
- It has the following criteria:

1. Fever lasting at least three weeks
2. Fever above 38.3ºC documented
3. The cause of fever could not be determined despite being investigated in the hospital for a week

FEVER OF UNEXPLAINED ORIGIN: REPORT ON 100 CASES

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INTRODUCTION

In 1868 Wunderlich, a German clinician, published in monograph form a convincing demonstration of the value of measuring the body temperature in various diseases. This work was soon translated into other languages (1), and the practice of making regular measurements of body temperature quickly became standard throughout the world. Thus the thermometer became the first instrument of precision to be used in medical practice. Long before Wunderlich, of course, physicians had known that illness was sometimes manifested by increased body warmth; in fact the word "Fever" came to be used to designate a certain form or forms of illness. Benjamin Rush maintained that there was "only one fever," but by the early part of the nineteenth century clinicians were able to distinguish between some of them, such as typhoid and typhus fevers, purely on clinical grounds. The introduction of clinical thermometry happened to come at the same time as the discoveries of Pasteur and the beginning of the Golden Age of Bacteriology; soon, therefore, it was no longer acceptable to say that a patient was suffering from 'a fever': the challenge was to determine the cause of that fever. It was also recognized that although infectious processes were the commonest causes of fever, other kinds of disease could also affect temperature regulation, and that a great variety of causes required consideration in the differential diagnosis of febrile illness. This became one of the main fields in differential diagnosis, and many of the great clinicians of the first half of the twentieth century, such as Horder and Libman, owed their reputations in some part to successes in diagnosis of febrile disease.

Fever of unknown origin (F.U.O.) is a common clinical problem, encountered frequently in nearly all branches of practice. Fortunately the cause is often an acute infection, which soon becomes evident and responds to treatment, or runs its course. In the present article we are not concerned with such short-term problems, but are restricting the discussion to cases of prolonged febrile illness of obscure cause. This is likely to be a source of perplexity and frustration to the physician, and for the patient the discomforts of illness are compounded by the anxiety of uncertainty. Those unhappy victims understandably tend to seek additional medical

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FEVER OF UNKNOWN ORIGIN
Prolonged Fever of Unknown Cause

TABLE 56-1 Summary of Definitions and Major Features of the Four Subtypes of Fever of Unknown Origin (FUO)

	CLASSIC FUO	NOSOCOMIAL (HEALTH CARE–ASSOCIATED) FUO	NEUTROPENIC (IMMUNE-DEFICIENT) FUO	HIV-RELATED FUO
Definition	>38.3° C (100.9° F), >3 wk, >2 visits or 3 days in hospital	>38.3° C (100.9° F), >3 days, not present or incubating on admission	>38.3° C (100.9° F), >3 days, negative cultures after 48 hr	>38.3° C (100.9° F), >3 wk for outpatients, >3 days for inpatients, HIV infection confirmed

Table 177-4 Summary of Definitions and Major Features of the 4 Subtypes of Fever of Unknown Origin

FEATURE	CLASSIC FUO	HEALTHCARE-ASSOCIATED FUO	IMMUNE-DEFICIENT FUO	HIV-RELATED FUO
Definition	>38°C (100.4°F), >3 wk, >2 visits or 1 wk in hospital	≥38°C (100.4°F), >1 wk, not present or incubating on admission	≥38°C (100.4°F), >1 wk, negative cultures after 48 hr	≥38°C (100.4°F), >3 wk for outpatients, >1 wk for inpatients, HIV infection confirmed

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Pyrexia of unknown origin in children: a review of 102 patients from Turkey

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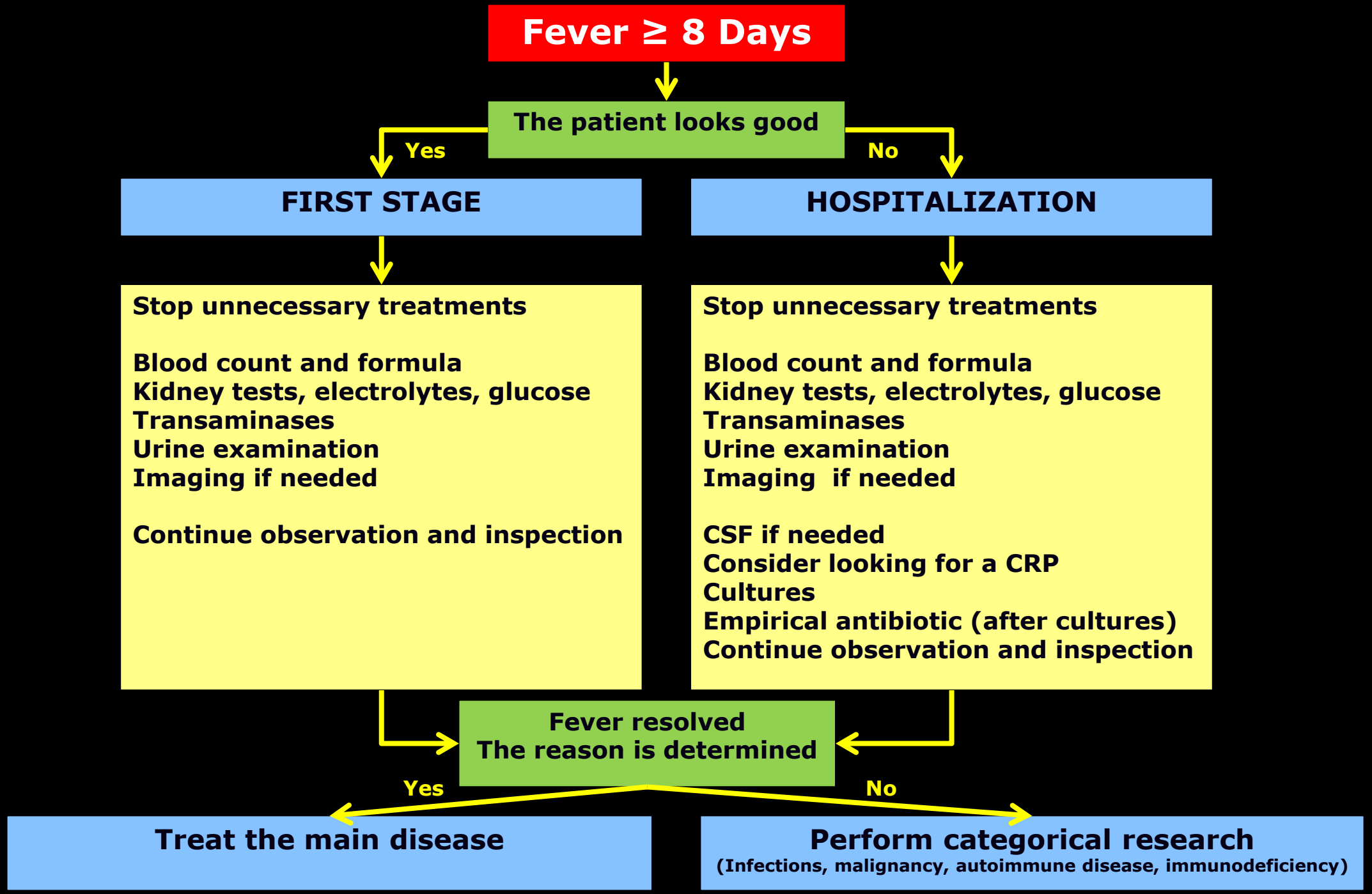
(Accepted July 2003)

