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ABSTRACT

Pediatric health screening procedures, both prenatal and postnatal, have a tremendous potential in improving the health status of children and in turn reducing the resource burden on the parents and the State. The existing recommendations, inherent problems and different screening procedures are discussed. The need for suitable mass screening pediatric procedures in the Indian context is stressed.

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Introduction

Throughout recorded history, concern for the lives of children have been unfortunately secondary to the needs of the State and the prerogative of parents. However with increasing awareness, technological advancement, and control of communicable diseases, the rights of children have assumed greater importance. There is a significant change in attitude among professionals, health administrators, and parents.

For pediatricians, preventing disease is second nature. They search for most of the problems as part of the routine care and are aware of most of the screening procedures. In the upcoming 21st century, pediatricians will be faced with an ever-increasing number of prospective parents inquisitive about their unborn child, early detection of medical problems, and for early interventional programmes to prevent later disabilities. In a country like ours, where, the priority of medical care is curative based, it will be appropriate that a beginning is made to nurture the concept of screening procedures.

What is screening?

Screening is a search, in an apparently healthy or asymptomatic population, for latent

disease or for the presence of factors that, if not removed or ameliorated, will increase the likelihood or seriousness of disease at some time later [1]. By definition it is not diagnostic. Screening is carried out for the purpose of early identification, treatment, counselling, and research.

Inherent problems in screening programmes

Ethics : the central ethical principle of a physician is to do no harm without compensating benefit and without informed consent. This means that screening programmes are not offered or imposed on patients until benefits and risks have been explained, costs have been found to be acceptable, and informed consent of the patient or his/her representative has been obtained. In addition, the value of a good programme depends on the existence of a good screening test. The accuracy of a test is determined by its sensitivity, specificity, positive predictive value, and negative predictive value [2].

However, these safeguards have not been systematically applied to screening programmes and have resulted in medical mishaps. Failure to identify benign hyperalaninemia and consequent restricted diet led to iatrogenic retardation in some normal

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children. Similarly, use of concentrated sodium bicarbonate solutions in preterm infants, for presumed acidosis, resulted in intracranial hemorrhage in many. Currently debated ethical issues concern screening for HIV infection. Lack of a specific test to distinguish infected newborns from those with passive transfer of maternal antibodies, stigmatization of an infected mother, and lack of effective health intervention have become bottlenecks for this screening programme.

Economic : Cost of a screening programme includes not only the screening itself, but also the subsequent diagnostic, therapeutic, and supportive services that are required. However, it has been amply demonstrated that the cost of case finding is considerably lower than that of treatment, special education and residential care needed for, say, the retarded child. At the same time this may not be true for disorders with low occurrence rates such as homocystinuria and maple syrup urine disease (incidence 1 : 225,000). Therefore each State has to outline its own screening programmes keeping in view the prevalence of a disease, availability of follow up services, and resources.

Lack of uniform policy : Though screening procedures have been in existence for quite some time, there is still no uniform policy regarding the regulations for types of screen-

ing tests, the laboratory site, or laid down mandate for screening process. The current recommendations of American Academy of Pediatrics are reflected in Table 1. In the United States itself, these suggested screening procedures are not universally followed. Each State has its own policy and recommendations. There are no similar guidelines in our country. The morbidity in infants and children in India is more related to communicable diseases, nutritional deficiencies, diarrhoeal disorders, and other deficiency diseases. Hence the existing health programmes stress more on preventive pediatrics rather than on selective screening of population. Greater proportion of the resources, financial and human, are diverted towards curative services. As a result very little attention has been given for preventive pediatrics. Health programmes such as the 'under five clinic', Integrated Child Development Services, National Tuberculosis Control Programme, school health services, and other programmes have been in existence for quite some time. However, due to various constraints there have been no effective monitoring and assessment of the efficacy of these programmes. Being inherently very sound, if implemented and monitored these health programmes will definitely reduce the incidence of common childhood diseases.

