Diabetes Screening Activities July 1958 to June 1963

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WHILE ESTIMATES of the prevalence of unsuspected diabetes vary according to the source of data and differences in definitions, there remains no doubt that public health workers face a problem of considerable magnitude in identifying such cases. Current estimates, considered conservative by some workers, point toward 2 million unknown cases in the United States. Since the disease can be treated and controlled, identification and referral of these persons to private physicians are important to the patient, his family, and the community because serious complications sometimes occur with diabetes that can drain both family and community resources.

Diabetes screening has been a part of public health activities for some years. Both blood testing and urine testing have been used. Blood testing is preferred since it is a more sensitive test at any given level of specificity. Greater numbers of persons are being tested for diabetes now than in previous years.

Numbers of Persons Tested

According to blood testing reports sent to the Public Health Service, the numbers of persons screened have increased from less than 200,000 in fiscal years 1959, 1960, and 1961 to 340,000 in fiscal year 1962. This represents an increase of 70 percent from 1961 to 1962. In 1963, 530,000 persons were reported to have been tested, an increase of 56 percent over the preceding year. Table 1 presents the numbers screened in these reporting periods by State and Department of Health, Education, and Welfare Regions. In addition, the number of positive screenees and the yield of new cases are presented for 1962 and 1963. The number positive increased by 128 percent from 1962 to 1963 and the number of new cases increased by 71 percent.

Thirty-one States, the District of Columbia, and Puerto Rico reported screening activity. Seven States reported screening in 1963 where none had been reported in 1962: Connecticut, Rhode Island, Vermont, Mississippi, Minnesota, Idaho, and Montana. Two of these, Rhode Island and Mississippi, tested more than 10,000 persons; Minnesota tested more than 4,000; and each of the others tested fewer than 1,000 persons.

The increases in numbers of persons screened, however, were not due to the initiating or reporting of screening projects in additional States as much as expansion of activities within those already screening. Sixteen States or areas reported increases; 12 of these had gains of more than 100 percent. The percentage increase, with States listed by magnitude of the numbers screened during 1963 (table 1), was Michigan, 154; Wisconsin, 1,716; Arizona, 16; Virginia, 55; New Jersey, 23; Ohio, 1,283; Kansas, 100; Tennessee, 750; Texas, 391; Maryland, 103; Illinois, 278; Puerto Rico, 287; Hawaii, 254; Wyoming, 448; Delaware, 164; and Nebraska, 9.

The first seven States listed in the previous paragraph accounted for 48 percent of the total screened in 1963. Substantial gains in numbers of persons tested were made in each of these States, not only from 1962 to 1963 but also from 1961 to 1962. From 1962 to 1963, their combined increase was 142 percent.

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Table 1. Diabetes screening activities reported to Public Health Service, blood testing only, fiscal years, 1959–63

Area	1963			1962			1961	1960	1959
	Total screened	Screened positive	New cases	Total screened	Screened positive	New cases	Total screened	Total screened	Total screened
Total	527, 195	23, 574	4, 286	325, 821	10, 315	2, 504	181, 925	181, 672	193, 510
Region I	28, 144	4, 836	32	10, 192	180	37	10, 627	10, 606	3, 241
Connecticut	722	7						405	505
Maine	9, 040	161	31	10, 192	180	37	10, 627	10, 201	2, 736
Rhode Island	17, 906	4, 665							
Vermont	476	3	1						
Region II	133, 346	5, 186	1, 520	136, 476	4, 028	1, 234	40, 048	31, 848	23, 236
Delaware	2, 789	96	4	1, 053	33	3	1, 057	3, 423	
New Jersey	18, 764	414	76	15, 274	233	36	11, 295	3, 876	
New York	29, 746	2, 722	1, 190	34, 685	2, 159	1, 043	1, 902	1, 971	17, 964
Pennsylvania	82, 047	1, 954	250	85, 464	1, 603	152	25, 794	25, 578	5, 272
Region III	80, 227	4, 206	897	58, 763	2, 320	432	45, 345	70, 086	75, 341
District of Columbia	23, 826	821	153	24, 215	334	105	24, 553	33, 842	37, 687
Kentucky								2, 503	
Maryland	6, 110	335	121	3, 004	53	12		2, 160	
North Carolina	12, 658	531	100	13, 850	891	109	6, 725	2, 712	2, 382
Virginia	22, 195	1, 053	257	14, 348	540	171	5, 977	18, 262	8, 746
West Virginia	1, 916	205		2, 121	385		2, 348	5, 675	3, 127
Puerto Rico	4, 743	447	136	1, 225	117	35	5, 742	4, 932	9, 313
Virgin Islands									9, 878
Federal employees [1]	8, 779	814	130						
Region IV	22, 624	1, 245	195	1, 273	44	4			615
Florida				57	10				615
Mississippi	12, 285	806	103						
Tennessee	10, 339	439	92	1, 216	34	4			
Region V	187, 179	6, 609	1, 277	51, 301	1, 761	398	42, 088	18, 573	26, 519
Illinois	5, 534	477	418	1, 464	76	20	2, 395		
Michigan	116, 666	4, 038	593	45, 963	1, 578	346	39, 386	12, 253	14, 275
Ohio	17, 226	899	64	1, 245	25	13		6, 320	12, 244
Wisconsin	47, 753	1, 195	202	2, 629	82	19	307		
Region VI	24, 944	350	55	16, 750	211	77	14, 651	6, 223	14, 609
Iowa				1, 633	18	12	2, 854	2, 074	3, 267
Kansas	11, 828	130	33	5, 902	28	24	6, 402	922	11, 342
Minnesota	4, 044	81	3						
Missouri	6, 568	58	14	6, 909	134	39	1, 945		
Nebraska	2, 504	81	5	2, 306	31	2	2, 790	3, 227	
South Dakota							660		
Region VII	14, 747	651	188	9, 577	517	83	9, 636	18, 005	1, 682
New Mexico	402	5		648	9	1	2, 559	13, 884	
Oklahoma	7, 118	245	81	7, 460	479	77	5, 694	4, 121	1, 682
Texas	7, 227	401	107	1, 469	29	5	1, 383		
Region VIII	4, 039	87	12	634	41	13	2, 983	3, 487	14, 588
Colorado							2, 695	3, 487	14, 588
Idaho	487	5							
Montana	77	5							
Wyoming	3, 475	77	12	634	41	13	288		
Region IX	31, 945	404	110	40, 855	1, 213	226	16, 547	22, 844	33, 679
Arizona	27, 508	223	67	22, 770	345	95	16, 547	19, 174	14, 333
California	650	15	8	16, 752	768	108		3, 670	
Hawaii	3, 787	166	35	1, 071	82	19			18, 561
Nevada									705
Oregon				262	18	4			

