Dischargees from the State Mental Hospital were evaluated for traffic accidents and violation rates both before and after hospitalization and rates were matched to appropriate comparison groups that were not hospitalized. Rates were higher as a group than the matched comparison groups; however, some subgroups improved after discharge. Single-car accidents occurred almost solely in the hospitalized group. Other findings point to the need for more sophisticated programs to control death and disability on the highway.

A STATISTICAL STUDY ON THE RELATIONSHIP BETWEEN MENTAL ILLNESS AND TRAFFIC ACCIDENTS— A PILOT STUDY

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Introduction

MANY restrictions relate to drivers but there were few data available to warrant some of these. For example, North Dakota requires dischargees of the State Mental Hospital to report to the Safety Responsibility Division of the State Highway Department, although it has never been adequately shown that mental illness is a handicap to safe driving. This assumption has not been adequately tested with the use of basic epidemiologic techniques.

Methods

In the summer of 1965, under the auspices of the North Dakota State Department of Health and through a United States Public Health Service Traineeship Grant, a pilot study was initiated to determine if any difference exists—with respect to the number of traffic violations and the number of traffic accidents—between a selected group of patients discharged from the North Dakota State Hospital and a comparison group selected from the general population. We obtained the driving records of 238 dischargees of the Jamestown Mental Hospital for a particular year (1960). They were matched by age, sex, and county of residence with 290 comparison subjects* from records chosen at random by the Safety Responsibility Division of the State Highway Department. Data for each individual were put on IBM punch cards and the driving records of the two groups

* Names appearing on the State Hospital records from the comparison group were dropped from the study. Additional names were dropped to obtain the desired number of age, sex, and geographical distributions for each diagnostic category.

Table 1—Experimental subjects by diagnosis and sex, Jamestown State Hospital, North Dakota, 1960

	No. of males	No. of females
Alcoholics		
a) Sociopathic personality disturbance—alcoholism	94	2
b) Acute brain syndrome with alcoholic intoxication	11	0
c) Chronic brain syndrome with alcoholic intoxication	4	0
d) Personality trait disturbance with alcoholism	3	0
Psychotics	45	26
Psychoneurotics	11	4
Personality disorders (not associated with alcoholism)	13	2
Chronic brain syndrome	5	0
Mental deficiencies	4	0
Without diagnosis or diagnosis unavailable	4	0
Totals	194	34

were analyzed and compared for periods both before and after 1960. For those qualified to drive, 1949 and 1965 were considered the cut-off years of experience of driving. For younger individuals the first date of driver licensure was used.

The driver was considered to be still driving if we had either no knowledge of failure to renew license, or of death, or that he had moved from the state.

Time in the hospital was subtracted from the total driving experience of the patients. Accidents and violation experiences were computed in terms of per hundred driver-years for five diagnostic categories (male alcoholics, male psychotics, female psychotics, male psychoneurotics, and male personality disorders) and their matched comparison groups. Data were also analyzed by type of violation and type of accidents for each diagnostic category and compared with periods both before (1949-1960) and after (1961-1965) hospitalization. Only significant findings will be outlined.

Findings

Table 1 depicts the number, diagnosis, and sex of the experimental group. Male alcoholics represent nearly half (49%) of the experimental subjects. Psychotics (male and female) make up nearly one-third (32%) of the group. There is perhaps too small a number in each of the five remaining categories, but psychoneurotics and personality disorders were included to establish a suggestion of a trend. Chronic brain syndrome, mental deficiencies, and diagnosis unknown were not included in the analysis.

Table 2 depicts the mean and median

Table 2—Birth years of subjects: experimental and match comparison subjects by diagnosis, sex, mean and median birth years, state of North Dakota, 1960

Group	Mean birth year	Median birth year
Alcoholics—experimental (male)	1918	1916
Matched comparison	1917	1915
Psychotics—experimental (male)	1926	1925
Matched comparison	1925	1926
Psychotics—experimental (female)	1926	1929
Matched comparison	1925	1928
Psychoneurotics and personality disorders—experimental (male)	1927	1928
Matched comparison	1927	1932
Total experimental males	1920	1920
Matched comparison	1921	1922
Total experimental females	1926	1928
Matched comparison	1925	1928

birth year for both the experimental and matched comparison group by diagnosis and sex. There is close agreement by age for the experimental and comparison subjects with the exception of the psychoneurotic and personality disorders. The matched comparison group is younger than the experimental subjects (median birth years 1928 versus 1932). Experimental and comparison subjects also were matched by geographic residence (Figure 1). Only 6 out of the 53 counties are not represented among the experimentals, while 7 of the counties are not represented among the comparison subjects. In general the patients and comparisons tend to follow the general population distribution of the state which is more heavily populated in the eastern counties.

