Implications for public health programing

Diabetes Prevalence in the United States

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DIABETES is a chronic disease that presents a serious health problem; this problem manifests itself in many ways. Our paper concerns the number of known, unknown, and suspect cases in the United States.

Of the 2.3 million patients in the United States known to have diabetes, many are poorly informed about the disease. To control diabetes, the patient must know something about it and practice what he knows.

Despite the knowledge and techniques that are available to identify diabetics and bring them to treatment, many persons in the United States have diagnosable diabetes and do not know it. Although public health casefinding programs are expanding, they are inadequate and bring only a small percentage of the total unknown cases to diagnosis each year. Today's public health challenge is to stimulate and to conduct casefinding programs big enough to identify all the "hidden" or unknown cases of diabetes. We estimate, at a minimum, that 1.6 million cases could be diagnosed today if physicians examined their patients for the disease.

There also is an increasing awareness that a large number of people are progressing into diabetes. These persons cannot be easily identified because their condition cannot be diagnosed by present techniques, yet they may have the disease or be developing some of the more serious chronic conditions associated with it—obesity, complications of pregnancy, vision troubles and blindness, cardiovascular and renal disease, and other chronic complications. Techniques are needed that will successfully identify these persons.

Programs of preventive care, directed toward delaying the disease and its progression, must be developed and evaluated. The Public Health Service is encouraging and supporting such research, and many investigators in the United States and foreign countries are conducting related research; however, a great deal remains to be done. Helpful data are available from several sources in estimating the number of persons in the United States who could be recipients of public health action programs.

Known Cases

The estimated number of persons with diagnosed diabetes can be obtained from the Health Interview Survey of the National Center for Health Statistics, Public Health Service. This continuous survey of representative samples of households provides a current estimate in the noninstitutionalized population for fiscal year 1964 (see table). Information about chronic diseases is obtained in this survey from a household member or each family member if available. Although some cases may not be found, the data from such surveys can be assumed to estimate adequately the number of persons who acknowledge their disease and who might use the information or services provided by community health programs. Almost all the diabetic patients reported to the survey had received medical attention.

Studies conducted by the National Center for

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Health Statistics have indicated underreporting of chronic conditions as compared with medical records or physical examinations. However, according to these studies, the known cases of diabetes appear to be less underreported than most other conditions because of several factors: diabetes requires medical attention for diagnosis; the lay terminology is essentially the same as the medical terminology; it usually requires some kind of action, diet, or medication; and no stigma is attached to the presence of the disease.

The estimated number of diagnosed cases of diabetes is particularly useful when planning for programs for patient services including the development of educational materials to assist the patient in following his prescribed regimen of diet, medication, and exercise; for dietary and occupational counseling; and for nursing and other related services. Such estimates also could be helpful in planning for emergencies; for example, the required storage of insulin.

The rates in the table may be applied to population figures to obtain gross estimates of known cases in any community in the United States. These statistics also could be useful in developing a sense of awareness within the community concerning the kind of environment in which diabetics should live. Ideally, the residents would be informed and sympathetic toward the special problems of the diabetic, the comunity would assist them readily in emergencies, employers would recognize that they are good workers, and insurance companies would not deny them protection simply because of the diagnosis of diabetes.

Unknown Cases

Several years ago, the Public Health Service developed estimated rates of prevalence in the United States for unknown cases of diabetes. A national rate of 8.1 persons per 1,000 population for unsuspected or unknown cases was first published by Remein in 1959 (*1*). Age-specific rates for unsuspected diabetes, based on the same data, were published in 1964 (*2*). Both estimates were prepared from the rather limited data of isolated community studies.

In the intervening years, there have been no studies of populations representative of the country as a whole in which standard diagnostic techniques were used. Several studies are underway that may be helpful in making new estimates (*3–5*). The results of such studies, however, still are limited by populations that do not necessarily represent the total U.S. population.

