Multiphasic Screening in Washington, D.C., 1968 and 1969 Results

SAMI A. KHOURY, MD, MPH

SINCE 1963 the District of Columbia Community Health and Hospitals Administration (formerly the department of public health) has been operating a program of multiphasic screening, consisting of testing and followup.

Testing is conducted full time in two units, one a neighborhood health center and the other a mobile trailer. The mobile unit usually is stationed in poverty areas where health facilities are scarce and the need is great. Ten locations were covered in 1968 and 1969. The health center population was drawn primarily from a depressed section of the city.

The activities of the program and the location of the mobile unit were advertised through newspapers, television, and radio stations; also, the personal activities of two community workers. Civic groups, churches, shops, schools, and community organizations were contacted, and posters and fliers were distributed.

Dr. Khoury is chief of the bureau of disease control, Community Health and Hospitals Administration, Government of the District of Columbia. Tearsheet requests to Sami A. Khoury, MD, Community Health and Hospitals Administration, 1875 Connecticut Ave., NW., Room 818, Washington, D.C. 20009.

Persons to be screened were scheduled by appointment; those who walked in also were accepted if time allowed screening them. Until January 1969 only those 40 years old and over were eligible for service. After that date the age limit was lowered to 21.

Materials and Methods

Both units offered the following screening tests: height, weight, visual acuity, audiometry, blood pressure, six-lead electrocardiogram, tonometry, and a 70-mm chest photofluorogram. Blood was collected for determination of urea nitrogen, hemoglobin, and sugar, and for serology. In addition to these tests, cervical smears for cytology tests and cervical cultures for *Neisseria gonorrhoeae* and urinalysis tests were collected at the health center. The head, neck, and heart were examined in the mobile unit—the heart by auscultation.

All screening tests in the units were performed by specially trained technicians. The electrocardiograms were interpreted by physicians, and the chest X-rays by radiologists. In the central laboratory of the department, cultures and other specimens for blood chemistry, blood serology, and cytology tests were analyzed.

Upper and lower normal levels were set for each test performed. Persons with deviations from

these levels were referred for further medical evaluation. At registration the persons to be screened were asked to name a source of medical care (physician or facility) where abnormal test results were to be referred. The referral decisions were made by the public health adviser coordinating the program. A staff physician was always available for consultation.

If the patient with an abnormal test was to be referred, the screening results were mailed to the source of medical care designated by the patient. The patient was notified by mail to report to that source. No indication of the nature or degree of abnormality was mentioned to the patient.

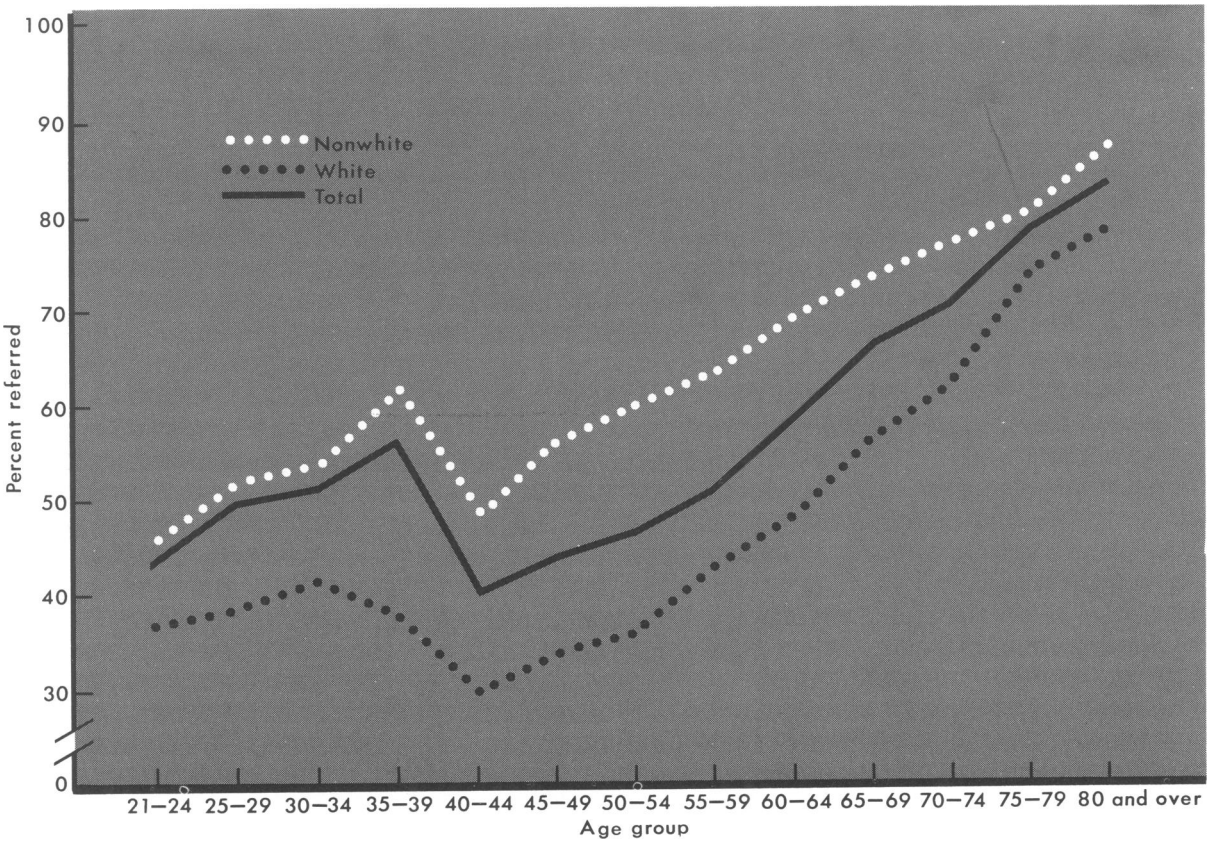
One multicopy form was used to collect all pertinent data: demographic information, medical and smoking history, source of medical care, tests performed and the results, decision to refer or not to refer abnormal tests, attending physician's evaluation, and any action taken by the field followup unit to obtain completion of this evaluation.