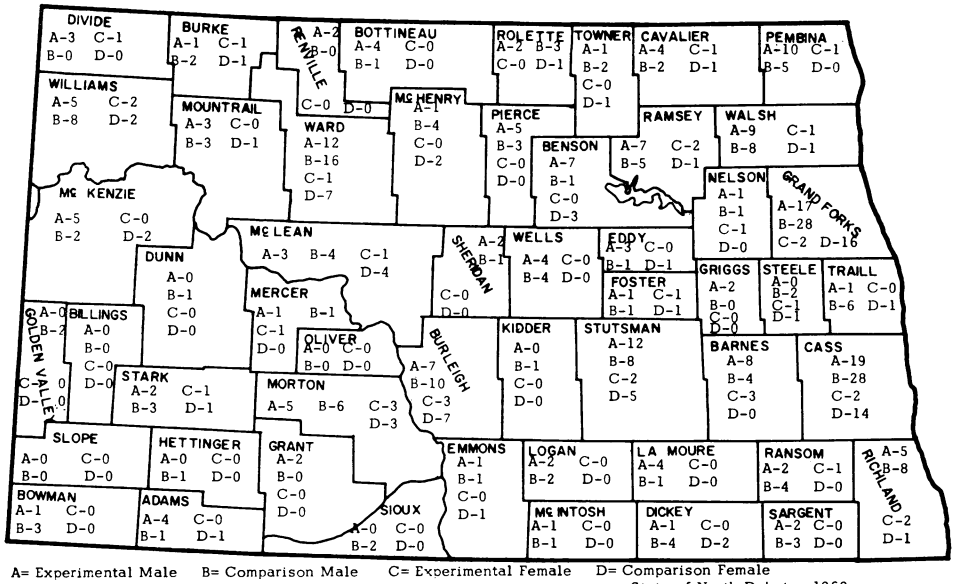
Table 3 reveals the accident rate per hundred driver years and the ratio between experimental and comparison groups before and after 1960. Although alcoholics had a poorer accident record after discharge (10.7 versus 12.7/HDY*) they compared more favorably with the general population (ratios of experimental to comparison groups, 1.59 before versus 1.15 after). All matched comparison subjects increased their accident rate from the pre-1960 level. The reasons for this are not clear.

Psychotics and psychoneurotics had a greater accident ratio (greater than 1) before 1960, but after discharge they actually were safer drivers than the matched comparison subjects (ratio less than 1).

As expected, personality disorders had the highest accident rate (35.1/HDY) of the experimentals before 1960 and tended to show minimum improvement after discharge (29.7/HDY). Females responded to hospitalization regardless of diagnosis by marked reduction in accidents (ratio 2.69 versus 0.33) after discharge. Males actually had a worse

* Hundred driver years.

Figure 1—Geographical distribution of experimental and comparison subjects by county of residence and sex



A= Experimental Male B= Comparison Male C= Experimental Female D= Comparison Female

State of North Dakota, 1960

Table 3—Accident rates per hundred driver years* and ratio between diagnosed experimental and matched comparison subjects, before and after 1960, state of North Dakota, 1966

Category	Accidents before 1960 per HDY	Ratio between experimental and control before 1960	Accidents after 1960 per HDY	Ratio between experimental and control after 1960
Alcoholics—male	10.7	1.59	12.7	1.15
Matched comparison	6.75		11.0	
Psychotics—male	10.4	1.35	9.15	0.89
Matched comparison	7.73		10.3	
Psychotics—female	9.26	1.94	3.20	0.35
Matched comparison	4.79		9.18	
Psychoneurotics—male	19.0	2.22	5.56	0.51
Matched comparison	8.54		10.9	
Personality disorders—male	35.1	∞	29.7	6.09
Matched comparison	0.0		4.88	
Total experimental—males	12.0	1.72	12.7	1.23
Total matched comparisons	7.0		10.3	
Total experimental—females	12.9	2.69	3.3	0.33
Total matched comparisons	4.8		9.9	

* Driving experience was computed by dates first licensed and/or the driving age of that person going back only to 1949 when accurate records were first kept. Total hospitalization time was subtracted from the experimental group.

accident rate after discharge (12 versus 12.7/HDY) but did not increase their accident proneness as fast as the general population (ratio 1.72 versus 1.23).

