An Updated Protocol for Pediatric Health Screening

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Pediatric health screening comprises a significant component of a family physician's practice. A variety of protocols exist for pediatric screening yet many of the diseases included in such screening have marginal supportive evidence in the literature.

This article examines 14 areas commonly included in pediatric health screening. Each is evaluated based on a thorough literature review, according to basic criteria necessary to justify periodic screening. Specific recommendations are made which are considered to be practical and appropriate in practice. These have been incorporated into the protocols currently used at the University of Washington Family Medical Center.

Preventive care for children is a major concern of family medicine. In establishing a health screening protocol for this patient population, one may find it difficult to decide which tests are important for patient well-being and which are unnecessary. Every test introduced can be measured in terms of financial cost but can also result in a net benefit, no significant effect, or a net harm. One must be aware that screening tests can have negative consequences, such as a false label for a patient due to a false positive test, unnecessary investigations, and patient and family misunderstanding of why a test was done. For any screening test one must address the key question, "Will the population benefit without undue cost from the screening procedure?"

For most screening tests, answering this question is not easy. How one answers it may have more to do with opinion than firm data. Various criteria have been used for deciding whether or not a population will benefit from a particular screening test. Five commonly used criteria are: (1) the disease is significant; (2) effective treatment is available; (3) there is an asymptomatic period during which detection and treatment will decrease morbidity and mortality from the disease; (4) an accurate test is available at an acceptable cost; and (5) the incidence justifies the screening. A major shortcoming of such criteria is that clarifying data may be unavailable, and opinions about how a test meets each of these criteria may vary as much as opinions about the original and key question. Ultimately the physician must be satisfied that a given population will benefit without undue cost from a screening program prior to establishing that program.

The University of Washington Hospital, Family Medicine Residency Program classifies screening tests into three categories:

Category I: Screening tests which have documented net benefit;

Category II: Screening tests which have uncertain benefit;

Category III: Screening tests which have little

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or no supportive evidence to justify their routine use.

Current screening is carried out routinely with Category I and Category II tests. (Whether or not one can justify routinely screening with tests in Category II is an issue not addressed here.) Category III tests are not recommended for routine use. A test is transferred from one category to another as research findings justify.

This paper considers and discusses the various screening tests which are commonly performed for a broad range of conditions occurring in childhood. The protocols currently in use in this program are presented in Figures 1-6.

Anemia of Iron Deficiency

The greatest prevalence of iron deficiency anemia is among infants between the ages of 6 and 18 months.[1] Screening at age 12 months has been advocated in order to identify the one to five percent of infants needing treatment.[2] Treatment has been recommended when the patient's hematocrit becomes less than 33 percent.[1,2]

However, there are other considerations. Wood and Elwood[3] found no convincing evidence to support the view that symptoms are related to hemoglobin levels when the levels are above 10 gm/100 ml. Also attempts to associate iron deficiency in childhood with low marrow stores by tissue sampling have shown correlations only at hemoglobin levels of less than 10 gm/100 ml.[4] Disagreement exists as to the hematologic values which define anemia in each of the pediatric age groups.[4]

If one screens and treats those who have "low normal" values, will the treatment harm that population? Perhaps so in light of the evidence that hyperferremic hosts have decreased "nutritional immunity" and increased susceptibility to infection.[5-10] Hence, screening and treating those who, in fact, do not have decreased iron stores may not be beneficial. Routine screening is not presently justified for low-risk asymptomatic children.

High-risk infants should be screened. These include those exclusively breast feeding during the first six months of life or longer, those with low neonatal hematocrits, premature infants, small for gestational age infants, infants from low socioeconomic families, and those associated with other factors deemed to cause significant iron deficiency as determined by individual physicians. There are no data to support the efficacy of annual screening.[4]

Screening for iron deficiency anemia is in Category II and included in the authors' protocol for those at high risk.

Congenital Heart Disease

The incidence of auscultated heart murmurs at birth is seven percent, of which 8.3 percent prove to be associated with congenital heart disease.[11] Morton[12] discusses the epidemiology of congenital heart disease and Richards[11] discusses the frequency and significance of heart murmurs in the first year of life. Bailey et al[4] recommends screening examinations twice in the first six months, then at ages one, three, five, and ten years.