The field investigators intervened if (*a*) cases were considered to be urgent because of unusual findings, (*b*) patient had not designated a source of medical care, and (*c*) medical evaluation for a routine case had not been received 60 days after screening. Cases were closed either after medical evaluation or administratively if an evaluation could not be obtained.

Table 1. Distribution of persons tested and referred, by sex and race, D.C. multiphasic screening program, 1968 and 1969

Sex and race	Tested		Referred	
	Number	Percent	Number	Percent
White male	4,932	23.6	1,953	39.6
White female	3,764	18.0	1,548	41.1
Nonwhite male	4,290	20.4	2,579	60.1
Nonwhite female	7,808	37.3	4,687	60.0
Race or sex not stated	151	.7	89	59.0
Total	20,945	100.0	10,856	51.8

Bimodal curve of referrals, by race and age of person with abnormal findings, D.C. multiphasic screening program, 1968 and 1969



The program did not have any provision for yearly followup of the persons screened except for a letter mailed to those with normal results, 1 year after their initial screening, urging them to undergo another round of testing.

Results and Discussion

During 1968 and 1969 a total of 20,945 persons were screened in the two units. The test results are summarized below:

Service	*Number of tests*	*Referrals*
Persons tested	20,945	
Persons referred	10,856	
Percent		51.8
Abnormal tests referred	18,045	
Ratio of tests referred to persons referred		1.662
Ratio of tests referred to persons tested		.861

The sources from which people were referred for screening follow:

Source	*Number*	*Percent*
Self	5,768	27.3
Private physician	325	1.6
Community health worker	10,184	48.6
Health and welfare departments	977	4.7
Neighborhood health centers	2,529	12.2
Other	1,162	5.6
Total	20,945	100.0

Obviously, private physicians made little use of this operation, and use by neighborhood health centers also lagged. The distribution of persons tested and referred for further medical evaluation, by sex and race, is shown in table 1. Nonwhite females formed the largest single group among both the persons tested and among those referred. Referral rates appear to be more directly related to race than to sex. Nonwhites were referred at a much higher rate than whites.

A breakdown of referred persons, by age and race, is given in the figure, which shows a bimodal curve of referrals. The first mode is characteristic of those under 40 years, and the second of those over 40. The profile of nonwhites shows parallel rates of referral that increase progressively, while a slightly different behavior is shown for whites in the younger group, reflected in a bell-shaped curve.

Table 3. Physician evaluation of abnormal tests referred, D.C. multiphasic screening program, 1968 and 1969

Test	Total evaluations received	Confirmed abnormalities, percent of total		
		Subtotal	Unknown[1]	Known[1]
Visual acuity	2,701	84.4	28.0	56.4
Audiometry	1,024	76.2	14.8	61.4
Blood pressure	2,364	84.0	41.5	42.5
Electrocardiogram, 6 leads	2,497	68.3	38.5	29.8
Tonometry	898	20.7	18.0	2.7
Hemoglobin	1,359	54.7	42.9	11.8
Blood sugar	1,423	50.2	33.2	17.0
Blood urea nitrogen[2]	233	4.7	3.0	1.7
Cervical (Papanicolaou) smear[2]	65	16.9	16.9	0
Chest X-ray[3]	3,665	44.8	14.7	30.1
Serology	889	84.5	6.3	78.2
Urinalysis[2]	285	28.8	21.8	7.0
Total[4]	16,303	65.7	29.1	36.6

[1] Known or unknown to evaluating physician. [2] Test started in 1969. [3] All abnormalities combined. [4] Spirometry, head and neck, heart sounds, and hematocrit are not included (455 tests).

