

## Diabetes in Industry

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In July 1952, the Committee on Employment of the American Diabetes Association published "Suggested Standards for the Employment of Diabetics." This committee of diabeticians sought the advice and guidance of several physicians with knowledge of, and experience in, the application of medicine to problems in industry. The statement is admirable in its simplicity, brevity and forthright presentation of basic principles.

Shortly after publication of the suggested standards, an effort was made to adapt the statement to the particular needs of this Company. A tentative policy statement was submitted to members of the medical staff. It was also sent to five competent diabeticians having a known diversity of view with regard to the control of diabetes. No unanimity of opinion could be reached about a number of basic issues. The tentative statement of policy will not be reproduced here, but a few of the problems encountered will be mentioned.

First, in spite of tremendous strides in the control of diabetes with demonstration in many clinics of a marked diminution in the frequency and severity of complications, there are still many diabetics who fare poorly. It is not possible, therefore, to assure management or insurance underwriters that the willful addition of diabetics to an employee group will not adversely affect sickness and permanent disability costs.

Second, while it is recognized that close cooperation with the employee's physician is desirable, any statement by the physician regarding the suitability of the candidate for the job in question is of limited value. The physician is not acquainted with the demands of the job and must ultimately base his recommendations upon what the worker tells him. This is likely to reflect the patient's eagerness for the job, rather than objective facts. To the physician in industry, on the other hand, is delegated full responsibility for the safe assignment of workers. Discharge of this responsibility requires independent judgment and control.

Third, agreement upon criteria for the adequacy of

diabetes control was totally lacking. The comments of Soskin regarding this problem are of interest.<sup>5</sup> Inasmuch as many physicians located in widely separated areas are involved, any attempts to establish criteria (either liberal or conservative) lead to strained relations between the physician in industry and the worker's doctor. This is not in keeping with the patient's best interests.

Fourth, it was agreed that workers requiring some dosage of insulin should be restricted from situations in which hypoglycemic episodes might endanger the worker or his confreres. Some thought such restrictions were important if the worker took any insulin, while others thought 40 units did not necessitate restrictions.

Finally, the physical demands made of workers and the conditions of work vary tremendously from one industry to another and even widely within one and the same industry. In petroleum refining, for example, plants must be kept operating on an "around-the-clock" basis 365 days per year. Shift work is an integral part of the working situation. A surprisingly large percentage of workers engage in maintenance operations—almost all crafts and trades are represented. The operation of heavy mechanical equipment and the use of a fabulous variety of tools are required. With rare exceptions, new recruits for employment begin at a uniform level. Progression is by way of fairly stereotyped channels which require a wide variety of physical capacities and abilities. It is not in the interest of the individual worker, his fellow employees, or management to begin this career progression with physical limitations that preclude the worker's traveling a reasonable portion of the course. Management is probably unwise, under such circumstances, to choose for employment an individual with "uncorrectible physical defects or disorders" if a reasonably adequate candidate is available without such limitations.

Dublin and Marks<sup>3</sup> have pointed out that "the problem of diabetes in industry stems not from the applicant for employment, but from the employee who has been in service for a long period." Inasmuch as a number of employees become diabetic during the course of employment, it was decided to review the experience with these workers, hoping thereby to clarify some of the problems.

The employee population studied consisted of approximately 27,000 workers (predominantly white males)

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From the Esso Standard Oil Company, New York, New York.

scattered over some twenty states east of the Mississippi River. Diabetic employees coming to the attention of the examining physicians were the subject of a special brief evaluation for the purpose of this report. No attempt was made to evaluate retroactively former employees who were deceased or on annuitant status at the time of this study.

## PREVALENCE OF DIABETES

Data were collected from each of the Company locations with full-time medical services.\* In table 1, the number of known cases in each unit is compared with the employee population at midyear (1956).

The percentage of the employee group with diabetes is approximately proportional to the average age of employees in the several groups. The correlation is not exact since the average age of any two groups might be similar in spite of differences in the age distribution within two such groups. This interpretation is confirmed by the data in table 2. The over-all prevalence of 1.3 per cent seems reasonable in view of the fact that this is a select group, each of whom may be assumed to have had no major defects at the time of employment.