Summary Pyrexia of unknown origin (PUO) has not been appropriately investigated in Turkish children and therefore a study was undertaken to determine the causes of PUO and to evaluate which clinical procedures are useful in establishing a diagnosis. A total of 102 children fitting the classical PUO criteria seen in our clinic between 1995 and 2002 were investigated retrospectively. Infections, collagen vascular disorders, malignancy and miscellaneous conditions constituted 44.2%, 6.8%, 11.7% and 24.5% of cases, respectively, while 12.8% of the cases remained undiagnosed. Enteric fever, brucellosis and respiratory tract infections were the most commonly encountered infections, whereas familial Mediterranean fever was the commonest non-infectious disorder. Biopsy, aspiration, serology, bacteriology, radiology and observation of the clinical course were the most useful diagnostic procedures.

TABLE 1. *Final diagnosis in 102 children with pyrexia of unknown origin.*

Diagnosis	No.
Infections ($n = 45$)	
Enteric fever	9
Brucellosis	8
Respiratory tract	7
Urinary tract	3
Infectious endocarditis	3
Epstein–Barr virus	3
Kala-azar	2
Osteomyelitis	2
Tuberculosis	2
Abdominal abscess	2
Malaria	1
Meningitis	1
Viral hepatitis	1
Cytomegalovirus	1
Collagen vascular diseases ($n = 7$)	
Juvenile rheumatoid arthritis	3
Undefined vasculitis	2
Polyarteritis nodosa	1
Lymphomatoid granulomatosis	1
Malignancy ($n = 12$)	
Acute lymphoblastic leukaemia	4
Chronic myelogenous leukaemia	2
Hodgkin's disease	2
Non-Hodgkin's lymphoma	2
Myelodysplasia	1
Malignant histiocytosis	1
Miscellaneous ($n = 25$)	
Familial Mediterranean fever	8
Haemophagocytic syndrome	5
Central fever	5
Diabetes insipidus	2
Kawasaki disease	2
Crohn's disease	1
Hereditary sensorial neuropathy	1
PFAPA syndrome	1
Factitious fever	1
Undiagnosed ($n = 13$)	


Fever ≥ 8 Days
The patient looks good
Yes
No
FIRST STAGE
HOSPITALIZATION
Stop unnecessary treatments
Blood count and formula
Kidney tests, electrolytes, glucose
Transaminases
Urine examination
Imaging if needed
Continue observation and inspection
Stop unnecessary treatments
Blood count and formula
Kidney tests, electrolytes, glucose
Transaminases
Urine examination
Imaging if needed
CSF if needed
Consider looking for a CRP
Cultures
Empirical antibiotic (after cultures)
Continue observation and inspection
Fever resolved
The reason is determined
Yes
No
Treat the main disease
Perform categorical research
(Infections, malignancy, autoimmune disease, immunodeficiency)

FEVER OF UNKNOWN ORIGIN
Prolonged Fever of Unknown Cause

Case Report

Hemophagocytic Lymphohistiocytosis Associated with Visceral Leishmaniasis

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Summary

Visceral leishmaniasis (VL), is a systemic disease caused by the dissemination of protozoan parasite *Leishmania* throughout the reticuloendothelial system. It may mimic or lead to several types of hematological disorders including hemophagocytosis. Infection associated hemophagocytic syndrome implicating *Leishmania* is very rare and often difficult to diagnose. Here, we describe a child with hemophagocytic lymphohistiocytosis (HLH) associated with VL.

Key words: *Leishmania*, hemophagocytosis, children

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FEVER OF KNOWN ORIGIN
Movie Recommendation

FAHRENHEIT 451 (1966)