[1] District of Columbia, Maryland, and Virginia.

NOTE: Screening was not reported by Massachusetts, New Hampshire, Alabama, Georgia, South Carolina, Indiana, North Dakota, Arkansas, Louisiana, Utah, Alaska, Washington, and Guam.

Table 2. Diabetes screening activities, evaluation statistics, blood testing only, fiscal years 1962–63

Area	1963				1962			
	Total screened	Percent positive	New case rate per 1,000 tested	Percent referred no diagnosis	Total screened	Percent positive	New case rate per 1,000 tested	Percent referred no diagnosis
Total	527, 195	4. 5	8. 1	54. 1	325, 821	2. 7	7. 4	45. 1
Region I	28, 144	17. 2	1. 1	97. 4	10, 192	1. 8	3. 6	32. 8
Connecticut	722	1. 0						
Maine	9, 040	1. 8	3. 4	23. 6	10, 192	1. 8	3. 6	32. 8
Rhode Island	17, 906	26. 1		100. 0				
Vermont	476	. 6	2. 1	33. 3				
Region II	133, 346	3. 9	11. 4	55. 1	136, 476	3. 0	9. 0	61. 2
Delaware	2, 789	3. 4	1. 4	89. 6	1, 053	3. 1	2. 8	
New Jersey	18, 764	2. 2	4. 1	37. 7	15, 274	1. 5	2. 4	22. 3
New York	29, 746	9. 2	40. 0	38. 5	34, 685	6. 2	30. 1	44. 1
Pennsylvania	82, 047	2. 4	3. 0	78. 9	85, 464	1. 9	1. 8	84. 2
Region III	80, 227	5. 2	11. 2	29. 5	58, 763	3. 2	6. 0	40. 5
District of Columbia	23, 826	3. 4	6. 4	36. 2	24, 215	1. 4	4. 3	22. 7
Maryland	6, 110	5. 5	19. 8	16. 4	3, 004	1. 8	4. 0	23. 5
North Carolina	12, 658	4. 2	7. 9	25. 3	13, 850	6. 4	7. 8	35. 2
Virginia	22, 195	4. 7	11. 6	16. 2	14, 348	3. 8	11. 9	6. 9
West Virginia	1, 916	10. 7			2, 121	18. 2		
Puerto Rico	4, 743	9. 4	28. 7	62. 4	1, 225	9. 6	28. 6	50. 0
Federal employees [1]	8, 779	9. 3	14. 8	26. 2				
Region IV	22, 624	5. 5	8. 6	13. 4	1, 273	3. 5	3. 1	25. 0
Florida					57	17. 5		60. 0
Mississippi	12, 285	6. 6	8. 4	20. 5				
Tennessee	10, 339	4. 2	8. 9	9. 3	1, 216	2. 8	3. 3	14. 7
Region V	187, 179	3. 5	6. 8	43. 3	51, 301	3. 4	7. 8	22. 4
Illinois	5, 534	8. 6	75. 5	8. 5	1, 464	5. 2	13. 7	3. 9
Michigan	116, 666	3. 5	5. 1	52. 7	45, 963	3. 4	7. 5	23. 8
Ohio	17, 226	5. 2	3. 7	73. 8	1, 245	2. 0	10. 4	16. 0
Wisconsin	47, 753	2. 5	4. 2	31. 9	2, 629	3. 1	7. 2	12. 9
Region VI	24, 944	1. 4	2. 2	46. 4	16, 750	1. 3	4. 6	34. 3
Iowa					1, 633	1. 1	7. 3	
Kansas	11, 828	1. 1	2. 8	23. 8	5, 902	. 5	. 4	7. 1
Minnesota	4, 044	2. 0	. 7	87. 1				
Missouri	6, 568	. 9	2. 1	37. 0	6, 909	1. 9	5. 6	49. 6
Nebraska	2, 504	3. 2	2. 0	50. 6	2, 306	1. 3	. 9	29. 0
Region VII	14, 747	4. 4	12. 7	36. 7	9, 577	5. 4	8. 7	46. 3
New Mexico	402	1. 2		100. 0	648	1. 4	1. 5	12. 5
Oklahoma	7, 118	3. 4	11. 4	51. 8	7, 460	6. 4	10. 3	46. 8
Texas	7, 227	5. 5	14. 8	29. 1	1, 469	2. 0	3. 4	52. 0
Region VIII	4, 039	2. 2	3. 0	29. 9	634	6. 5	20. 5	7. 7
Idaho	487	1. 0		100. 0				
Montana	77	6. 5		20. 0				
Wyoming	3, 475	2. 2	3. 5	26. 0	634	6. 5	20. 5	7. 7
Region IX	31, 945	1. 3	3. 4	19. 6	40, 855	3. 0	5. 5	35. 4
Arizona	27, 508	. 8	2. 4	10. 7	22, 770	1. 5	4. 2	16. 7
California	650	2. 3	12. 3	11. 1	16, 752	4. 6	6. 4	42. 2
Hawaii	3, 787	4. 4	9. 2	27. 0	1, 071	7. 7	17. 7	14. 5
Oregon					262	6. 9	15. 3	16. 7