Table 4 reveals the violation rate per hundred driver years and ratio between diagnosed experimental and matched comparison groups before and after 1960. Violation rates tended to increase for both the comparison and experimental subjects from pre-1960 to post-1960. For alcoholics, violations increased after discharge but at a lesser rate than the matched comparison subjects, giving a more favorable ratio (2.03 versus 1.66).

Male psychotics increased their violations faster than the matched comparison (1.25 versus 2.57) while female psychotics improved (1.27 versus 0.81). The reasons for this are not clear, especially in the face of the male psychotics' superior accident record compared to the general population. This may be related to our society's definition of deviancy and our harassment thereof.

Male psychoneurotics followed a similar pattern to that of male psychotics. However, the personality disorders had an inordinately large number of violations both pre- and post-1960, consistent with their diagnosis and younger age, with a ratio of 5.75 versus 6.67. Again total females tended to improve after 1960 (2.84 versus 1.45) while total males got worse (1.90 versus 2.06).

It is interesting that, even though violations after 1960 were increased with greater frequency by psychotics and psychoneurotics, their accident rates improved. In the matched comparison, on the other hand, violations did not rise as much pre- and post-1960, while their accident records tended to become worse after 1960.

Alcoholics increased their violation rate (23.9 versus 30.1/HDY) but at a

Table 4—Violation rates per hundred driver years and ratio between experimental and matched comparison subjects before and after 1960, state of North Dakota, 1966

Category	Violations before 1960 per HDY	Ratio between experimental and control before 1960	Violations after 1960 per HDY	Ratio between experimental and control after 1960
Alcoholics—male	23.9	2.03	30.1	1.66
Matched comparison	11.8		18.1	
Psychotics—male	12.8	1.25	28.0	2.57
Matched comparison	10.2		10.9	
Psychotics—female	3.71	1.27	4.26	0.81
Matched comparison	2.93		5.24	
Psychoneurotics—male	25.0	1.22	25.0	3.84
Matched comparison	20.5		6.52	
Personality disorders—male	68.4	5.75	97.3	6.67
Matched comparison	11.9		14.6	
Total experimental males	22.8	1.90	32.0	2.06
Total matched comparisons	12.0		15.5	
Total experimental females	6.8	2.84	7.4	1.45
Total matched comparisons	2.4		5.1	

slower pace than the comparison group (ratio 2.03 versus 1.66) after 1960, although their accident rate tended to improve slightly (see Table 3).

Increasing violations by the personality disorders had little effect on their accident rate. Otherwise, police and court actions do little to affect accident and violation records for alcoholics and personality disorders. Increasing violations to the matched comparison subjects also had minimal impact in decreasing the rising accident rate.

As revealed in Table 5, alcoholics are more likely to have violations such as "driving while intoxicated" (DWI), with concomitant severe penalties such as driver's license revocations and/or

Table 5—Violations for alcohol causes before and after hospitalization by diagnosis

Diagnosis	Total no. cases	DWI* before 1960	DWI after 1960	Other alcohol before 1960	Other alcohol after 1960	Total violations
Male alcoholics	112	76	36	30	14	156
Male psychotics	45	3	2	2	0	7
Male psychoneurotics	11	1	4	2	0	7
Female psychotics	26	0	0	0	0	0
Personality disorders—male	13	10	8	4	2	24
Other diagnosis—male	13	6	0	1	1	8
Other diagnosis—female	8	0	2	0	2	4

* Driving while intoxicated.