The cardiac examination is in Category I and is performed *four times* in the first year.

Galactosemia

The incidence of this disease is in the range of 1 in 40,000[16] to 1 in 75,000[17] births. Galactosemia is characterized by failure to thrive, jaundice, and hepatomegaly. Death associated with sepsis may occur in up to 30 percent of cases, with many succumbing in the first few days of life. Untreated survivors develop mental retardation, cirrhosis, and cataracts. The criticism that routine screening is unnecessary is based on the misconception that the diagnosis will almost always be made clinically.[16] Oberklaid[18] presents several clarifying case reports. Although previous screening tests have had disadvantages,[4,19] screening became practical with the Paigen assay which has been used in regional screening.[16] Levy[16] and Mamunes[17] have advocated routine screening of all newborns. However, a cost-benefit analysis of galactosemia screening was presented at the University of Washington by A.O. Berg (February 1979), and the authors conclude that the costs of screening may prove to be prohibitive. Also, in the development of a regional screening program, logistics may be a problem. The time delay may be too great to benefit some victims if blood samples are mailed to a central laboratory. Furthermore, quality control may be a problem in some areas.

Where regional programs have been developed, screening for galactosemia by the Paigen assay is in Category II.

PEDIATRIC HEALTH MAINTENANCE

UNIVERSITY OF WASHINGTON
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Name _____
D.O.B. _____

WELL-CHILD EVALUATIONS (see age specific data sheets)

<1½ yr	2 weeks PNP or MD	2 months MD	4 months nurse	6 months MD	12 months MD	15 months nurse
>1½ yr	18 months	2 years	4 years	6-11 years	12 years	15 years

IMMUNIZATIONS & PPD

Record date/Initial

DPT	2 months	4 months	6 months	18 months	4-5 years	15 years Td
TOPV						

PPD: 12 months (only if prevalence >1%)

MMR: 15 months

Rubella Titer: 10+ years

LABORATORY

- neonate T_4, PKU (galactosemia)
- 6 mo-18 mo Hct in high risk
- 1 yr - 5 yr Lead (FEP) in high risk
- 3 yr - 5 yr Audiometry if indicated
- Sickle Cell Trait (adolescent)

OTHER

- Ipecac ≤ 6 mo
- Home hot water htr. lowered
- Electric outlet guard ≤ 6 mo

INDIVIDUAL NEEDS

Record review Date/Initial

Figure 1. Pediatric health maintenance—Master check list

Immunizations

1. PPD for screening only in high-risk groups (where prevalence of (+) reactors is greater than one percent, eg, in Seattle: Oriental population, foreign student families).
2. PPD (not tine) should be used if TB is suspected.
3. PPD can be given at time of MMR.
4. MMR can be given with other vaccines and to children of pregnant mothers.
5. An interruption of immunization schedule does not necessitate starting series over again. Regardless of interval, simply pick up where it left off.
6. Unimmunized adults may contract polio from children given TOPV.
7. Except during a febrile period, a URI is not a contraindication to immunization.
8. Reimmunize for measles if given before 1968 or before age 12 months.

Physical Examination

1. Strabismus screen: Instruction (for ages to screen, see individual check sheets).
   a. *Hirschberg test:* Hold a pen light at eye level about 13 inches from patient. Examiner should be directly behind light. Observe symmetry of corneal reflection.
   b. *Cover/uncover test:* Hold an object (toy) about 1 meter from child. Cover the "straight eye" and watch the other eye. If it moves outward to fixate, the test is (positive) for convergent strabismus. Also watch each eye as it is uncovered.
   c. *Fixation test:* Observe the ability of each eye to track a moving object while the other eye is covered.
2. The Visual Acuity testing is done at entry and at intervals by Seattle schools.
3. A BP cuff should be 20 percent wider than the diameter of the upper arm; 2/3 length of upper arm is less accurate. Less error results from a cuff too large than one too small.