[1] District of Columbia, Maryland, and Virginia.

NOTE: Screening was not reported by Massachusetts, New Hampshire, Kentucky, Virgin Islands, Alabama, Georgia, South Carolina, Indiana, North Dakota, South Dakota, Arkansas, Louisiana, Colorado, Utah, Alaska, Nevada, Washington, and Guam.

There was a decrease in the numbers reported tested in 10 areas. With States listed by magnitude of the numbers screened in 1963 (table 2), the percentage decrease was Pennsylvania, 4; New York, 14; District of Columbia, 2; North Carolina, 9; Maine, 11; Oklahoma, 5; Missouri, 5; West Virginia, 10; California, 96; and New Mexico, 38.

Percentage of Positive Screenees

In 1963, the percentage of positive screenees ranged from 0.6 to 26.1, with a median of 3.4. Of the 527,195 screenees reported nationally, 4.5 percent were positive (table 2). The percentage positive is a result of the particular test and procedures used and the type of population tested. Very low yields in terms of percentage positive indicate, therefore, either problems in the choice of procedures and test or of the persons to be tested.

Since the number positive and the number of new cases have increased at a more rapid rate than the numbers tested from 1962 to 1963, an overall improvement in program efficiency in identifying new cases is apparent.

Thirteen States and the District of Columbia have improved their yield in terms of percentage positive from 1962 to 1963. The largest increases were noted in Maryland, Texas, Illinois, Ohio, New York, and the District of Columbia. (The increases in Illinois and New York were to a high degree influenced by Chicago and New York City where the procedures for screening and the standards for diagnosing are different from the rest of the State.) Other areas which showed increases are Nebraska, Tennessee, Virginia, New Jersey, Kansas, Pennsylvania, Delaware, and Michigan. While they did increase yields, some of these States still had a relatively low yield in terms of percentage positive.

Interpretation of data where the percentage positive is quite high is difficult. Some of the factors that contribute to a high yield are the screening of a highly susceptible group, use of a low critical level for interpretation of the test (usually in a program which retests positive screenees prior to referral), referral of patients for testing by private physicians when diabetes is suspected, inclusion of known diabetics in the testing program, and many others. Evaluation of these programs necessitates review of procedures and methods. Generally, they represent comprehensive, well-planned programs.

A decrease from 1962 to 1963 in the percentage of positive screenees was noted in 11 States.