Table 6—Single-car accidents per hundred driver years by diagnosis and matched comparison subjects before and after 1960, state of North Dakota, 1966

Category	Total before 1960	SCA rate/HDY before 1960	Total after 1960	SCA rate/HDY after 1960
Alcoholics—male	22	2.1	7	1.56
Matched comparison	0	—	1	0.22
Psychotics—male	8	2.32	4	2.44
Matched comparison	0	—	1	0.58
Psychotics—female	1	0.93	0	—
Matched comparison	0	—	0	—
Psychoneurotics—male	2	2.0	1	2.86
Matched comparison	0	—	0	—
Personality disorders—male	1	1.76	2	5.40
Matched comparison	0	—	0	—
Total experimental males	36	2.1	17	2.3
Total matched comparisons	0	—	2	0.26
Total experimental females	2	1.4	0	—
Matched comparisons	0	—	0	—

jail sentences. Also, compared to other diagnoses, alcoholics have repeated (second, third, and fourth DWI) offenses, even in the face of severe punishment actions. Other diagnostic categories are less likely to have repeated offenses after one punitive action. It is obvious that we need a different kind of treatment for such cases if we are going to truly improve the present social situation.

Table 6 depicts the striking difference between single-car accidents in the experimental and comparison subjects. There were a total of 55 single-car accidents among the hospitalized groups and only two in the matched comparisons. In North Dakota, 60 per cent of all traffic deaths annually are credited to single-car accidents.*[6,7] In 1967, the North Dakota Legislature instructed the state toxicologist[8] to have blood specimens drawn from all persons who died as the result of motor vehicle accidents over a two-year period. Fifty-nine deaths involving single-car accidents were studied. They included 39 drivers, 18 occupants, and 2 of unknown relationship. The report of their blood alcohol analysis showed that 63 per cent of the victims, or 37 persons, had the minimum amount of alcohol in their blood or 0.1 of 1 per cent for legal intoxication. It showed that 74 per cent or 29 of the driver victims had at least the minimum of alcohol for legal intoxication. This is consistent with previously published reports.[9] In the single-car accident fatalities, the drivers' level of alcohol in the blood tended to be higher in the definite intoxication range (0.15% or greater) compared to other types of accident fatalities. Unfortunately, we do not have data on their prior driving experiences nor do we have a record of previous hospitalizations for mental causes. Care must be taken in comparing single-car accident fatalities with single-car nonfatal accidents.

One of the investigators (RCE) re-

* Single-car accidents represented 4,170 out of a total of 20,237 total accidents or 20 per cent of all accidents in 1967.

viewed the hospital records for 139 patients by their driving records (single-car, other motor vehicle and no accidents) to ascertain suicidal and homicidal tendencies. Table 7 summarizes the findings. There is a statistically significant difference at the 5 per cent level of confidence between suicide ideation for those with single-car accidents and those with only other motor vehicle accidents and/or no automobile accidents on their driving record. There is no significant difference for suicide attempts between patients with single-car accidents and other motor vehicle accidents, but there is a significant difference in suicide attempts between patients with single-car accidents and no accidents. There is no significant difference in homicide threat attempts and successes and the various driving categories.

Table 8 outlines pertinent comments and sources of error. Every attempt was made to obtain accurate data with the records we have available. It is a tedious and frustrating task. We assume the same kinds of errors also held true for the comparison subjects thereby somewhat canceling each other out. However, the significance of finding single-car accidents almost solely among the hospitalized group cannot be overlooked nor discounted.

Discussion

Waller[1] obtained a wealth of epidemiologic data when he analyzed 2,672 persons with known reported chronic medical conditions and a comparison sample of 926 California drivers studied by questionnaire. The medical sample was divided into seven medical categories: epilepsy—580; cardiovascular—231; diabetes—287; alcoholism—319; drug usage—352; mental illness—292; and miscellaneous—99. After examining the accident experience per 1,000,000 miles for each group of people with medical conditions. he concluded that (1) drivers with medical conditions had significantly higher accident and violation rates at all ages than did those in the comparison sample; (2) drivers in the comparison sample under the age of 30 and over the age of 59 had higher individual accident rates than those in the middle years.

Table 7—Suicidal and homicidal tendencies for 139 patients discharged from the Jamestown State Hospital in 1960 by their driving records (single-car accidents, other motor vehicle accidents, and no accidents)

Driving history	Total		Suicidal				Homicidal					
			Ideation		Attempts		Threats		Attempts		Success	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Single-car accidents	50	100	26*	52.0	11†	22.0	10‡	20.0	8	16.0	2	4.0
Other motor vehicle accidents	47	100	15	31.9	6	12.8	6	12.8	3	6.4	1	2.1
No accidents	42	100	9	21.4	2	4.7	8	19.0	2	4.7	0	0

* There is a significant difference at the .05 per cent level of confidence between suicide ideation for those with SCA and those with other motor vehicle accidents and/or no accidents.