Laboratory

1. Galactosemia will be Category II if technical problems of obtaining laboratory results quickly can be overcome.
2. PKU should be performed once. Repeat testing is of minimal yield.
3. Hct: High-risk children are those on breast milk only for more than first six months of life, those with low neonatal Hct, or those with other factors deemed to cause significant Fe deficiency.
4. Lead Poisoning: Screening justified in high-risk groups, ie, those in dilapidated housing in communities where lead is known to be a problem. No screening is necessary in Seattle. FEP (Free Erythrocyte Protoporphyrin) is probably best test.
5. Audiometry is performed at entry and at intervals by Seattle schools. One must screen for hearing defects prior to this time if speech development is not normal and as soon as hearing loss is suspected.
6. Sickle Cell: The need for screening high-risk population is controversial with uncertain benefit. Screening can be done on the newborn or adolescent for the purpose of genetic counseling.

Other: Any decrease in water heater temperature decreases chance of accidental scald burns and saves energy. Ideally decrease to 52 C.

Screening Test Categories

Category I (benefit documented): Immunizations, PKU(1st), physical examination, strabismus screens, T_4.
Category II (benefit uncertain): Audiometry, BP, galactosemia, growth and development screening, Hct, sickle cell trait, PPD.
Category III (benefit unsupported): Lead (for Seattle), PKU repeat test, urinalysis, urine culture and sensitivity.

Figure 2. Explanations and answers to common questions

PEDIATRIC HEALTH MAINTENANCE

UNIVERSITY OF WASHINGTON
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Name _____

(☐ = check if done, Developmental Screen = 90 percent of children pass (DDST))

2 weeks	Date	Age	2 months	Date	Age	4 months	Date	Age
Review growth charts			Review growth charts			Review growth charts		
Interval Hx gestation: ____ wks Apgar: ____ birth wt: _____			Interval Hx			Interval Hx		
☐ Nutrition Hx			☐ Nutrition Hx			☐ Nutrition Hx		
Developmental Screen (P = Passed R = Reported) ☐ Prone-lifts head ☐ Regards face ☐ Responds to noise			Developmental Screen ☐ Vocalizes ☐ Smiles responsively ☐ Prone-lifts head to 45 degrees ☐ Follows to midline ☐ Responds to noise			Developmental Screen ☐ Prone-lifts head to 90 degrees ☐ Rolls over one way ☐ Grasps rattle ☐ Follows to 180 degrees ☐ Responds to noise		
Physical Examination	Abnormalities		Physical Examination	Abnormalities		Notes		
Skin ☐ Head ☐ Eyes RR ☐ ENT ☐ Nodes ☐ Chest ☐ Heart ☐ Fem. pulse ☐ Abdomen ☐ Ext. gen. ☐ Back ☐ Extremities ☐ Hip abduct ☐ Neuro ☐			Skin ☐ Head ☐ Eyes ☐ ENT ☐ Nodes ☐ Chest ☐ Heart ☐ Pulses ☐ Abdomen ☐ Ext. gen. ☐ Back ☐ Extremities ☐ Hip abduct ☐ Neuro ☐					
☐ Laboratory: PKU if not previously done								
Problems and Plans			Problems and Plans					
Teaching Topics ☐ Safe handling, car seats ☐ Startle reflex ☐ Sibling jealously ☐ Have parents had polio vaccine			Teaching Topics ☐ How to take temperature, tylenol, sponging, etc ☐ Anticipate colds, URI ☐ Safety-rolling over ☐ Responsible babysitter ☐ "Talk to your baby"					
			☐ DPT, TOPV #1			☐ DPT, TOPV #2		
Signed _____			Signed _____			Signed _____		

Figure 3. Pediatric health maintenance—2 weeks to 4 months

PEDIATRIC HEALTH MAINTENANCE

UNIVERSITY OF WASHINGTON
FAMILY MEDICAL CENTER

Name _____

(☐=check if done)