Yield of New Cases

The yield of new cases per 1,000 persons tested in 1963 ranged from 0.7 to 75.5 (table 2), with a median of 5.8. For the total screenees reported nationally, the rate was 8.1. Eleven States, the District of Columbia, and Puerto Rico increased the yield of new cases from 1962 to 1963. The largest increases were noted in Illinois, Maryland, Texas, New York, Tennessee, Kansas, and the District of Columbia. Smaller increases were noted in New Jersey, Pennsylvania, North Carolina, Nebraska, Oklahoma, and Puerto Rico.

Generally, the areas that have increased their percentage of positive screenees have also increased their yield of new cases.

Since conservative estimates indicate approximately 8 to 10 persons per 1,000 population may have diabetes and not know of their condition, it might be expected that most screening programs could yield 5 to 8 new cases per 1,000 tested, unless the population was younger than average or unique in other ways. When the population is well chosen in terms of characteristics that are often associated with diabetes, the new case yield should be considerably greater. Fourteen (45 percent) of the areas reporting followup results have a case yield of 5 or less per 1,000 tested. Evaluation of projects must include consideration of the percentage referred where no diagnosis or final report is obtained. A large contributing factor to this is the lack of followup. When the percentage referred with no diagnosis is high, it can be assumed that the yield of new cases will not represent completely the results of the screening program.

The following eight States screened relatively large numbers of persons with low case yields during 1963 (table 2): Pennsylvania, Wisconsin, Arizona, New Jersey, Ohio, Kansas, Maine, and Missouri.

Table 3. Areas with good yields of new cases of diabetes, fiscal year 1963

Area	Number screened	Percent screened positive	New cases per 1,000 tested	Percent referred no diagnosis	Screening
Illinois	5,534	8.6	75.5	8.5	
Chicago	1,932	18.7	198.2	6.8	AutoAnalyzer at 105 or 150. Retest with AutoAnalyzer and GTT.
Rest of State	3,602	3.2	9.7	23.8	Clinitron at 130. Some retesting.
New York	29,746	9.2	40.0	38.5	
New York City	19,477	13.0	60.9	38.6	AutoAnalyzer and Clinitest. Positive Clinitest gets modified GTT regardless of blood level. AutoAnalyzer level is 130; 130 to 180 get modified GTT; 180+ is diagnosed as diabetes and patient referred for treatment.
Rest of State	10,269	1.8	.2	10.0	Clinitron. No retesting.
Puerto Rico	4,743	9.4	28.7	62.4	Dextro test at 100. Retest with Folin-Wu at 150.
Maryland	6,110	5.5	19.8	16.4	Clinitron at 130–180. 1 project retests with Hoffman at 150.
Federal employees	8,779	9.3	14.8	26.2	AutoAnalyzer at 130. Retest with AutoAnalyzer and GTT.
Texas	7,227	5.5	14.8	29.1	Klinikit and Clinitron, mostly at 160+. 5 projects retest.
Virginia	22,195	4.7	11.6	16.2	Glover-Edwards Kit and Clinitron at 130. 1 AutoAnalyzer screens at 120; 6 projects retest mostly at 130.
Oklahoma	7,118	3.4	11.4	51.8	Clinitron and Somogyi-Nelson. Critical level is related to time since eating. No retesting.
Tennessee	10,339	4.2	8.9	9.3	Screen and retest with Clinitron at 130.
North Carolina	12,658	4.2	77.9	25.3	Glover-Edwards Kit and Clinitron mostly at 130. Retests with Glover-Edwards Kit and Clinitron 130–160 and GTT.
District of Columbia	23,826	3.4	6.4	36.2	Clinitron at 130. 1 project retests.
Michigan	116,666	3.5	5.1	52.7	Most projects use Clinitron at 160. No retesting.
Mississippi	12,285	6.6	8.4	20.5	Screen and retest with Clinitron at 130.

Low yields from these projects may be due to a variety of factors. In Arizona where age of the screenees could be examined, a large proportion, 53 percent, were under 45 years of age; therefore, these reports were not likely to include large numbers of undiagnosed diabetics. Many of these areas are using 160 mg. as the critical level for the screening test. If blood specimens are drawn at random times after meals, use of 160 mg. or higher critical levels produces a low yield and probably erroneously reassures some persons with mild diabetes that they show no evidence of the disease. Completeness of followup reporting is poor in some areas; some projects have not been successful in obtaining such reports. Yields could be improved in these areas by obtaining complete reporting, by encouraging high-yield groups to participate, and by modifying techniques and procedures.

Some of the areas showing high yields are listed in table 3 by order of the magnitude of the yield of new cases. The overall yields reported by Illinois and New York are influenced greatly by the results of the Chicago and New York City programs. In both of these projects, diagnosis is based on other than a report of a private physician. Results of a glucose tolerance test are used in New York City and in Chicago. In Chicago, patient characteristics also contribute to diagnosis.