The estimated rates of unknown cases of dia-

Estimated number of diagnosed and undiagnosed cases of diabetes and persons with elevated levels of blood glucose in the United States, by age groups

Age group (years)	Diagnosed cases, July 1963–June 1964 [1]		Undiagnosed cases, July 1964 [2]		Persons with elevated blood glucose levels, 1960–62 [3]			
					200 mg.—percent		180 mg.—percent	
	Number in thousands	Rate per 1,000	Number in thousands	Rate per 1,000	Number in thousands	Rate per 1,000	Number in thousands	Rate per 1,000
All ages	2,313	12.4	1,555	8.1	4,277	39.0	9,374	84.0
0–24	115	1.3	62	.7	[4] 73	5.0	[4] 173	11.0
25–44	319	7.0	243	5.2	689	15.0	1,872	41.0
45–54	346	16.2	390	17.9	756	37.0	1,695	82.0
55–64	646	39.6	404	24.2	1,149	73.0	2,352	150.0
65–74	585	52.6	299	26.2	1,040	93.0	2,436	218.0
75 and over	302	51.2	158	24.5	[5] 571	199.0	[5] 846	295.0

[1] Civilian noninstitutional population. Unpublished data, Division of Health Interview Statistics, National Center for Health Statistics, Public Health Service.
[2] Reference 2.
[3] Reference 9.
[4] Ages 18–24.
[5] Ages 75–79.

betes are useful. When applied to the U.S. population by age, a gross estimate of the total number of persons with unknown diabetes can be obtained. The rates, if applied to today's population, give a total of 1.6 million persons with "hidden" diabetes.

These rates are conservative estimates of the number of new cases of diabetes that will be diagnosed by practicing physicians after referral. They do not reflect the frequency of any defined criteria for diagnosis such as a specific interpretation of a standard glucose tolerance test. Because the rates indicate the number of new cases that may be identified by physicians, they are useful in evaluating community diabetes screening programs. When the age distribution of a screened population is known, the rates can be applied to obtain a gross estimate of the number of unknown cases of diabetes in the population. This figure can be compared with the number of new cases that are actually identified as a result of the screening program. While admittedly a crude approach, the procedure has been useful.

For the past few years it has become apparent that with good screening techniques, more new cases than the estimated number of unknown cases based on these rates can be identified. For example, when 15,000 unselected office workers were screened, it was estimated that 183 unknown cases would be found; however, 210 cases were identified. In this screening project, fewer persons under 50 years of age were found with diabetes than were expected, but more cases in persons age 50 and over were diagnosed. Such findings have been noted in projects where screening procedures have included quantitative tests of blood samples taken post prandially or after glucose loading, low criteria for interpretation of positive screenees with a retest before referral, and good followup procedures. The findings show that the estimated rates for unknown diabetes are conservative (*6*). It is recognized that the identification of new cases is influenced by the characteristics of the screened population, the screening procedures, and the changing diagnostic criteria used by practicing physicians.

Screening programs conducted throughout the United States have indicated probable characteristics of the 1.6 million unknown diabetics. Generally they are part of the older population, and obesity and a family history of diabetes are characteristic of the unknown group.

According to the Health Interview Survey for fiscal 1964, an estimated 325,000 persons in the United States consulted a physician and were told they had diabetes. Compared with the estimated 1.6 million unknown cases of diabetes, the magnitude of casefinding needed is emphasized. Also, in the 1965 fiscal year 35 States and territories, using blood-testing techniques, reported screening more than 700,000 persons. These projects brought to diagnosis more than 6,000 new cases (unpublished data on diabetes screening activity reported to the Diabetes and Arthritis Branch, Public Health Service, fiscal 1965.) Although such programs are expanding and testing procedures are improving, much greater effort is required to meet the nation's casefinding needs.

Suspect Cases

The identification of persons who could be considered "suspects," that is, those who are more likely to develop diagnosable diabetes, is of interest and value in planning diabetes programs in public health agencies. These suspects should be given information on the early symptoms of diabetes. They also should be tested periodically for blood glucose. As better and more efficient diagnostic tests and techniques are developed and evaluated, these persons can be identified and care made available to them.

In many areas, the relatives of diabetics, parents of large babies, and persons with the characteristics associated with diabetes have been placed in the suspect category. Recently, another important suspect group has been recognized in several programs. We have defined this group as persons with deviations from a normal carbohydrate metabolism, on one or more tests, who are not diagnosed as having diabetes but who have such deviations in tolerance to carbohydrates that they cannot be returned confidently to the nondiabetic population. Generally, the agencies that maintain contact with such persons include in the suspect category those who were positive, at a selected level, to the screening test but were not referred to a private physician because their retest was negative and those who were referred but were

not diagnosed by their physician as having diabetes.

Until recently, screening tests indicated only that a person's blood glucose reading was above or below an arbitrarily selected level. However, with automated equipment that gives quantitative results on blood glucose, a mechanism for identification of the suspect population is provided plus a record of the actual level of blood glucose for each person screened.