## WHEN AND HOW DIAGNOSIS WAS ESTABLISHED

Some previously unrecognized diabetics were discovered in each age group during the course of employment. Most cases, however, were recognized after thirty-five years of age, with a definite peak of incidence in the forty-five- to sixty-year age group. (See table 3.) †

Four out of five were devoid of symptoms or physical signs of diabetes at the time of discovery. Most of these were recognized in the course of periodic health examinations (66.0 per cent), usually by the plant physician, while 13.3 per cent were found during the course of treatment (usually in a hospital) for other and unrelated medical problems (fractures, hernia repairs, etc.).

Visual disturbances, weight loss, polydipsia, polyuria, caused 18.4 per cent to seek medical advice either in the plant dispensary or from their family physicians. Thus, only one in five was brought to the attention of the physician; he found four of every five cases by the simple routine of urinalysis, later confirmed by blood sugar studies. Inasmuch as such examinations are usually on an

\*The author wishes to acknowledge with gratitude the cooperation of these physicians.

† Table 3 and subsequent tables provide data on 315 cases. These additional cases were females, nonwhites and annuitants not included in the previous tabulation.

TABLE 1

Prevalence of diabetes according to average age and location

	Male employee population 6/30/57	Number of diabetics	Per cent of diabetics	Average age
Everett Refinery (Massachusetts)	507	13	2.6	45.2
New Jersey Marketing (Elizabeth, N.J.)	900	14	1.6	44.5
Charleston Refinery (South Carolina)	66	1	1.5	44.5
Baton Rouge Refinery (Louisiana)	6,899	86	1.3	43.9
Bayonne Refinery (Bayonne, N.J.)	1,835	41	2.2	43.6
Bayway Refinery (Elizabeth, N.J.)	3,958	35	0.9	42.2
New York Marketing Del.—Md.—D.C.	790	6	0.8	41.4
Marketing New York "15,"	806	11	1.4	41.1
New York City	1,074	26	2.4	41.0
Louisiana Marketing	371	4	1.1	40.9
North Carolina Marketing	635	6	0.9	40.8
Baltimore Refinery (Maryland)	1,374	11	0.8	40.0
Virginia—West Virginia Marketing	815	10	1.2	39.6
South Carolina Marketing	436	2	0.5	38.2
Totals	20,466	266	1.3	42.6

annual or biennial basis, it seems improbable that many of the asymptomatic cases were of long standing. The detailed diagnostic studies outlined by Sisk et al.<sup>4</sup> are not practicable when dealing with a large employee population.

One might ask if any clues could arouse suspicion,

TABLE 2

Prevalence of diabetes according to age

Age	Male employee population 6/30/56	Number of diabetics	Per cent of diabetics
15 to 20	30	0	—
20 to 25	506	2	0.4
25 to 30	1,829	4	0.2
30 to 35	3,191	7	0.2
35 to 40	3,366	18	0.5
40 to 45	2,924	26	0.9
45 to 50	2,594	42	1.6
50 to 55	2,444	54	2.2
55 to 60	2,208	63	2.9
60 to 65	1,374	50	3.6
Totals	20,466	266	1.3

TABLE 3

When and how diagnosis was established

Age when discovered	Number	Per cent	Periodic examination by company physician Per cent	Asymptomatic		Symptomatic Per cent	Unknown Per cent
				Armed services, insurance, and other Per cent	In connection with other illness Per cent		
15-20	2	0.6	0	1	0	1	0
20-25	4	1.3	0	3	0	1	0
25-30	9	2.9	3	1	1	4	0
30-35	20	6.3	11	2	5	2	0
35-40	35	11.1	23	2	3	7	0
40-45	37	11.8	21	3	2	11	0
45-50	69	21.9	44	5	10	9	1
50-55	59	18.7	26	4	12	13	4
55-60	52	16.5	38	0	5	9	0
60-65	26	8.3	19	2	4	1	0
Unknown	2	0.6	0	0	0	0	2
Totals	315	100.0	58.8	7.3	13.3	18.4	2.2

permitting earlier recognition of the disease. In this regard, the family history was examined in each instance. Only slightly more than one fourth of the total group (27.9 per cent) had definite knowledge of other cases in their immediate family. (See table 4.)

In these instances, the parents (51.1 per cent), grandparents (9.1 per cent), and aunts and uncles (11.4 per cent) accounted for roughly three quarters of the relatives having the disease. (See table 5.)