† There is no significant difference for suicide attempts between patients with single-car accidents and other motor vehicle accidents. There is a significant difference for suicide attempts between patients with single-car accidents and no accidents.

‡ There is no significant difference for homicide threats and/or attempts and the various driving categories.

Although this was invaluable information, mental illness is unfortunately not subcategorized and we have only individuals who state this condition on the driver's license application. There is also no correlation to treatment. A significant number of the comparison samples could have had inapparent or unreported conditions. We have no knowledge of the type or outcome of reported accidents. In terms of denominator data, rates per unit of time more directly measure the risk that a driver represents to himself and to the community. For example, a poor driver who drives little may be no more dangerous than a good driver who drives extensively. Perhaps one should use a combination of years of exposure and miles traveled.

Selzer[2] points out that a substantial number of drinking drivers who cause serious traffic accidents are chronic alcoholics, and often have a long history

Table 8—Pertinent comments and sources of error on selected patient records*

I—*Errors of denominator and numerator*

34A Patient was a resident of California from 1956-1958. No California record available.

19C Moved in 1961 and no driving record available after 1961.

20C North Dakota resident for 20 months prior to hospitalization. The Minnesota driving record is unavailable.

23C Moved to Wisconsin in 1962. No driving record available after 1962.

26C Suicidal patient with no accidents or violations on record. However, no record of ever being a resident of another state.

44C Suicidal patient who lived and worked in Maryland prior to admission. No driving record is available.

II—*Classification errors*

6B Suicidal patient with a record of a single car accident. Misclassified on the punch card.

8B Reclassified. Card punched in error to 4C or "no motor vehicle accidents."

10C Suicidal patient with no accidents noted on initial perusal of records. Later driving records (after 1965) revealed two violations related to alcohol and a single-car accident (ran off road, property damage, 2/25/66).

25C Suicidal patient with no accidents reported on the North Dakota record. A single-car accident one year prior to suicide attempt with serious injury while driving a jeep alone in Texas.

III—*Pertinent comments*

35A Patient's elderly parents were killed in an intersection collision with a sheriff who was speeding. The sheriff was routinely delivering a prisoner to another jurisdiction.

41A Patient verbally threatened to commit suicide by using his automobile.

30B Suicidal patient with four other motor vehicle accidents over a period of two years with also five serious violations involving punitive fines and license revocations.

36B Suicidal individual with a record of six other motor vehicle accidents over a period of nine years. One accident involved a pedestrian with injuries reported.

40B Patient has four accidents over a period of two years. Occupation—cab driver; diagnosis—alcoholism.

45B Patient has eight violations of driving while intoxicated with punitive fines and license revocations. He proved completely immune to punitive measures.

46B Similar to 45B.

5C An alcoholic with a comparatively good driving record remarked that he "pulls off the road and sleeps when he feels he is too drunk to drive." This type of alcoholic is more likely to be a voluntary admission with strong family ties.

9C Nine violations related to alcohol with no record of accidents. A case of futile punitive measures.

32C Suicidal patient's driving record was thought to be that of a person with the same name but different birth dates. Her driving record could not be located after a careful search. She was excluded from the study.

*A=Those patients with a history of a single-car accident.
B=Those patients with a history of only other motor vehicle accidents.
C=Those patients with a history of no accidents.

of serious psychiatric illness which possibly contributes to their accident susceptibility.

McFarland[3] states, "recent research has indicated that factors of attitude, personality and adjustment are of greater importance in safe driving than sensory defects, reaction times, and psychomotor skills." Brennan[4] suggests that psychotics per se are not necessarily accident prone.

Haddon[5] very ably assesses the quality of current accident research and points out common pitfalls in research in this area.

Like preceding studies, there is obvious and not-so-obvious built-in bias to this study, and the results and conclusions should only be quoted with suitable reservations.

Our study reveals treatment benefit (decreasing accidents) in all categories, perhaps with the exception of personality disorders. However, violations tend to increase for male psychotics, male psychoneurotics, and personality disorders. Alcoholics show slight improvement in their posthospitalization violation rate compared to the general population. No previously published controlled study relates accidents and violations to therapy. Waller,[10,11] suggests that arrests for driving-while-intoxicated violations are primarily due to problem drinking and that punitive measures are futile. Our study bears this out but, in addition, points out the potential benefits of therapy. Most hospitalized alcoholics are severely impaired mentally, socially, and physically by the time they are first admitted. Earlier detection, referral, and treatment may produce even a better treatment record in regard to auto accidents. We need pilot programs with well-controlled evaluation techniques to ascertain if earlier intervention programs will be in fact beneficial to society and to the patient.

