Cost Effectiveness of Screening Children in Health Centers

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SCREENING FOR PROBLEMS IN HEARING, VISION, development, and other areas is an accepted part of health care for children. In the pediatric clinics of the Denver Neighborhood Health Program (*1*) and the pediatric clinic of the University of Colorado Medical Center, such screening has been done by paraprofessional aides recruited from poor neighborhoods. Previous work had already shown that such aides could be trained to perform screening tests accurately (*2*). In this paper we present the results of an assessment of the cost effectiveness of the aides' work. We also compare the results with those of a previously reported outreach project in which aides conducted screening tests in housing projects (*3*).

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Methods

Paraprofessional aides conducted screening tests in four facilities in Denver: two neighborhood health centers, one smaller health station, and the pediatric clinic of a university hospital. The tests used were pure-tone audiometry, the Denver Developmental Screening Test (DDST), the Denver Articulation Screening Examination, tests of visual acuity, and tests for strabismus. All tests were done routinely except the one for articulation, for which children usually were screened only when a problem was suspected. The aides automatically referred the children who failed the vision tests to specialists for evaluation. Likewise, children with abnormal test results in hearing, articulation, or motor or mental development were also usually referred to specialists, but such referral depended on the judgment of the pediatricians or child health associates. (The pediatric practice of child health associates has been described by Fine (*4*).) The aides kept daily logs of the screening they did. Three-month samples of these logs for early 1974 enabled us to review the charts of the children with abnormal test results and determine whether the children had been seen for diagnosis, and if so, whether they had required treatment.

We determined both the direct and indirect costs of the screening. Direct costs were those allocable only to the screening activities, such as those for the aides' salaries, fringe benefits, training, and supplies. Indirect

costs were those shared with other services, such as the costs for supervision of the aides and the costs of medical records, appointments, billing, data processing, and administration. Estimates of indirect costs were included so that the result would reflect the increase in the workload of other departments due to the aides' activities. The estimates were based on cost-centered accounting carried out at all the clinics. The cost of clinic visits for diagnosis and treatment—costs which could be significant—were excluded from the estimates.

Results

The aides did 3,183 screening tests in the 3-month period sampled (see chart). Nine percent (302) of the test results were abnormal. These abnormal results led to diagnostic evaluation by a specialist in 146 instances and to a decision that treatment was required in 95 of them. (The number of children is smaller at each stage than the number of abnormalities because some children had more than one abnormality.)

The results varied according to the type of test (see table). In development, 35 percent of the children with abnormal test results were seen for diagnosis, and 83 percent of those seen required treatment. In articulation, fewer children were tested than in other areas, but 94 percent of those seen required treatment. In hearing, only 45 percent of the children seen for diagnosis required treatment.

The average annual cost of the screening services provided by one aide was $10,937 ($7,022 for direct costs and $3,915 for indirect). The cost was $2.87 per test, $30 per abnormal test result, and $96 per test that resulted in a decision to treat.

Discussion

Only 48 percent of the abnormal test results led to clinic visits for diagnosis. The staffs of the health centers attributed this small proportion to the frequency of missed appointments. However, when aides had screened children in their homes in the housing projects and had encouraged the parents to bring the children with abnormal test results to the health centers, they obtained followup 63 percent of the time (chi square = 22.03, degree of freedom = 1, $P < 0.01$) (*3*). This result led the staffs of three of the health centers to decide to enter abnormal test results in the problem list in the child's medical record so as to improve followup. Aides also began assuming more responsibility for making referrals themselves and for checking later to see whether problems had been resolved.

The need for followup of screening becomes clearer when one looks at costs in relation to yields. As stated previously, the costs were $2.87 per screening test, $30 per abnormal test result, and $96 per test that resulted in a decision to treat. Because with each suc-

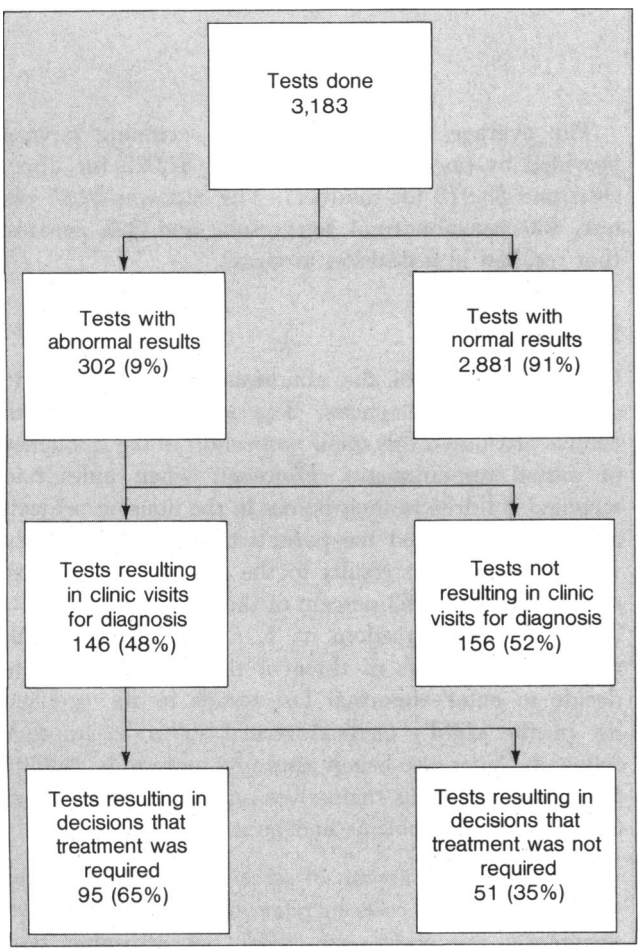
cessive stage of the screening program there are fewer and fewer cases, the cost per unit of yield becomes higher and higher. The importance of looking at the later stages of screening gains further support from two studies of multiphasic testing. In one, more than half of the positive results led to no referreal or no treatment (*5*). In the other, screening had little effect on the subjects' morbidity, partly because the physicians failed to follow up, even when presented with a previously unknown abnormal result (*6*).