#### THE CLINICAL COURSE OF THE DISEASE

Some might question whether the finding of these asymptomatic cases made any positive contribution to the subsequent health and welfare of the individuals. Possibly one is dealing with laboratory data of little real

clinical importance. While modes of therapy vary considerably, it seemed likely that the need for insulin to bring about or to maintain control could be used as a measure of the clinical severity of the disease. In table 6, it will be noted that approximately three quarters of these employees did require insulin therapy.

The larger percentage of such cases was found in the group without knowledge of other cases in their family. The fact of insulin therapy did not necessarily reflect better control of the disease. (See table 7.) This, of course, is not surprising since many other factors are important in the control of diabetes.

TABLE 4

Was there family history of diabetes?

	Number	Per cent
Yes	88	27.9
No	195	61.9
Uncertain	32	10.2
Totals	315	100.0

TABLE 5

Which relative had history of diabetes?

	Number	Per cent
Parents	45	51.1
Grandparents	8	9.1
Aunts & uncles	10	11.4
Siblings	22	25.0
Other or unknown	3	3.4
Totals	88	100.0

TABLE 6

Was insulin required for control?

	Yes Per cent	No Per cent
Positive family history (88)	59.1	40.9
Negative family history (195)	82.6	17.4
Unknown family history (32)	62.5	37.5
Totals	74.0	26.0

TABLE 7

How nearly adequate was control of diabetes?

	Insulin		No insulin		All	
	Number	Per cent	Number	Per cent	Number	Per cent
Excellent	26	11.2	18	22.0	44	14.0
Good	103	44.2	27	33.0	130	41.3
Fair	66	28.3	19	23.0	85	27.0
Poor	24	10.3	9	11.0	33	10.5
Not known	14	6.0	9	11.0	23	7.2
Totals	233	100.0	82	100.0	315	100.0

DIABETES IN INDUSTRY

TABLE 8

Percentage of diabetic employees with cardiovascular-renal disease and obesity\*

Control	Insulin-treated		No insulin		All	
	Cardio-vascular-renal Per cent	Obesity Per cent	Cardio-vascular-renal Per cent	Obesity Per cent	Cardio-vascular-renal Per cent	Obesity Per cent
Excellent	15.4	30.8	22.2	75.0	18.2	25.0
Good	18.4	26.2	29.6	14.8	20.8	23.8
Fair	37.9	40.9	57.9	36.8	42.4	40.0
Poor	45.8	54.2	44.4	44.4	45.5	51.5
Unknown	21.4	14.3	55.6	33.3	34.8	21.7
All	26.6	33.0	39.0	25.6	29.8	31.1

\*15 per cent or more in excess of height-weight data provided by Metropolitan Life Insurance Company tables.

The occurrence of cardiovascular-renal disease and/or obesity is of interest. While the numbers are small, it is of interest that cardiovascular disease was roughly 50 per cent more prevalent in those not receiving insulin. (See table 8.) Obesity, on the other hand, was more common among those requiring insulin (33 per cent compared with 25.6 per cent).

KINDS OF WORK ASSIGNMENTS

In very few instances was the advent of diabetes a cause for job reassignment. The comment was frequently made, however, that if a promotion or reassignment were necessary for managerial reasons, limitations might have to be imposed by the medical department. In table 9 are tabulated the various kinds of jobs in which these workers were productively engaged. No particular significance can be attributed to the actual numbers assigned to various kinds of work since these merely represent the jobs occupied at the time the diabetes was discovered. It is of interest, however, that workers con-

TABLE 9  
Job assignments

Boilermaker	8
Carpenter, painter, etc.	8
Chemist, laboratory technician, etc.	7
Clerical, office, etc.	87
Cook, chef, etc.	2
Electrician, mechanic, etc.	19
Engineer	8
Guard	8
Janitor	4
Laborer	66
Machinist	17
Mason, insulator	5
Motor tank sales (drivers)	12
Process operators, stillman	33
Pipefitter, welder	16
Plantman	5
Pumpman	3
Salesman (drivers)	7
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	315

tinued satisfactorily in both sedentary jobs and heavy physical labor.

Approximately 10 per cent of the total group was restricted. (See table 10.)