With the use of quantitative equipment in screening tests, it has been noted consistently that many persons with highly elevated levels of blood glucose do not necessarily retest positive, or if they are referred with a positive retest they are not necessarily diagnosed as diabetic. However, if the original test or retest showed sufficiently elevated levels, one could not confidently classify these persons in the "no diabetes" category. This concept has stimulated some programs to maintain contact with suspects on a continuing basis, as many new cases of diabetes have been detected when these persons were subsequently tested. In one large screening project based on 800 undiagnosed persons, tested within 2 years after showing elevated levels of blood glucose, the rate of new cases was 80 per 1,000 persons (*7*). Such data show that screening agencies have a continuing responsibility for testing suspect persons.

Quantitative results after screening for blood glucose have led to the identification of a population that will be particularly important in future public health diabetes programs. Not only will casefinding be possible at a lower cost, but this group can provide candidates for the application of new developments in preventive medicine.

There are no adequate estimates of the number of persons who can be considered diabetic suspects. Such estimates are not easily obtained, and agreement on definitions and criteria is difficult to reach (*8*).

Available data indicate that the number of diabetes suspects may be large. For example, the National Center for Health Statistics, which conducted a health examination on a representative sample of the U.S. adult population, has shown that elevated values of blood glucose (venous samples) frequently have been obtained in this population (*9*, *10*), 1 hour after they took 50 grams of a glucose drink. Other studies of populations less representative of the nation have shown similar results, but there are no critical levels for these modified tests that would generally be accepted as diagnostic.

Based on the health examination, it was estimated that 4.3 million adults, 18 to 79 years of age, have whole-blood glucose levels of 200 or more 1 hour after taking a 50-gram glucose drink, 6.6 million have levels of 190 or more, 9.4 million 180 or more, and 12.9 million 170 or more. Critical levels for the interpretation of initial screening tests are often set at points that will yield 5 to 10 percent of an unselected adult population. This is particularly true for projects in which it is possible to retest positives before referral. The number of new cases found per 1,000 persons tested increases by this combination of procedures. If one selected a level indicating that 5 to 10 percent of the adult population was positive and then examined the results of the health examination project, one would find 5 to 10 million persons with critical glucose levels of 180 or 200 mg. per 100 ml. of blood.

Arbitrarily selecting a point that gives a 5 to 10 percent yield of positive cases may seem to be an unusual approach, but it is appropriate to the situation that exists in the United States today, where so many cases of diabetes are unknown. In one of our large screening projects 10 percent of an unselected adult population tested positive 2 hours after a 75-gram glucose loading. Within a 2-year period, approximately one of four persons who screened positive had been diagnosed by his physician despite the fact that the followup of cases was incomplete. During the 2-year period, one of three had been diagnosed by his private physician or had a standard glucose tolerance test that was interpreted as diagnostic by accepted criteria (*8*).

Summary and Conclusions

Public health programing can provide needed services to the 2.3 million persons in the United States with known diabetes. Expanded and improved casefinding efforts will identify the large number of persons with diagnosable diabetes, a minimum 1.6 million persons.

The suspect population, or those persons showing deviations from normal carbohydrate

metabolism on one or more tests and who are not diagnosed as having diabetes, cannot confidently be returned to a "no diabetes" classification. Diabetes testing on a periodic basis should include not only testing for carbohydrate tolerance but also measurement of other parameters that are now available or are shown later to be useful in identifying the diabetic state. Diabetic patients would benefit from more information on the nature of the disease.

Screening tests that provide quantitative results permit identification of cases that require immediate referral, as well as the identification of a suspect group for continued followup, with a resulting yield of new cases. Quantitative test results also permit more flexibility in interpretation; for example, critical levels can be related to the time since the last meal.

More research is needed on improved techniques for diagnosis and early identification of diabetes and preventing the onset and complications of the disease. The new techniques or procedures could then be applied to suspect groups.

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Metabolic Research Unit for Phoenix Medical Center

A 25-bed unit, designed and staffed by the National Institute of Arthritis and Metabolic Diseases, will be the first research unit to be incorporated into a Public Health Service Indian hospital in the proposed new Phoenix Medical Center in Arizona.

The 200-bed center will be a referral facility providing diagnostic services and specialized treatment for 10 peripheral hospitals and 7 health centers in Arizona and Nevada, and 25 satellite clinics in Arizona, California, Nevada, and Utah which serve Indian tribes of those States.

The decision to place a research unit in the Phoenix hospital stemmed from recent studies which show that Pima Indians of the nearby Gila River Reservation have the highest rate of diabetes of any population on record. Research projects will include a wide range of metabolic disturbances, including gallbladder diseases, heart conditions, and cancer.