TABLE 1
Screening procedures at different ages [3]

Procedure	Infancy			Early childhood			Late childhood			Adolescence		
	1	6	12	1½	3	4	5	10	12	14	16	18
	(months)			(years)			(years)			(years)		
Development	x	x	x	x	x	x	x	x	x	x	x	x
Metabolic	x											
Hemoglobinopathies	x											
Vision	s	s	s	s	s	o	o	o	o	o	s	o
Hearing	s	s	s	s	s	o	o	s	o	s	s	o
Blood pressure					x	x	x	x	x	x	x	x
Hemoglobin			x									
Mantoux test			x			x					x	

Key : x = to be performed; S = subjective, by history; o = objective, by standard testing method.

School health services are an important branch of community health. According to modern concepts, school health services are an economical and powerful means of improving community health, and are more important to future generations. School health services in India have been in existence since 1909. The various aspects of a school health service are as follows :

- i. Health appraisal of school children and school personnel.
- ii. Remedial measures and follow up.
- iii. Prevention of communicable disease.
- iv. Healthy school environment
- v. Nutritional services
- vi. First aid and emergency care
- vii. Mental health
- viii. Dental health
- ix. Eye health
- x. Health education
- xi. Education of handicapped children
- xii. Proper maintenance and use of school health records

However, due to lack of resources, services provided are hardly more than a token service. Hence the teachers' role in maintaining health of school children becomes more important in our country.

Specific screening areas

Prenatal screening : It is intended to determine whether a fetus, believed to be at risk for some genetic disease, is affected. The common indications for prenatal screening are chromosomal abnormalities, biochemical disorders, x-linked diseases, and neural tube defects. Some of the commonly employed prenatal screening procedures are outlined in Table 2. Negative results provide the parents with many months of reduced anxiety. A positive diagnosis allows the parents to choose their subsequent course of action. Following many collaborative studies, the conclusion is that prenatal diagnosis is safe, highly reliable, and extremely accurate in several conditions [4,5].

TABLE 2
Prenatal screening procedures

Screening procedure	Diseases screened
Serum alpha feto protein (AFP)	Initial screening for neural tube defect (NTD)
Amniotic fluid AFP	Anencephaly Meningomyelocele Encephalocele Omphalocele
Amniotic fluid acetyl cholinesterase	Confirming NTDs
Ultrasonography	Gestational age Placenta location Multiple pregnancy Congenital anomaly
Chorionic villus sampling	Metabolic diseases
Percutaneous umbilical cord blood	Karyotype analysis Erythrocyte enzyme defects Coagulopathies Fetal thrombocytopenia
Skin biopsy	Bullous ichthyosis Erythroderma Ichthyosis congenital
Liver biopsy	Glycogen storage disease I

Neonatal screening : Non-selective screening of newborns for preventable metabolic disorders is performed to identify the homozygous affected newborn and to prevent mental retardation and other irreversible clinical manifestations. Some of the principles for non-selective neonatal screening are outlined in Table 3.

TABLE 3
Principles for non-selective neonatal screening

* The disorder should produce a high burden to the affected individual, yet be preventable.
* Methods for screening, retrieval, diagnosis, and management must be practical and available to the population as a whole.
* Inheritance and pathogenesis of disease should be understood and genetic counselling available.
* Benefit to cost ratio of the programme should be greater than 1.
* Patients rights should be protected.
* False negative laboratory screening results should not occur.
* False positive laboratory results should be minimised.

Blood samples are obtained by heel-prick from all newborns either 48 hours after the first feed, or before they leave hospital. Samples are analyzed by microbiological, biochemical, and immunological methods. The conditions currently amenable to mass neonatal screening are congenital adrenal hyperplasia, cystic fibrosis, Duchenne's muscular dystrophy, hemoglobinopathy, hypothyroidism, and metabolic disorders like phenylketonuria, maple syrup urine disease, tyrosinemia, homocystinuria, galactosemia, and biotinidase deficiency.