6 months	Date	Age	12 months	Date	Age	15 months	Date	Age
Review growth charts			Review growth charts			Review growth charts		
Interval Hx			Interval Hx			Interval Hx		
☐ Nutrition Hx			☐ Nutrition Hx			☐ Nutrition Hx		
Developmental Screen ☐ Pulled to sit-no head lag ☐ Reaches for object (5 mo) ☐ Smiles spontaneously (5 mo) Consider DDST			Developmental Screen ☐ Sits without support (8 mo) ☐ Stands holding on (10 mo) ☐ Plays peek-a-boo (10 mo) ☐ Bangs 2 cubes ☐ Mama, dada Consider DDST			Developmental Screen ☐ Walks without support (14 mo) ☐ Neat Pincer grasp ☐ Drinks from cup (16 mo) ☐ Indicates wants without cry		
Physical Examination Abnormalities Skin ☐ HEENT ☐ Nodes ☐ Chest ☐ Heart ☐ Pulses fem ☐ Abdomen ☐ Ext. Gen. ☐ Hip abduct ☐ Back ☐			Physical Examination Abnormalities Skin ☐ HEENT ☐ Nodes ☐ Chest ☐ Heart ☐ Abdomen ☐ Ext. gen ☐ Hip abduct ☐ Back ☐ Extremities ☐ Neuro ☐ Hearing ☐ ☐ Try fixation test ☐ Ask: "Are eyes ever not straight"			Notes		
Problems and Plans			Problems and Plans					
Teaching Topics ☐ Stranger anxiety ☐ Pronounced drooling ☐ Sleep independently ☐ No bottles in bed ☐ Safety-poisons, Mr. Yuk, Ipecac			Teaching Topics ☐ Safety: climbing, bathing ☐ Normal drop in appetite ☐ Continue talking & naming objects for baby ☐ Discipline - maintain consistency					
☐ DPT, TOPV #3			☐ PPD, Hct, & lead, if high risk			☐ MMR		

Signed _____ Signed _____ Signed _____

Figure 4. Pediatric health maintenance—6 to 15 months

PEDIATRIC HEALTH MAINTENANCE

UNIVERSITY OF WASHINGTON
FAMILY MEDICAL CENTER

(☐=check if done)

Name _____

18 months	Date	Age	2 years	Date	Age	4 years	Date	Age
Review growth charts			Review growth charts			Review growth charts		
Interval Hx			Interval Hx			Interval Hx		
☐ Nutrition			☐ Nutrition			☐ Nutrition		
Developmental Screen ☐ Walks well (14 mo) ☐ Initiates housework ☐ Tower of 2 cubes (20 mo) ☐ Three words other than mama-dada (21 mo)			Developmental Screen ☐ Kicks ball forward ☐ Points to 1 named body part ☐ Walks up steps (22 steps) ☐ Two-word sentences (24 mo)			Developmental Screen ☐ Pedals tricycle (3 yr) ☐ Uses plurals (3½ yr) ☐ Knows first & last name ☐ Plays cooperatively Consider DDST		
Physical Examination Skin ☐ Abnormalities HEENT ☐ Nodes ☐ Chest ☐ Heart ☐ Abdomen ☐ Ext. gen. ☐ Back ☐ Hip abduct ☐ Extremities ☐ Neuro ☐ Hearing ☐ Hirschberg ☐ Cover ☐			Physical Examination Skin ☐ Abnormalities HEENT ☐ Nodes ☐ Chest ☐ Heart ☐ Abdomen ☐ Ext. gen. ☐ Back ☐ Extremities ☐ Neuro ☐ Hearing ☐ Hirschberg ☐ Cover ☐			Physical Examination BP ☐ Abnormalities Skin ☐ HEENT ☐ Teeth ☐ Nodes ☐ Chest ☐ Heart ☐ Abdomen ☐ Ext. gen. ☐ Back ☐ Extremities ☐ Neuro ☐ Hearing ☐ Hirschberg ☐ Cover ☐		
Ask: Are eyes ever not straight?			Ask: Are eyes ever not straight?			Ask: Are eyes ever not straight?		
Problems and Plans			Problems and Plans			Problems and Plans		
Teaching Topics ☐ Siblings-jealousy ☐ Toilet training-start 18-24 months ☐ Discipline-ignore temper tantrums			Teaching Topics ☐ Need for playmates ☐ Inability to share ☐ Sibling adjustment ☐ Teeth care			Teaching Topics ☐ School readiness (attention span, easy separation from mother) ☐ Fine motor development ☐ Adult seat belts, street sense		
DPT, TOPV #4						DPT, TOPV #5, audiometry if indicated		