Table 2. Test results, D.C. multiphasic screening program, 1968 and 1969

Test	Total tests completed	Abnormal and referred, percent of total			Minor abnormality, not referred (percent of total)
		Subtotal	Unknown[1]	Known[1]	
Visual acuity	20,530	13.9	9.4	4.5	31.4
Audiometry	20,677	5.2	5.0	.2	58.9
Blood pressure	20,710	12.1	8.3	3.8	3.8
Electrocardiogram, 6 leads	19,921	13.6	12.9	.7	8.1
Tonometry	11,712	8.3	8.2	.1	.2
Hemoglobin	17,934	8.0	7.5	.5	.9
Blood sugar	20,026	7.7	6.8	.9	.3
Blood urea nitrogen[2]	2,349	10.5	10.5	0	0
Cervical (Papanicolaou) smear[2]	1,218	5.7	5.7	0	9.2
Chest X-ray[3]	17,223	16.5	16.4	.1	.3
Serology	19,565	5.1	5.1	0	0
Urinalysis[2]	3,059	12.0	11.5	.5	1.9

[1] As stated by person screened. [2] Test started in 1969. [3] All abnormalities combined.

Individual test results are shown in table 2. Visual acuity and audiometry had the highest rates of abnormalities, but most were considered minor and did not show enough evidence for referral. The rate of test referrals for further medical evaluation varied from a low 5 percent for serology and audiometry to a high 16.5 percent for chest X-rays. Significant rates of abnormality were found for the electrocardiogram (13.6 percent), blood pressure (12.1 percent), tonometry (8.3 percent), hemoglobin (8.0 percent), blood sugar (7.7 percent), blood urea nitrogen (10.5 percent), and urinalysis (12 percent). Almost all abnormalities detected were not known to the person tested.

Followup activities are summarized below:

Followup	*Number*	*Percent*
Test referred	18,045	100.0
Physician evaluation	16,758	92.9
File closed	1,287	7.1
No physician evaluation	892	5.0
Other	395	2.1

Physicians returned final evaluations for 92.9 percent of all tests referred. Our study showed, however, that only 10 percent of the evaluations were returned without intervention by a member of the field followup team.

A correlation of testing results with final evaluation by a physician is shown in table 3. Attending physicians confirmed 84 percent of the tests referred for visual acuity, blood pressure, and serology. Abnormalities in electrocardiograms were confirmed in 68 percent of the cases and in blood sugar in 50 percent. Among the abnormalities confirmed, only 8 percent of the positive serology tests were new to the physician compared with 50 percent of the blood sugar tests, 57 percent of the electrocardiograms, 87 percent of the tonometry tests, and 100 percent of the cervical smear tests.

Final diagnoses and action taken by the evaluating physician are shown in table 4. After diseases of the eye, hypertension ranked first in order of frequency; 78 percent of the hypertensive cases were previously unknown. Combined, diseases of the cardiovascular system ranked much higher than any other group; 60 percent were previously unknown. Diabetes mellitus and anemias also ranked high on the list of new diagnoses. Of persons initially screened for glaucoma, 8 percent were referred and 198 cases were confirmed; 90 percent were newly diagnosed cases and the patients were placed under medical care.

Table 4. Selected diagnoses and actions reported by physicians, D.C. multiphasic screening program, 1968 and 1969

Diagnosis	Total reported	Patient status at time of diagnosis, percent of total		
		Already under care	Placed under care	Not placed or not stated
Tuberculosis	16	18.7	68.7	12.6
Other respiratory diseases	833	66.0	26.0	8.0
Syphilis and other venereal diseases	743	87.6	8.2	4.2
Malignant neoplasms	12	16.6	75.0	8.4
Diabetes mellitus	746	16.5	82.3	1.2
Anemias	740	8.4	90.9	.7
Glaucoma	198	9.6	90.4	0
Other diseases of eye	2,225	38.3	54.7	0
Deafness	703	57.3	23.0	19.7
Chronic rheumatic heart disease	21	47.6	38.1	14.3
Hypertensive disease	1,850	20.6	78.1	1.3
Hypertensive heart disease	250	44.0	55.6	.4
Chronic ischemic heart disease	919	35.7	62.6	1.7
Symptomatic heart disease	293	28.3	66.9	4.8
Other diseases of circulatory system	1,090	31.5	58.5	10.0

General Considerations

In the overall operation of a multiphasic screening program, the following phases need to be considered.