Metabolic screening studies are useful in those mentally retarded patients in whom the history and physical examination have provided the appropriate clues to the possibility of an inborn error of metabolism. Routine use of metabolic screening studies to detect aminoacidurias, mucopolysacchariuria, phenylketonuria, and homocystinuria are controversial because of their low yield [6]. Even though individually rare, these disorders in aggregate are not too uncommon. Some inborn errors of metabolism such as phenylketonuria, biotinidase deficiency or medium chain fatty acid acyl Co - A dehydrogenase deficiency are treatable [7]. Being genetic disorders, their recognition is of great value to the family. A systematic biochemical screening of 3000 cases of mental retardation at the National Institute of Mental Health and Neurosciences, led to detection of 66 (2.2%) cases of metabolic defects. Some of the inborn errors of metabolism detected were phenylketonuria (25), homocystinuria (5), histidinuria (2), and Hartnup's disease (6). The authors recommended that in a high risk population, routine biochemical screening has great value [8].

Developmental screening : Assessment of the neuro-developmental status of infants and children should be a routine action at each contact. The goals of such a screening programme are to identify infants with mental retardation due to organic brain disease, detection of neuromotor and sensory deficits, identification of children with delayed development due to environmental circumstances,

and detection of other medical conditions that can be treated. Such screening practices would enable the pediatrician to counsel the parents, interact with them effectively and recommend appropriate interventional therapy. Among the various screening tests available, routine assessment of growth and development during the 'well baby clinic' and 'under five's clinic' visit is the most easy and quick means of screening. However at the same time an infant found to be deviant in neuro-development must be assessed by use of standard tests [9].

Screening of vision and hearing : About 30% of the blind in India are said to lose their eyesight before they reach the age of 20 years, and many under the age of 5 years. Apart from this, a fair percentage of preschool children have other visual problems. Screening for visual defects upto the age of 3 years is subjective [3]. Routine examination of the eyes is an effective way to identify otherwise unsuspected problems that are amendable to correction. During the first year, examination of the eye must include red reflex, pupillary light reflex, ability to track an object, position and symmetry of the corneal light reflex, and fundus. The preschool child can be evaluated by corneal light reflex, extraocular muscle movements, and cover tests. The visual acuity of children above the age of 3 years could be assessed every year as part of the school health programme.

Deafness is another disabling malady, more so when it occurs in a child. The most common cause of hearing loss in children is reported to be middle ear infection and occurs in 5% to 15%. Congenital and genetic hearing loss occurs in less than 1% of the population [10]. Sensori-neural hearing loss, whether due to congenital or acquired causes, needs early detection. Ninety percent of children with hearing impairment are not diagnosed before the age of 1 year and only 50% are diagnosed by the age of 3 years. A high risk registry, parental awareness and auditory evoked brain stem responses hold the greatest promise as neonatal screening programmes. Auditory evoked brain stem response is a

very sensitive and reliable tool today [11]. Impedance audiometry is helpful in screening preschool children. In older children, pure-tone audiometry should be used for selective screening programmes.

Blood pressure screening : It is an established fact that blood pressure levels tend to track from childhood into adulthood. The present recommendation is that routine blood pressure screening should be undertaken for all otherwise well children, 3 years and older, at least once a year. Blood pressure recordings should also be taken in the ill and potentially symptomatic children as well as in the younger age group who are felt to be at increased risk for hypertension due to coexisting problems [12].

Cholesterol and lipid screening : Like blood pressure, serum cholesterol levels tend to track along the same population percentile from childhood into adulthood. Hence there is a scope for identifying hyperlipidemia at an early age. The early recognition may prevent or delay premature onset of ischaemic heart disease and other forms of atherosclerotic changes in many adults. A complete lipid profile is not feasible as a screening test. Kwitrovich et al [13] found that by measuring the concentration of low density lipoproteins, the diagnosis can be predicted reliably in newborns with affected parents. However the present recommendation is serum cholesterol measurement in selected children identified by family history [14].