TABLE 10  
Frequency and cause for restrictions

	Number	Per cent of diabetics
Diabetes	10	3.2
Vascular disease	23	7.3
Coronary insufficiency	12	3.8
Hypertensive cardiovascular disease	7	2.2
Arteriosclerosis obliterans	2	0.6
Cerebral arteriosclerosis	1	0.3
Cataracts	1	0.3
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	33	10.5

Only ten workers (3.2 per cent) were restricted because of their diabetes. The possibility of insulin reactions required assignment of eight workers in vocations where they were not likely to injure themselves or others if such reactions occurred. The other two could not be adequately controlled during the irregularities of shift work. (See table 11.)

TABLE 11  
Nature of restrictions

	Number
No climbing or working at unprotected heights	5
No driving of company vehicles	3
No shift work	2
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	10

Most restrictions were imposed for cardiovascular-renal disease. These were the same as in other workers with similar vascular disease but without diabetes.

## MORBIDITY AND MORTALITY

The premature and unexpected loss of an employee's services through death or premature medical retirement is costly to industry. Management is obviously concerned about the acceptance of applicants for career employment posing such a risk unless such applicants provide unusual abilities that warrant the added risk and cost. A review of morbidity and mortality experience is not presented at this time, but such a study is under way. Two obstacles confront one gathering data: (1) The numbers available for study are small; and (2) these workers have received varying degrees of supervision under many different philosophies of control.

Casual observations suggest that diabetes is not an infrequent complication of other disease (particularly vascular disease) which "tips the scale" in favor of premature medical retirement. Diabetes alone, however, is not the cause of such disability or death, in our experience.

## ARE DIABETICS SATISFACTORY EMPLOYEES?

Diabetes is no respecter of persons. It occurs among serious-minded, competent workers and among those who are nonproductive. The occurrence of diabetes has no effect on underlying personal traits. Efforts to relate work proficiency, accident rates, absenteeism, problem drinking, etc., to the diabetic state are not likely to reveal any startling findings. Weaver and Perret, in a detailed study<sup>6</sup> of about one third the cases reported here, found the average time lost due to illness essentially the same as among nondiabetic employees.

## DISCUSSION

A small percentage (1.3 per cent) of ostensibly normal workers developed clinically significant diabetes mellitus. A careful family history might have made possible the exclusion of approximately one fourth (27.9 per cent) of these individuals from employment. Exclusion on this basis would, however, undoubtedly have led to the refusal of employment to many others who did not develop clinically significant diabetes—how many was not determined in this study.

Fortunately, more than three fourths of these cases appeared after forty years of age. Work assignments had usually become stabilized and were not incompatible with the diabetic state. The advent of insulin therapy in a few instances was thought to warrant restriction of individuals from driving Company vehicles or working about heavy or potentially hazardous machinery. A number of conscientious diabetics could probably work safely even under such circumstances. It is a terrific responsibility, however, for any plant physician to approve such

assignments. Fortunately, the problem arose surprisingly infrequently. Restriction of work assignment was sometimes necessitated by concomitant vascular disease. In these instances, the restrictions were no different from those imposed on workers with similar vascular disease, but without diabetes.

Much of the data point up the importance of an adequate occupational health program. Early detection of asymptomatic cases was most frequently the result of periodic health examinations. Proper education of the diabetic (as a part of an over-all health education program) is important. Cardiovascular-renal disease was more common among those not receiving insulin even though control seemed adequate at the time of periodic health audits. Obesity was more common among those requiring insulin therapy. The findings and conclusions are remarkably similar to those of Brandaleone and Friedman.<sup>2</sup>

We believe the data do provide useful clues to job placement of younger diabetics seeking employment. Diabetics should not be hired where normal advancement requires rotation through assignments necessitating the operation of motor vehicles, fast-moving or heavy machinery. Nor should shift work be essential in the course of their careers. Failure to assume a fair share of the "graveyard" shift is not looked upon favorably by fellow workers. The desire of most shift workers to rotate at relatively short intervals (one or two weeks) makes an adjustment of eating and insulin schedules complex and incompatible with optimal diabetic control.

On the other hand, diabetes does not preclude productive employment as evidenced by the experience reported in this study. Physicians responsible for the control of young diabetics, however, would do well to counsel them on the choice of careers, keeping in mind the limitations outlined above.