Referrals, No Diagnosis

A diagnosis or final report is not obtained on all referred persons. In many situations, there is no indication that the referred persons have or do not have diabetes. In some of these cases, the physician may return the report and indicate that he has not made any conclusion concerning the person referred. For others, no reports have been obtained from the physician. The percentage of referrals with no final disposition ranges from 8.5 percent to 100 percent

among reported projects. The median percent is 32.6.

After the termination of a screening project, 6 months is generally considered sufficient time for followup. However, reports received by the Public Health Service up to February 1, 1964, are included in this paper. Several States submitted reports after this date, and these reports could not be included. In general, these later reports do not greatly alter the statistics presented for fiscal year 1963; however, Michigan did forward late reports which indicated more complete followup of referred cases.

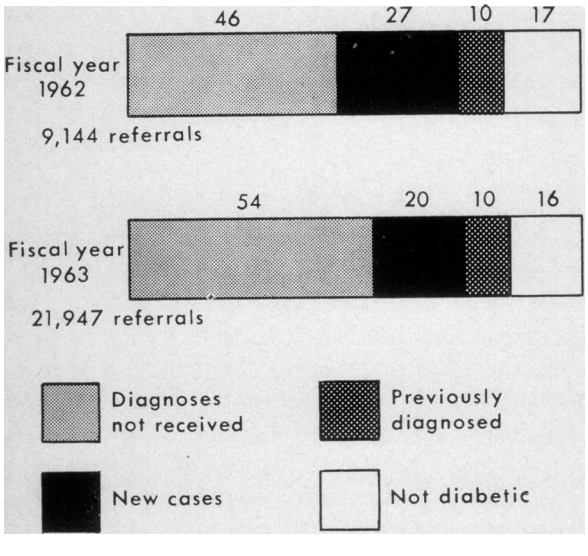
Evaluation of the success of a project is more effective if the numbers of referrals without diagnosis or final reports are kept at a minimum. It also seems that the cooperation and enthusiasm of communities could be maintained if they are aware of the yield of new cases resulting from their efforts. Identification of new cases should conform to community interests and practices. Most areas identify new cases as those diagnosed by a private physician. In some areas, however, diagnosis may depend on an agreed-upon interpretation of a glucose tolerance test or other patient characteristics, or both.

The following are areas which have obtained final reports on at least 75 percent of their referred cases (presented in order of percentage without diagnosis, lowest to highest): Illinois, 9; Tennessee, 9; Arizona, 11; California, 11; Virginia, 16; Maryland, 16; Montana, 20; Mississippi, 21; Maine, 24; and Kansas, 24.

Areas where the percentage without diagnosis is more than 50 percent of referred cases (presented in order of percentage with no diagnosis) are Rhode Island, 100; Idaho, 100; New Mexico, 100; Delaware, 90; Minnesota, 87; Pennsylvania, 79; Ohio, 74; Puerto Rico, 62; Oklahoma, 52; and Nebraska, 51.

The referrals for fiscal 1962 and 1963 are shown in figure 1. In 1962 diagnoses were not received for 46 percent of all screenees who were referred to physicians. In 1963 the figure rose to 54 percent, a difference of 9 percent, apparently at the expense of new cases. In 1963 only 20 percent of all referrals were newly diagnosed; in 1962, 27 percent were newly diagnosed with diabetes. The percentage of persons diagnosed as not diabetic is about the same for both years, and likewise the percentage of those previously known to be diabetic remains constant for both years.

Figure 1. Percentage of diabetes screenees referred to physicians, 1962 and 1963.



Yield of New Cases, 1960–63

Nationally, the yield of new cases per 1,000 tested increased from 1961 to 1962 and from 1962 to 1963. The percentage positive decreased from 1960 to 1961 and from 1961 to 1962. However, it has increased considerably from 1962 to 1963. The percentage without diagnosis has increased every year, as shown below.

Cases	*1963*	*1962*	*1961*	*1960*
Percent positive	4.5	2.7	2.9	3.8
Case yield-rate per 1,000 tested	8.1	7.4	5.4	5.6
Percent referred, without diagnosis	54.1	45.1	38.0	36.3

Retesting of Positive Screenees

The retesting of positive screenees, using a new blood sample prior to referral, is an effective means of avoiding large numbers of over-referrals to private physicians. It is important to make the most efficient use of the physician's time by keeping over-referrals to a minimum. Retesting is particularly recommended when the critical value for the interpretation of the screening test can be set at a relatively low level. It has been demonstrated that

the combination of an effective screening test with a low critical level and a good retesting program succeeds in identifying a larger number of persons who will be diagnosed as having diabetes while keeping the number of referrals at an acceptable level (*1*).

Sixteen States, the District of Columbia, and Puerto Rico reported retesting; eight of these States and Puerto Rico reported retesting on all projects. States in which all screenees positive for diabetes were retested prior to referral to the physician include North Carolina, Mississippi, Tennessee, Ohio, Nebraska, Montana, Arizona, and California.