Screening for anemia : Till recently hemoglobin or hematocrit values used to be obtained from all children at 9 to 15 months, then at 4 to 6 years, and then during adolescence. However, with the decline in the prevalence of iron deficiency anemia in developed countries, the policy has been revised to favour selective screening of infants (9 to 15 months age), and of any child in whom anemia is suspected by history or examination. Various risk factors identified are prematurity, low birth weight, introduction of cow's milk before six months of age, insuf-

ficient dietary intake, and low socioeconomic status. In developing countries it is recommended that screening for anemia be continued in the three age groups as before. Although iron deficiency anemia represents, in most affected children, a condition of low morbidity, screening is worthwhile because of the impossibility of predicting in which child anemia will progress.

Screening for bacteriuria : Mass screening of children, either in schools or in the community, by urine examination is not recommended because there may be 3 to 4 false positives for every true positive bacteriuric urine [15]. However any child with past history of urinary tract infection should have urine examined for bacteriuria periodically even if the child is asymptomatic.

Screening for tuberculosis : With the recent increased incidence of tuberculosis, screening for tuberculosis assumes greater significance. In a community with low prevalence, most reactive tests with tuberculin reflect false positive results due to cross reactivity with non-tubercular mycobacteria leading to unnecessary treatment. Hence the current recommendation is that skin testing should be limited to high risk groups. The strategy for a community with high prevalence would be to focus on contact-case tracking by sputum smear examination and adequate treatment to prevent spread to younger population.

Dental screening : Dental diseases including dental caries and periodontal diseases are very common in children. The incidence of these conditions, however, varies in countries and even in different parts of the same country. In an Indian study, the authors have reported an incidence of 54% in 5 to 9 years age group and 32% in 10 to 13 years age group [16]. Screening for dental diseases in children should become part of the school health service. Using the simple definition of dental caries i.e. decayed, missing, and filled teeth, it is very easy, even for a school teacher, to screen children at regular intervals for dental caries [17].

Nutritional screening : From the nutritional point of view, the Indian society is a dual society consisting of a small group of well-fed and a very large group of undernourished. The best indicator of the level of adequacy of nutrition in a child is his/her growth pattern. The growth or 'Road to health' chart is a visual display of the child's physical growth and development. Anthropometric measurements such as weight, height, and mid-arm circumference are valuable indicators of nutritional status. In young children additional measurements like head and chest circumference help in detection of faulty growth. Ideally children should be weighed at least once every month during the first year, every 2 months during second year, and every three months thereafter up to 5 to 6 years of age. The delivery of nutritional surveillance in our country is done through multiple health agencies like Integrated Child Development Services (ICDS) scheme, Maternal and Child Health Services, and Under-five Clinic.

Cost effectiveness of screening procedures

As mentioned earlier, every country, state and community has to choose screening procedures based on the prevalence of different diseases. Also closely linked is the availability of manpower and financial resources. There is no doubt that in the ultimate analysis, case finding will be much cheaper than treatment and rehabilitation. To assess health programmes, regular auditing at national level is mandatory. In the absence of an organized audit at national level, it is difficult to quantify the effectiveness of various programmes [18]. However individual studies have suggested that interventional programmes have resulted in reduced incidence of severe malnutrition and iron deficiency anemia [19]. Our own results of a study of preschool children covered by an urban ICDS indicated that the incidence of mild and moderate malnutrition was still high (58%). However the prevalence of severe malnutrition, like Kwashiorkor and marasmus, was significantly less (6%). These findings would prob-

ably indicate that growth monitoring and promotion was not adequate. Contrary to this, in a recent study on the impact of ICDS scheme, the authors concluded that there was no significant difference in the nutritional status of children covered by ICDS scheme and those not covered [20]. Hence the question arises as to why the results of various health programmes in existence for decades are not significant? One very important aspect is financial investment. Against the WHO recommended expenditure of 5% of GNP by a country on health care, India is spending about 3% of GNP on health and family welfare development [21]. Lack of coordination among various health agencies, administrative delays, and hurdles in implementation of health programmes are other factors [22].

Conclusion

The outlined screening procedures in pediatrics have to be tailored to suit each community, state, and country. Success of a screening programme would depend upon the prevalence of the disease, cost effectiveness and adequate follow up services. Our aim should be to reduce the high prevalence of preventable diseases. With little more attention and modification, this can be achieved within the available resources.

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