## CONCLUSIONS

1. Diabetes was present among 266, or 1.3 per cent, of approximately 20,000 petroleum workers.
2. The diagnosis was more common in the older age groups.
3. Approximately 80 per cent of the cases were asymptomatic when discovered.
4. A family history of diabetes was elicited in only 27.9 per cent of these workers.
5. In 74 per cent of the cases, insulin therapy was required for control.
6. In 55.3 per cent of the cases, control was considered "good" or "excellent" while 37.5 per cent were only "fair" or "poor."

7. Clinically significant cardiovascular-renal disease was present in 29.8 per cent of the workers (26.6 per cent of those receiving insulin and 39.0 per cent of those not receiving insulin).

8. Obesity (15 per cent or more in excess of Metropolitan Life Insurance Company standards) was present in 31.1 per cent of the cases (33.0 per cent of those on insulin therapy and 25.6 per cent of the remaining group).

9. A wide variety of job assignments was carried on satisfactorily by these workers.

10. Restrictions because of the diabetes were limited to ten workers (3.2 per cent of the total group) receiving insulin. These restrictions usually precluded the driving of Company vehicles and the operation of fast-moving or heavy machinery.

11. Restrictions because of concomitant cardiovascular-renal disease were more common (twenty-three employees, or 7.3 per cent of the group). These restrictions were the same as in instances of cardiovascular-renal disease not complicated by diabetes.

12. Those responsible for the care of young diabetics might well counsel them to prepare for vocations where the operation of machines, shift work, etc., is not important at the time of employment or during the subsequent course of advancement.

#### SUMMARIO IN INTERLINGUA

##### *Diabete In Le Industria*

1. Diabete esseva presente in 266 ex circa 20.000 obreiros de petrolieria. Isto es un incidentia de 1,3 pro cento.

2. Le diagnose de diabete esseva plus frequente in le gruppos de etate plus avantiante.

3. Circa 80 pro cento del casos esseva asymptomatic al tempore de lor detection.

4. Un historia familial de diabete esseva obtenite in solmente 27,9 pro cento del casos positive.

5. In 74 pro cento del casos, therapia a insulina esseva requirite pro effectuar un control del diabete.

6. In 55,3 pro cento del casos le control effectuate esseva considerate como "excellente" o "bon," durante que in 37,5 pro cento illo esseva solmente "satis bon" o

"non satisfactori."

7. Grados clinicamente significative de morbo cardiovascular-renal esseva presente in 29,8 pro cento del patients (i.e. in 26,6 pro cento de illes recipiente insulina e in 39,0 pro cento de illes non recipiente insulina).

8. Obesitate—amontante a 15 pro cento o plus secundo le standards del Metropolitan Life Insurance Company—esseva presente in 31,1 pro cento del casos (i.e. in 33,0 pro cento del patients recipiente insulina e in 25,6 pro cento del patients non recipiente insulina).

9. Un grande varietate de typos de labor esseva executate satisfacientemente per iste obreros.

10. Restrictiones in le genere de labor a executar esseva applicate a solmente dece obreros (i.e. 3,2 pro cento del gruppo diabetic total). Omnes pertineva al gruppo sub tractamento con insulina. Iste restrictiones, a generalmente parlar, prohibiva le conduction de vehiculos del compania e le manipulation de machinas pesante o a motion rapide.

11. Restrictiones a causa de concomitante morbo cardiovascular-renal esseva plus commun. Illos afficeva 23 obreros (i.e. 7,3 pro cento del gruppo total). Iste restrictiones esseva identic con illos usate in casos de morbo cardiovascular-renal sin complication per diabete.

12. Le individuos responsabile pro le curatela de juvene diabeticos deberea recommendar a illes le preparation pro typos de labor in que le manipulation de pesante machinas, le conduction de vehiculos, etc., non es importante al initio del empleo o durante le curso subsequeunte de avantiamento.

#### REFERENCES

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<sup>3</sup> Dublin, L. I., and Marks, H. H.: The diabetic in industry and his employer. *Ind. Med. and Surg.* 19:279-82, 1950.

<sup>4</sup> Sisk, W. N., Locher, K. A., and Titus, E. I.: The value of early diabetes detection. *Ind. Med. and Surg.* 27:39-42, 1958.

<sup>5</sup> Soskin, S.: Diabetes: Its relation to industry. *Ind. Med. and Surg.* 23:106-07, 1954.

<sup>6</sup> Weaver, N. K., and Perret, J. T.: Personal communication.