Variations in procedure in the different types of screening help to explain the observed variations in results. In developmental screening, the proportion of abnormal test results that led to clinic visits for diagnosis was low, but the proportion of children who required treatment was high. The explanation offered by the staffs of the centers was that children were not referred automatically when the results of a DDST were abnormal. Rather the pediatricians or child health associates made a judgment that took into account both the DDST and their own findings. Therefore the children who tended to be referred were those who were more deviant and of greater concern to these clinicians.

The number of children screened for articulation was small, but a high proportion of those seen for diagnosis needed treatment. The reason was that children were not screened for articulation routinely, but only on suspicion that they had a problem. In the hearing screening, several difficulties arose. At one center, the audiometer was often out of order; at another, a few aides started testing without any training or supervision (supervision has since been intensified). In the other two centers, only 43 percent of the children seen for hearing evaluation needed treatment. Possible reasons for the low proportion needing treatment include ambient noise in some centers and the transitory nature of some cases of hearing loss.

In the home project, four aides, who were closely supervised and worked out of a single office, had screened children in housing projects (*3*). Their work differed from that of the aides in the health centers

Tests done, abnormal test results, and tests resulting in clinic visits for diagnosis and in decisions to treat



NOTE: At each stage of the screening program, the number of children was smaller than the number of tests because some children had more than 1 abnormal test result. Of 274 children with abnormal test results, 133 were seen for diagnosis and 88 required treatment.

Results of screening and followup, by type of screening test

Test results and followup [1]	Total tests	Development	Articulation	Hearing	Vision
Total	3,183	879	306	940	1,058
Normal results:					
Number	2,881	814	262	862	943
Percent	91	93	86	92	89
Abnormal result:					
Number	302	65	44	78	115
Percent	9	7	14	8	11
No clinic visit for diagnosis:					
Number	156	42	26	29	59
Percent	52	65	59	37	51
Clinic visit for diagnosis:					
Number	146	23	18	49	56
Percent	48	35	41	63	49
Decision that treatment was not required:					
Number	51	4	1	27	19
Percent	35	17	6	55	34
Decision that treatment was required:					
Number	95	19	17	22	37
Percent	65	83	94	45	66

[1] At each stage of the screening program, the number of children was smaller than the number of tests because some children had more than 1 abnormal test result. Of 274 children with abnormal test results, 133 were seen for diagnosis and 88 required treatment.

in that these four aides did inspections for severe dental caries, took histories of immunization, and collected cultures for bacteriuria, in addition to performing the tests done by the aides in the health centers. The home aides' work also differed in that they rescreened children with abnormal test results before referring them and spent about one-third of their time encouraging parents to bring children with abnormal test results to the health centers. The housing projects in which the home aides worked were in the catchment area of the Denver Neighborhood Health Program, and the residents used the program's health centers for medical care.

The annual cost for a screening aide was about 20 percent less in the home screening project than in the health centers ($9,173 compared with $10,937). In part, this difference was due to the lower salaries of the aides in the home screening project; in part, it reflected the lower indirect costs for that project, which was a smaller and simpler operation than that of the health centers. These factors offset the higher costs of mileage and supervision in the home screening project.

The costs per unit of yield in the home screening project were of the same order of magnitude as those in the health centers. They were $3.19 per test, $32 per abnormal test result, and $67 per test that resulted in a decision to treat, as compared with $2.87 per test in the centers, $30 per abnormal test result, and $96 per test resulting in a decision to treat. This comparison suggests that screening children in their home may be worthwhile in some settings, especially if families do not readily use preventive services. However, one reason that home screening was so cost effective was that the aides did seven different kinds of tests. If the aides had done only four tests in the homes rather than seven, we estimate that the cost of their work would have been about 25 percent less, but they would have done 40 percent fewer tests and found 59 percent fewer abnormalities, largely because immunization was so commonly deficient among the children screened in the housing projects. The result would have been that the home screening would have cost more: $3.97 per test, $59 per abnormal test result, and $216 per test resulting in a decision to treat. Thus, it seems that multiple tests need to be used in home screening if the costs are to be kept comparable with those for screening done at health centers.

The yields and costs of screening programs in other health centers will no doubt differ from those of this study. However, we have demonstrated a method for studying the cost effectiveness of screening programs. Our study also shows that it is important to consider the later stages of followup in evaluating a screening program.

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SYNOPSIS

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Aides from poor neighborhoods in Denver, Colo., screened children in four health centers for problems in hearing, vision, articulation, and development, and children with abnormal test results were referred to specialists for evaluation. In 3 months, paraprofessional aides did 3,183 tests, of which 302 yielded abnormal results. In 146 instances, these abnormal results led to the evaluation of the children by a specialist, who recommended treatment in 95 instances.

The total annual cost of maintaining one paraprofessional aide was $10,937. The average cost per test performed by such an aide was $2.87, $30 per abnormal test result, and $96 per test resulting in a decision to treat. The results show the importance of considering the later stages of followup in evaluating a screening program.