Signed _____ Signed _____ Signed _____

Figure 5. Pediatric health maintenance—18 months to 4 years

PEDIATRIC HEALTH MAINTENANCE

UNIVERSITY OF WASHINGTON
FAMILY MEDICAL CENTER

Name _____

(☐ = check if done)

6-11 years	Date	Age	12 years	Date	Age	15 years	Date	Age
Review growth charts			Review growth charts			Review growth charts		
Interval Hx (school, friends, family relationships, accidents, etc)			Interval Hx (school, family, social, menstruation, alcohol, drugs, accidents, etc)			Interval Hx (school, family, sexual, drugs, smoking, accidents, etc)		
☐ Nutrition Hx			☐ Nutrition Hx			☐ Nutrition Hx		

Physical Examination

	Abnormalities		Abnormalities		Abnormalities
BP		Skin		BP	
Skin		HEENT		Skin	
HEENT		Teeth		HEENT	
Teeth		Nodes		Teeth	
Nodes		Chest		Nodes	
Chest		Breast		Chest	
Heart		Heart		Breast	
Abdomen		Abdomen		Heart	
Ext. gen.		Ext. gen.		Abdomen	
Back		Back		Ext. gen.	
Scoliosis		Scoliosis		Back	
Extremities		Extremities		Scoliosis	
Neuro		Neuro		Extremities	
Hearing		Hearing		Neuro	
Vision		Vision		Hearing	
Strabismus		Puberty stage			

Problems and Plans	Problems and Plans	Problems and Plans
Teaching 1. Bicycle safety 2. (♀>10) Discuss puberty and answer questions	Teaching 1. Smoking 2. Alcohol, drugs 3. Bicycle safety 4. Sexual information (as appropriate, discuss puberty and answer questions)	Teaching 1. Smoking 2. Alcohol, drugs 3. Car safety, accidents 4. Sexual information
	Rubella titer ♀ (may defer)	Td, Rubella titer ♀ (if unknown)

Signed _____ Signed _____ Signed _____

Figure 6. Pediatric health maintenance—6 to 15 years

Hearing Loss

The prevalence of hearing impairment among school age children is three to five percent.[1,20] Screening for hearing impairment can be performed by several means at different ages. Hearing is not fully developed until six to seven months of age, and neonatal screening lacks both sensitivity and specificity.[1] A "distraction technique" has been used during the first year of life to identify those babies whose responses are not normal.[21] Parental history of a child's vocalization and response to sound as well as the monitoring of language development during the first three years may give important early clues to hearing deficits. After 3 to $3^1/_2$ years it is possible to screen with play audiometry.[1,4] A review of various tests for various ages has been given by Northern,[22] who recommends pure tone audiometry for all school age children. A review of various office techniques for the early identification of those with hearing loss has been presented by Downs.[23]

Although there is no justification for postponing full audiologic assessment when a hearing impairment is suspected, much more knowledge of the epidemiology and natural history of hearing impairment is needed before rational recommendations can be made.[2] It is unknown whether there is any benefit to be gained by routine audiometry for the child who is developing normally. Since this protocol does not include routine audiometry at an early age, clinicians must follow a child's language development and perform full audiologic assessment as soon as a hearing impairment is suspected.

For the normally developing child, audiometry is a Category II test. In Seattle, audiometry is performed on all children upon their entrance to school.

Hypertension

Screening for hypertension is controversial. It remains unclear as to when a blood pressure reading actually constitutes pediatric hypertension.[24] North[2] remarks that the cost and risk of subsequent unnecessary diagnostic studies and of patient mislabeling may outweigh any theoretical advantage to be gained by routine screening. Bailey[4] has stated that screening is appropriate at three, five, and ten years of age. Incorporation of hypertension screening in the child's health care program has been recommended by the Task Force on Blood Pressure Control in Children.[25] When screening, the blood pressure cuff for children as well as adults should be 20 percent wider than the diameter of the limb.[26]

Screening for pediatric hypertension is in Category II and is arbitrarily done at ages 4, 6 to 11, and 15 years.