We have enough information now to substantiate the failure of punitive measures against the problem drinker. Punitive measures against the social drinker convicted of drunken driving may materially affect his future driving record, but this is a futile action against the problem drinker. Waller[10,11] recommends that we need to develop an administratively feasible method for the courts, the motor vehicle authorities, and others to identify problem drinking among persons arrested for drunken driving. Our findings—that the single-car accident appears almost solely in the hospitalized population—may be just the "red flag" we are looking for. The surviving driver of a single-car accident needs to be evaluated from a social, cultural, and psychological standpoint to ascertain severe emotional problems that may seriously affect his risk not only to himself but to society. In terms of reducing the accident toll, this appears to be a most fruitful avenue of study and evaluation.

Several studies[2,12-14] have pointed out the automobile as an almost ideal instrument of self-destruction. Our study tends to substantiate this, particularly among those individuals surviving single-car accidents. In fact the survivor of the single-car accident may be trying to tell us something, but we are not listening. We should perhaps consider the single-car accident as a suicide gesture, just as we consider sublethal intoxications and self-inflicted wounds. Suicide prevention programs should explore this further. Undoubtedly we need additional substantial information on the feasibility of this type of preventive program. Most accident studies only include fatalities which may or may not be related to nonfatal types of accidents. We need to know the cultural, social, and psychological characteristics of the individual involved in accidents, and specifically the single-car accident because it represents such a large proportion of total accidents, both fatal and nonfatal; it may also be a quick, feasible method of

administratively identifying the high-risk population. Control programs designed to reduce death and disability on the highways should not continue to be shotgun across-the-board measures; sophisticated programs must be developed that are not only punitive in nature for those sensitive to such measures, but also therapeutic and preventive for "punitive immune" individuals. In fact, suicide prevention centers and alcoholic detoxification programs should become the interest and province of the Highway and Judicial Departments as well as Public Health Departments. We can no longer afford to compartmentalize our total road safety programs if we are truly interested in reduction of death and disability on the highway.

Summary and Conclusions

Over the past three years we have studied the accident and violation rates of state hospital dischargees in 1960 and compared driving records, by diagnosis before and after hospitalization, with the driving records of matched (age, sex and geographical location) comparison groups selected at random from the files of the Safety Responsibility Division of the State Highway Department. The study indicates:

1. Hospital dischargees as a group have a higher accident and violation rate per hundred driver years.
2. Psychotics and psychoneurotics tend to have better records than their matched comparison group after discharge.
3. Alcoholics show some improvement after discharge in both their accident and violation rates in relation to their matched comparison group.
4. Repeated punitive measures toward alcoholics and personality disorders do little to affect accidents and/or violations. They are "punitive immune."
5. Single-car accidents were almost solely found among the experimental groups. A significant number of individuals involved in single-car accidents are suicidal compared to hospitalized individuals not involved in single-car accidents.
6. Violations related to alcohol and single-car accidents could better be used as an early detection mechanism to identify the mentally disturbed and thus the high-risk driver.
7. Control programs designed to reduce death and disability on the highways should not continue to be shotgun across-the-board measures, but sophisticated programs must be developed, not only punitive in nature for those sensitive to such measures, but therapeutic and also preventive for "punitive immune" individuals. In fact, suicide prevention centers and alcoholic detoxification programs should become the interest and province of the Highway and Judicial Departments as well as Public Health Departments. We can no longer afford to compartmentalize our total road safety programs if we are truly interested in reduction of death and disability on the highways.

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Opportunities in Food Science and Technology

The University of Massachusetts, in a brochure describing its program in Food Science and Technology, defines the field as the "application of the physical and biological sciences to food processing and preservation, and the development of new and improved food products from knowledge of their chemical and physical characteristics." The university has both a four-year undergraduate program and a graduate program offering Ph.D. and M.S. degrees. Typical of positions held by graduates are: director of research in industry, vice-president in charge of research, director of quality control, research scientist, food manufacturer, and college professor. (For additional information, write: Head of Department, Department of Food Science and Technology, University of Massachusetts, Amherst, Mass. 01002)