Health care system. To maximize its effectiveness, multiphasic screening should operate as an integral part of the total health care system. Neighborhood health centers, private practitioners, and voluntary clinics could participate in and avail themselves of the services offered. Incorporation of such a program into the general health care system would provide a much needed continuity of care.

Diversity of norms. Since the evaluating physician has the final say concerning the test referred, no uniform standards can be established. The District program does not have access to the tools and processes used by the physician to confirm or reject the initial findings. Personal interest of the physician and financial conditions of the patients influence the outcome of the medical evaluation. Diversity in the diagnostic processes precludes any meaningful calculation of the rate of

false positives and forces us to accept the confirmed and unconfirmed results.

Followup activities. We remain responsible for followup of cases until the final medical decisions are reached. Only 10 percent of the physicians spontaneously return their evaluations, and in a sample survey 56 percent of the patients failed to report on their own initiative to their physicians. Many persons who are eligible for medical assistance are not aware of their eligibility rights, and they neglect followup services because they lack financial resources. In all such situations, intervention by the followup investigators becomes mandatory. On the other hand, the followup unit is not equipped to maintain a patient within the health care system or to secure periodic checkups for persons with normal screening results. Failure in these aspects of followup makes it difficult to evaluate the long-term effectiveness of the program.

Cost. All phases of the field screening operation are still carried out manually; blood and cytology examinations are processed automatically in the central laboratory. A detailed analysis for fiscal year 1970 showed a cost of $17.75 per person for screening and followup, including all direct, indirect, and overhead costs and depreciation.

Technician-screenee ratio. Our experience showed that the total daily volume of persons screened in relation to the technicians working on the line should be

$$\text{number of persons screened} = \text{number of technicians} \times 10.$$

This formula excludes the clerk receptionist and the community worker.

The current nonautomated multiphasic screening operation is thought to be adequate for the needs of the city. It is inexpensive to operate and maintain. At current costs elsewhere (*1*), automation of the field testing components is beyond our financial resources.

The D.C. operation is versatile enough to allow existing units to be moved on short notice, with or without the mobile trailer, and to permit new screening units in several neighborhoods. In the present context, the key to the program's success is to take the service to the people, not the reverse.

By providing centralized followup to all screening units in the city, the program maintains cohesion and uniformity of the entire operation.

REFERENCE

(*1*) Mackintosh, D. R., and Kraus, G. P.: Cost analysis of the developmental phase of an automated multiphasic health testing facility. Public Health Rep 85: 685–690, August 1970.

KHOURY, SAMI A. (D.C. Community Health and Hospitals Administration): *Multiphasic screening in Washington, D.C., 1968 and 1969 results. Health Services Reports, Vol. 87, August–September 1972, pp. 664–668.*

Two full-time screening units, one a neighborhood health center and the other a mobile trailer, were used in the District of Columbia's 1968 and 1969 multiphasic screening program. The tests offered were height, weight, visual acuity, audiometry, blood pressure, six-lead electrocardiogram, tonometry, chest photofluorogram, serology, blood glucose, hemoglobin, blood urea nitrogen, cervical cytology, and cervical culture for *Neisseria gonorrhoeae*.

A total of 20,945 persons were screened; 51.8 percent were referred for further medical evaluation. Nonwhites had a higher rate of referral than whites. The significant rates of referral were blood pressure, 12.1 percent; electrocardiogram, 13.6 percent; tonometry, 8.3 percent; hemoglobin, 8.0 percent; blood sugar, 7.7 percent; serology, 5.1 percent; and chest X-ray, 16.5 percent.

Confirmation by a physician of abnormal referred tests were as follows: blood pressure, 84.0 percent; electrocardiogram, 68.3 percent; tonometry, 20.7 percent; hemoglobin, 54.7 percent; blood sugar, 50.2 percent; serology, 84.5 percent; and chest X-ray, 44.8 percent. Most of these confirmed abnormalities were newly discovered.

The following number of final diagnoses were made: diabetes 746, anemia 740, glaucoma 198, hypertensive disease 1,850, diseases of the heart 1,462, other diseases of the circulatory system 1,090, tuberculosis 16, and other respiratory diseases 833. Two-thirds of these diseases were newly diagnosed.

To succeed, multiphasic screening must include complete followup, be an integral part of the health care system, and be flexible enough to allow the services to be provided where the needs arise.