Hypothyroidism

Congenital hypothyroidism has an incidence of between 1 in 5,000 and 1 in 10,000 in most studies. There is clearly documented benefit from early treatment, making it one of the most important defects for which mass screening can be conducted.[17] T_4 and TSH determinations can be performed along with PKU from blood specimens obtained at birth. Screening programs have been successful and are recommended by the American Thyroid Association.[27] Several reviews of screening for this entity have been written.[28-30]

Screening for hypothyroidism is clearly a Category I test. In the state of Washington a T_4 is obtained first, followed by a TSH if indicated.

Lead Poisoning

The age group at highest risk for lead poisoning is nine months to five years. The prevalence of children with blood levels above 40 μg may be over 20 percent in high-risk urban areas.[4] The Surgeon General's report of 1970 recommends that all children who live in or visit old dilapidated buildings should have periodic blood lead determinations.[31] North[2,13] recommends that high-risk populations be screened periodically between one and five years using the free erythrocyte protoporphyrin (FEP) test which has advantages over the blood lead level.[31]

Children who have high blood levels but do not develop overt encephalopathy may not suffer any important ill effects.[31] If only very high levels are associated with ill effects, current screening and treatment criteria may cause unnecessary worry, pain, inconvenience, and expense to children's families. One recent study,[32] however, using dentine lead levels does give evidence that lead exposure short of that causing encephalopathy is associated with deficits in psychologic and classroom performance. This needs further evaluation. In Seattle, there has never been a documented case of lead poisoning in a child. Whether or not

lower level lead exposure is a problem in this city will be evaluated.

At the present time screening for lead poisoning in Seattle is in Category III. For communities with higher risk, screening for lead poisoning may appropriately be placed in Category I or II.

Mental Retardation

It has been stated that all children should be screened periodically for mental retardation.[1] Due to the problems of over-referral and the mislabeling of patients, formal screening tests have not been recommended.[4,13] Furthermore, benefits derived from early identification are not well documented.[13] The importance of making some routine developmental observations may outweigh the uncertainties. North[13] suggests that a practical approach would be to use an explicit protocol of relatively simple questions and observations, applying formal testing (eg, DDST) only to those children not clearly normal. Data on the validity of various developmental questionnaires are not conclusive.[14]

Developmental screening is in Category II. A few simple questions and observations patterned after those from other sources are used.[14,15]

Phenylketonuria

Phenylketonuria is an autosomal recessive disorder with an incidence of from 1 in 10,000[4] to 1 in 14,000.[17] It affects all races; however, lower incidences occur in blacks and Ashkenazi Jews. Severe mental retardation results if this disorder is not identified early and treated with special diet restrictions. Victims account for one percent of the population in institutions for the mentally retarded.[4] Screening of neonatal blood samples using the Guthrie test has been accepted as cost effective.[2]

An important consideration is whether or not repeat testing should be done at the first well child visit. Holtzman[33] recommends repeat testing if the first one is done before four days of age. The yield of the second test has been estimated to be less than 1 in 100,000 or slightly more if the first test is done before five days.[33] In Oregon and Massachusetts, no new cases were found in 700,000 repeat tests.[17] Sepe[34] shows that the yield of follow-up testing is 1 in 596,000 and therefore questions its cost effectiveness.

Initial PKU is a Category I test while repeat testing is so minimally productive that it is placed in Category III and is not recommended.