While 36 percent of the projects reported retesting, they accounted for only 27.3 percent of the total persons tested. Projects doing retesting accounted for 21.5 percent of the total screened positive and 27.8 percent of the total new cases.

The overall yield of new cases from these projects is higher than that from projects not retesting, 15.4 per 1,000 tested, compared with 6.5 per 1,000 in areas not retesting. In general, the areas using the lower screening levels obtain higher yields. Our recommendation, when retesting can be incorporated into the program, is to select the lower screening levels.

Most of the projects which retest also obtain a completed report on most of the patients referred from their program. With three exceptions, all of the areas incorporating retesting into all of their projects had obtained reports on 75 percent or more of their referred cases.

Glucose loading for retesting was used in only a few of these programs, none of which used a loading test for screening. It is recommended that retesting should include, whenever possible, testing after a meal or after glucose. Although it is recognizably difficult in some situations, loading for screening tests is also desirable.

Testing Procedures and Equipment

In 148 programs during 1963, 68.8 percent of the total number screened were tested with the Clinitron; 35.4 percent of the total at 130 mg., 13.9 percent at 160 mg., and 6.2 percent at 180 mg. per 100 ml. The remaining numbers tested with the Clinitron were in projects where the level was not stated. Some of the projects using Clinitrons also used other equipment. The Clinitron was used in one project in Virginia and one in Wisconsin in conjunction with the Glover-Edwards Kit. In Texas, it was used in one project in conjunction with the Klinikit.

The AutoAnalyzer has been used in screening projects that reported in 1962 and 1963. Of the total screened in 1963, 2.2 percent had been tested in programs using the AutoAnalyzer. This was a lower percentage of the total screened than in 1962. (The numbers tested with the AutoAnalyzer were greater in 1963.) Reports were obtained from one project in Norfolk, Va., where the AutoAnalyzer was used to test venous whole blood with the critical level set at 120 mg. per 100 ml. Positive screenees were not retested. Chicago reported three projects using the AutoAnalyzer; one project used venous plasma (*2*) with 105 mg. as the critical level and the second and third used venous plasma with 150 mg. as the critical level. All three projects retested using a glucose tolerance test.

In the Federal employees screening program, venous plasma samples are processed on the AutoAnalyzer. The critical screening level is set at 130 mg. and a glucose tolerance test is used in retesting positives. An automated technique similar to that of the AutoAnalyzer has been developed and used in Cleveland, Ohio, on capillary blood, with 140 mg. as the critical level.

Four projects used manual laboratory methods for determining blood glucose. Ohio had three projects, with 8,510 screenees, in which the Somogyi-Nelson (*3*) technique was used for screening and the glucose tolerance test for retesting. Rhode Island screened 6,420 persons using the Folin-Wu technique (*4*).

The Glover-Edwards Kit was used in 22 projects: North Carolina, 9; Virginia, 3; Michigan, 3; Wisconsin, 2; Montana, 1; and Wyoming, 4. Five projects in Texas used the Klinikit. Two projects in Puerto Rico used the Dextro test.

While the Clinitron was used alone or in combination for approximately 80 percent of the total numbers screened during 1963, only about 50 percent of the total positive screenees and new cases were tested in projects using the Clinitron (table 4). Projects using the AutoAna-

lyzer reported 5.4 percent of the total positive and 12.1 percent of the new cases, while only 2.2 percent of the total tested were screened with this technique. Projects using manual laboratory procedures reported 20.5 percent of the positive screenees, but only 1.5 percent of new cases. The low case yield is due in part to one State where large numbers of positive screenees are obtained but no followup results are reported. The type of equipment used was not stated for many projects, and these projects contributed a large proportion of the positive screenees and new cases. Areas not reporting this information include Illinois (except Chicago), Michigan, Missouri, New York, five projects in North Carolina, and two projects in Oklahoma.

In 1963 the most frequently used screening level was 130 mg. per 100 ml. Of the total screened, 39 percent were tested in projects using this critical level. The next most frequently used level was 160 mg.; 24 percent of the total population screened at this level. Six percent were screened at 180 mg., and 10 percent were screened in projects using multiple levels. Projects using multiple levels included North Carolina, where 130 mg. was regarded as suspicious and 160 mg. as positive, and Ohio, where 170 mg. 1 hour after food and 120 mg. 2 hours after food were regarded as positive. Pennsylvania used 130 mg., 160 mg., and 180 mg., depending on the choice of the local medical society; Oklahoma used 180 mg. if food had been taken in less than 1 hour, 160 mg. if food had been taken from 1 to 2 hours, and 130 mg. if it had been more than 2 hours since food intake.