Sickle Cell Anemia

The prevalence of sickle cell trait in American blacks is approximately eight percent and sickle cell anemia is found in 1 of 625 American blacks at birth and in 1 of 1,875 adult blacks.[4] Programs have been instituted to screen newborn babies at risk.[35]

No effective treatment is available for sickle cell anemia and screening simply to identify those affected may be difficult to justify. North[2] has stated that by the end of the first year of life affected children can be identified through symptoms and that screening is no longer necessary or desirable. There is no good evidence that sickle cell trait carries any real danger and unjust discrimination against those identified with the trait has occurred.[35]

The only real controversy is whether or not screening should be performed to provide genetic counseling in order to reduce the incidence of the disease.[36] Headings[37] has provided guidelines for such counseling. The consumer's desire for such information and willingness to act on it is unknown. The only way to prevent sickle cell anemia is for those with the trait to avoid reproduction or predetermine the genetic pattern of their mates. Prenatal diagnosis is not at present practical for this group, but recent research is promising and may radically change the approach to this disease.[38]

Screening for sickle cell trait and anemia is in Category II. Whether or not screening should be done on the newborn (for earlier counseling of parents) or on the adolescent (to decrease the chance that the one identified with the trait will be unnecessarily overprotected and stigmatized) is a question left to individual physicians.

Tuberculosis

Routine screening of children for tuberculosis has evoked much controversy.[1] Where the prevalence rate of positive reactors is less than one percent, routine skin testing is an inefficient strategy for the detection of tuberculosis.[2] In 1970 the reported prevalence of TB sensitivity among those entering school was 0.2 percent, which indicates

an incidence of new reactors to be less than 3 per 10,000 children per year.[39] It is possible that an irreducible rate of apparent tuberculin sensitivity may remain because of the inherent variability of the test itself and because of cross sensitivity with atypical mycobacterial infections. In addition, tuberculosis may progress from a minimal state to a frank disease with too short a lead time to make even frequent screening effective. North[2] states that routine skin testing can no longer be recommended. Frankenburg[1] recommends that if the prevalence of TB is greater than one percent, all children should be screened initially at 12 to 15 months and rescreened annually.

Questions often arise regarding the timing of the skin testing in relation to the measles, mumps, and rubella immunizations. Concerns have been that (1) temporary anergy induced by the vaccine may give a false negative test, and (2) active tuberculosis may be aggravated by the vaccine. It has not been demonstrated that anergy is induced if the skin test and vaccine are given together and one can deal effectively with a positive reaction even if the vaccine is given.[40] The American Academy of Pediatrics advises that the TB skin test be given at the time of or preceding measles immunization. Therefore, where routine skin testing is undertaken, it can be given before or simultaneously with the MMR.

In the absence of careful community surveys, the physician's review of his own past experience can indicate to him whether or not in his practice there is the one percent prevalence of positive reactors that would justify routine screening.[39] This test is Category I only for communities with one percent or greater prevalence and can be performed simultaneously with the MMR.[40,41] The authors recommend the use of PPD (5 TU) rather than tine testing which has an unacceptably high incidence of false-negative reactions.[42]

Urinary Tract Disease

There is no evidence to justify routine urinalysis in the pediatric age group.[1,2,4] Proteinuria and hematuria in the absence of symptoms and signs appear to be benign.[43-45] Dodge[45] found a greater than six percent cumulative occurrence of proteinuria and hematuria in five consecutive examinations of more than 12,000 children with probable self-limited or no disease. The needless anxiety and expense to the families of children so identified should be considered. In addition, there is no evidence that screening for glucosuria in asymptomatic children is beneficial.

Thus, the screening urinalysis is in Category III, and routine use of it is not recommended.

Screening for asymptomatic bacteriuria is more controversial. Kunin[46,47] clarified the epidemiology of asymptomatic bacteriuria. Approximately five percent of girls will have detectable episodes of bacteriuria by the time of graduation from high school with an annual conversion rate of about 0.32 percent. Until the early 1970s, screening of girls for asymptomatic bacteriuria was generally recommended.[1,4] An association between vesicoureteric reflux and pyelonephritic scarring has been found.[47-50] The recommendation for antibacterial suppression and antireflux surgery in selected cases has been made.[51] Thus, the argument is put forward that screening may be important to identify those cases which would benefit from this suppression and/or surgery. There are problems with this view. Savage[52] noted that screening on a single occasion would detect less than 20 percent of those at risk during school years and, moreover, there is no evidence that asymptomatic bacteriuria causes progressive disease. Dodge[53] found that treatment for asymptomatic bacteriuria does not alter its frequency once treatment is stopped and questioned the advisability of screening all schoolgirls. Kunin[54] has stated that the screening of children for bacteriuria remains experimental. The Newcastle Group,[55] Lindberg,[56] and the Cardiff-Oxford Bacteriuria Study Group[57] have found no evidence that asymptomatic bacteriuria leads to progressive renal damage and do not support screening. The American Academy of Pediatrics[58] has stated that:

1. If there is an age when the discovery and correction of reflux would prevent pyelonephritis, it is probably before age five years as there is no difference in prevalence of reflux or pyelonephritis between preschoolers and those of school age;
2. There are no data which show that screening results in decreased morbidity and mortality;
3. Mass screening of school age children is not productive enough to warrant the expense of initial screening and follow-up of children with bacteriuria.

Urine culture screening is thus classified as a Category III test. The symptomatic child, however, should be evaluated fully.

Vision Impairment and Strabismus

Little is known regarding the validity of the techniques currently used for screening visual acuity in young children.[2] Thus, in the normally developing child the authors do not recommend visual acuity testing until school age. In Seattle, this is done on school entry.

Amblyopia has a prevalence of 0.4 percent at age three to four years and two to three percent in those children of school age.[22] Amblyopia is most commonly secondary to strabismus[1] which has a prevalence of one to four percent, increasing with age. Frankenburg[1] finds three procedures to be best in the detection of strabismus: (1) asking the parents if the eyes are ever "not straight"; (2) the cover test (Figure 2); (3) the Hirschberg test (Figure 2). He notes that the fixation test can be used at ages less than $2^1/_2$ years and recommends the Hirschberg and cover tests for ages three to five. Bailey[4] recommends looking for gross strabismus between 2 and 18 months and using the Hirschberg and cover tests yearly from age two. Early treatment of strabismus is clearly beneficial and delay of treatment beyond age four years to six years results in less favorable outcomes.[1,59]

Screening for strabismus is in Category I and is performed as follows:

1. Before age 12 months look for gross strabismus.
2. At age 12 months begin asking parents if the eyes are ever "not straight," and perform the fixation test.
3. At age 18 months begin the use of the Hirschberg and cover tests, continuing these until age six years.

Well Child Examination and Frequency of Visits

As with much of pediatric screening, little data is available supporting the value of routine growth measurements. Care must be taken to assure that the six percent of children who by definition fall outside the 3rd and 97th percentile are not subjected to unnecessary investigations.[2,13] Routine measurements *do* have value in reassuring most parents and physicians. Bailey[4] reviews several authors and recommends that the OFC (occipital/frontal circumference), weight, and height be measured on all routine visits during the first two years of life followed by yearly measurements until six or seven years of age.

The value of the physical examination was studied by Anderson[60] who found that significant findings were elicited in 3.9 percent of initial examinations and 1.5 percent of follow-up examinations.

Hoekelman,[61] in a detailed study, found no differences in end points which compared first year well child examinations delivered in one of four ways: (1) six visits by a physician; (2) three visits by a physician; (3) six visits by a pediatric nurse practitioner; (4) three visits by a pediatric nurse practitioner. He concluded that abbreviated visit schedules by either professional does not reduce the adequacy of care. Also noted is the fact that a marked saving of maternal time and costs (eg, babysitter, transportation, loss of income) as well as a saving in office practice time would result from an abbreviated schedule. It is difficult to justify frequent screening with these associated costs when there is no evidence to support their benefit.

Screening for growth has been placed in Category II in this protocol and the physical examination in Category I. For low-risk children an abbreviated visit schedule is suggested (Figure 1).

Summary

A practical pediatric health maintenance program based on a literature review has been presented. One expects that the protocol will evolve as research adds to current knowledge. Opinions of those who agree or disagree with the stated conclusions are welcome, and hopefully in either case positions can be supported with convincing data.

One must continue to realize that there is a clear need for persistent review and research in the development of health screening protocols.

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