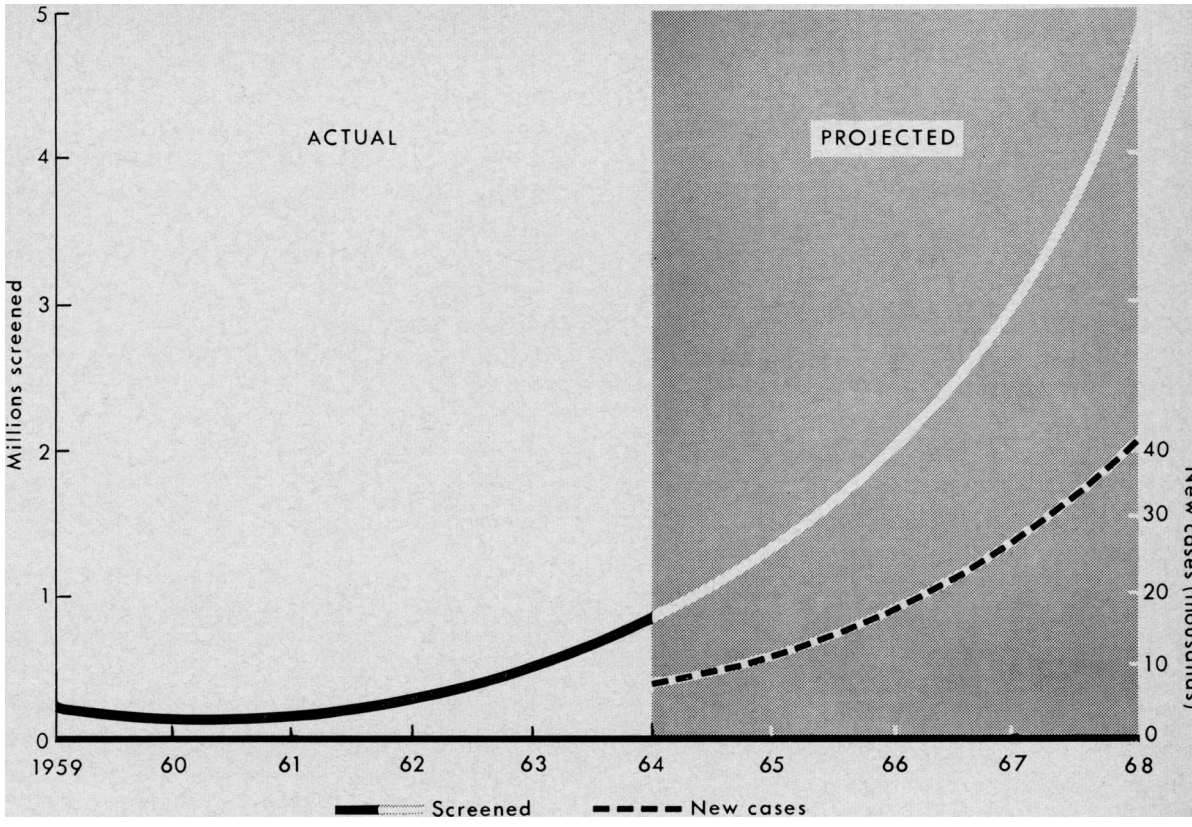
Although recommendations are being made to use lower levels for screening whenever possible, no strong trend is apparent (table 4). In these reports, there is a tendency for the yield of new cases to be higher when lower screening levels are used. We feel that if data could be controlled for differences in the test population and followup reporting this relationship would be more evident.

Venous whole blood was used to test approximately 70 percent of the population screened,

Table 4. Equipment, screening level, and type of blood, diabetes screening activities, 1960–63

Screening factor	Percent of total screened				Percent of total screened positive				Percent of total new cases			
	1963	1962	1961	1960	1963	1962	1961	1960	1963	1962	1961	1960
Equipment:												
Clinitron	68.8	80.6	79.4	55.5	44.1	59.4	77.0	58.2	41.7	43.7	73.6	46.2
Glover-Edwards Kit	1.1	2.0	3.9	------	1.1	3.8	7.0	------	1.4	3.0	7.9	------
AutoAnalyzer	2.2	6.2	------	------	5.4	4.8	------	------	12.1	42.3	------	------
Klinikit	.1	------	------	------	.1	------	------	------	------	------	------	------
Laboratory	4.7	------	------	------	20.5	------	------	------	1.5	------	------	------
Clinitron and Glover-Edwards Kit	9.7	------	------	------	5.4	------	------	------	5.1	------	------	------
Clinitron and Klinikit	.9	------	------	------	1.1	------	------	------	2.1	------	------	------
Other equipment	2.6	------	------	------	4.6	------	------	------	3.2	------	------	------
Not stated	9.9	11.2	16.7	44.5	17.7	32.0	16.0	41.8	32.9	11.0	18.5	53.8
Screening level (mg. per 100 ml.):												
<130	1.4	------	------	------	2.7	------	------	------	7.7	------	------	------
130	38.5	33.2	43.2	30.0	31.5	31.3	50.6	31.7	29.9	66.2	48.0	25.7
140	1.7	1.0	------	2.0	2.7	4.8	------	1.9	------	2.2	------	------
150	.1	------	------	------	1.1	------	------	------	4.5	------	------	------
160	24.1	32.1	45.2	33.0	10.7	21.2	38.1	24.1	12.5	15.2	44.3	26.7
180	6.3	9.3	.8	3.9	3.8	4.6	2.1	1.5	5.5	2.3	------	2.1
Multiple levels	9.9	15.3	10.2	7.6	7.9	10.8	8.1	12.4	5.3	8.5	7.4	10.5
Not stated	18.0	9.1	.6	23.5	39.6	27.3	1.1	28.4	34.6	5.8	.3	35.0
Type of blood:												
Venous whole blood	69.1	73.6	73.4	61.1	63.0	60.6	75.0	61.0	43.2	84.9	79.7	52.2
Venous plasma	2.1	------	------	------	5.0	------	------	------	10.8	------	------	------
Capillary whole blood	10.5	17.5	26.5	20.0	10.0	13.1	24.9	17.5	10.5	9.5	20.0	16.0
Venous and capillary whole blood	4.0	------	------	------	1.4	------	------	------	1.7	------	------	------
Not stated	14.3	8.9	.1	18.9	20.6	26.3	.1	21.5	33.8	5.6	.3	31.8

Figure 2. Diabetes screening projections to 1968



capillary whole blood was used for 10 percent, venous and capillary whole blood for 4 percent, and venous plasma for 2 percent. The type of blood used was not stated for 14 percent of the population tested in 1963.

Venous plasma was used principally in conjunction with the use of the AutoAnalyzer. Plasma samples are processed with less difficulty on the AutoAnalyzer than are whole blood samples. However, the use of plasma has created some difficulty in interpretation of results since plasma tested on the AutoAnalyzer produces consistently higher results than does whole blood. Critical levels should be adjusted for these differences (*2*).

Discussion

The challenge to public health workers to detect the 2 million or more persons with unknown diabetes is great. To assist in meeting this need, more public health programs are increasing their diabetes activities.

Community organizations, casefinding, referral of positive cases, and provision for followup and educational services are necessary for effective diabetes screening programs. These are also skills which are available in most public health agencies.

Considerable progress has been made in recent years. Screening for diabetes has become an integral part of the activities of many State and local areas. It has been a forerunner of activities in screening for chronic disease. Our knowledge of techniques, procedures, and the most effective use of equipment is greater today. In addition, persons thought to be susceptible to diabetes can be identified.

With this battery of skills and knowledge, one might ask why current diabetes screening activities seem to be identifying so few new cases—few in comparison to the estimate of the problem.

It is apparent through analysis of our data and information from other sources involved in identifying and diagnosing diabetic persons that we have just begun to undertake this task.

Emphasis must be directed toward increasing dramatically the number of persons tested for diabetes and toward testing those most susceptible—older people, the obese, those with a family history of diabetes, and those with previous symptoms or positive blood tests. Greater effort is required to disseminate more rapidly current information and data relative to the effectiveness of various techniques, procedures, and equipment. Case yields from most programs, as seen in this report, do not reflect the application of the best techniques to the most susceptible persons.

Community organization and education can stress the characteristics of persons who should be tested, pointing out that since diabetes is not likely to be found among the very young, there is no need to test this group unless there is a family history of diabetes. The local medical society can do much through its recommendations to encourage the high-yield groups to participate in the screening program.

Between 1962 and 1963, the numbers of persons tested for diabetes and reported to the Public Health Service increased by 56 percent, and the yield of new cases was 8.1 per 1,000 tested. Assuming that the numbers tested would increase at a rate of 56 percent per year for 5 years and that new cases were consistently identified at a rate of 8.1 per 1,000 tested, we could anticipate that approximately 12 million persons would have been tested between 1964 and 1968 but only 100,000 new cases would have been identified (fig. 2). While such progress would be notable, the contrast between the accomplishment and the need sharpens our recognition of the total problem.

The magnitude of undiagnosed diabetes among the population should not discourage us, however, since we do have the required knowledge and skills to identify most of these people. Staffing problems are always difficult, but increased use of automated equipment and improved procedures can do much to alleviate these problems.

Much encouragement can be obtained from review of the statistics presented in this report. The percentage increase in numbers tested is impressive. Much of this increase is noted in programs established in previous years and, therefore, represents a healthy expansion of activities. Techniques and procedures are improving as noted in the increase in the yield of new cases. Automated equipment is being used more frequently and widely in the time subsequent to the reporting period for these data. We are making progress in meeting an important public health problem.

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