

REFERENCES

1. MYASNIKOV, A. L.: *Amer. J. Cardiol.*, 13: 435, 1964.
2. ECKSTEIN, R. W. *et al.*: *Amer. J. Physiol.*, 163: 539, 1950.
3. RAAB, W.: *Amer. Heart J.*, 66: 685, 1963.
4. RONA, G. *et al.*: *A.M.A. Arch. Path.*, 67: 443, 1959.
5. APTHORP, G. H., CHAMBERLAIN, D. A. AND HAYWARD, G. W.: *Brit. Heart J.*, 26: 218, 1964.
6. GILLAM, P. M. S. AND PRICHARD, B. N. C.: *Brit. Med. J.*, 2: 337, 1965.
7. KEELAN, P.: *Ibid.*, 1: 897, 1965.
8. HOROWITZ, D. AND SJOERDSMA, A.: Hypertension, Proceedings of the Council for High Blood Pressure Research, American Heart Association, 13: 39, 1964.
9. GIANELLY, R. E. *et al.*: *Ann. Intern. Med.*, 67: 1216, 1967.
10. RABKIN, R. *et al.*: *Amer. J. Cardiol.*, 18: 370, 1966.
11. GRANT, R. H. E. *et al.*: *Ibid.*, 18: 361, 1966.
12. CONN, R. D. AND BRUCE, R. A.: *Clin. Res.*, 15: 92, 1967 (abstract).
13. GILLAM, P. M. S. AND PRICHARD, B. N. C.: *Amer. J. Cardiol.*, 18: 366, 1966.
14. HEBB, A. R., GODWIN, T. F. AND GUNTON, R. W.: *Canad. Med. Ass. J.*, 98: 246, 1968.
15. MCALPIN, R. N., KATTUS, A. A. AND WINFIELD, M. E.: *Circulation*, 31: 869, 1965.
16. SRIVASTAVA, S. C., DEWAR, H. A. AND NEWELL, D. J.: *Brit. Med. J.*, 2: 724, 1964.
17. HOLLOSZY, J. O. *et al.*: *Amer. J. Cardiol.*, 14: 761, 1964.
18. SIBLEY, J. C.: *Appl. Ther.*, 7: 300, 1965.
19. HARRISON, D. C. *et al.*: *Circulation*, 29: 84, 1964.
20. STEPHEN, S. A.: *Amer. J. Cardiol.*, 18: 463, 1966.
21. MCNEILL, R. S.: *Lancet*, 2: 1101, 1964.
22. WOLFSON, S. *et al.*: *Amer. J. Cardiol.*, 18: 345, 1966.
23. SHANKS, R. G.: *Ibid.*, 18: 308, 1966.
24. MCKENNA, D. H. *et al.*: *Circ. Res.*, 19: 520, 1966.
25. MENDEZ, R. AND KABELA, E.: *Lancet*, 1: 907, 1966.
26. MCGREGOR, M. L.: Personal communication.
27. WOLFSON, S., AMSTERDAM, E. A. AND GORLIN, R.: *Circulation*, 36 (Suppl. 2): 274, 1967 (abstract).

SPECIAL ARTICLE

Farm Accidents in Saskatchewan

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HIGHLY mechanized farming is the basis of economic life on the Canadian prairies, particularly in Saskatchewan. In spite of some diversification in recent years, dependence on farming is likely to persist and the health, safety and working conditions of farmers and their families are legitimate and important subjects for physicians to study. Although Canada is one of the world's leading agricultural producers, except for an editorial in this Journal on "Tractor Accidents"¹ the specific subject of farm accidents has received relatively little attention in the country's medical journals.

The general problem of accidental death and injury has been the subject of several communications in recent years. An approach to the problem of accidents has been discussed² with some brief comments on farm accidents, and editorial comments have appeared on the responsibility of public health workers in the face of the problem.³ A policy statement on accident prevention has been made by the Canadian Public Health Association,⁴ re-emphasizing that accidents form one of Canada's leading public health problems

and that this country has one of the world's highest recorded accident fatality rates. In this statement much of the emphasis is on traffic and home accidents, but it is recorded that over 200 deaths in Canada in 1964 were due to farm accidents. In 1961 the challenge of accident prevention in public health was expressed and it was suggested that the training public health workers receive in the fundamentals of disease prevention can readily be applied to accident prevention as well.⁵ Traffic accidents as an epidemiological problem have been studied⁶ and their neurosurgical aspects described.⁷ The problem of home accident prevention has been discussed,⁸ while accidents in childhood,⁹ to Indians,¹⁰ and the general problem of accident proneness¹¹ have all received attention. It therefore appears timely to comment on the problem of accidents on the farm as seen in a province whose main activity is agriculture.

Much information about farm accidents is available in Saskatchewan and elsewhere in reports and monographs. A survey of farm accidents based on Ontario experience has been published,¹² while quite extensive information is made available in Saskatchewan in reports to the Saskatchewan Department of Public Health.¹³⁻¹⁵ There has been more extensive reporting in other countries, and particular reference to the major problem of tractor accidents

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has been made in the United States,¹⁶ Great Britain¹⁷ and France.¹⁸

THE SASKATCHEWAN MATERIAL

The information contained in this report has been obtained from four main sources: (1) Saskatchewan Accident Facts¹³⁻¹⁵ (monographs prepared for the Department of Public Health by the Provincial Department of Research and Statistics); (2) reports of claims paid by *The Western Producer* Accident Insurance Service, 1965-67; (3) reports on fatal accidents submitted by the Royal Canadian Mounted Police to the Saskatchewan Department of Public Health, 1955-67; and (4) experience in treatment of severe injuries, particularly paraplegia and amputation, in one of the rehabilitation centres operated by the Department of Public Health in Regina.

ACCIDENT FACTS

A brief extract from these comprehensive reports is shown in Table I, in which total accidents, road accidents and farm accidents are compared. The number of fatalities, hospital in-patient admissions and, where available, hospital outpatient attendances are considered.

These reports indicate that in the causation of fatal accidents the farm plays much less part than the road. It is worth recording, however, that a substantial number of the road fatalities were on rural roads and occurred to rural farm residents. As a cause of injury requiring hospital admission or outpatient treatment, farm accidents approach the problem of road accidents in importance.

WESTERN PRODUCER ACCIDENT INSURANCE REPORTS

The well-known farm newspaper, *The Western Producer*, operates an accident insurance service for subscribers, and issues quarterly re-

TABLE I.—ACCIDENTS IN SASKATCHEWAN (COMPARISON OF TOTAL ROAD AND FARM ACCIDENTS)

	1960	1961	1962
Accidents, fatal			
Total.....	451	481	461
Road.....	158	176	193
Farm.....	23	42	18
Accidents, hospital in-patient admissions			
Total.....	14,629	15,274	15,043
Road.....	3218	3314	3542
Farm.....	2207	2122	2045
Accidents, hospital outpatient attendances			
Total.....	53,622	64,420	not available
Road.....	5121	5450	
Farm.....	5477	5163	

ports of claims with brief indications of the cause of accident. Perusal of these reports for a two-year period, from August 1, 1965, to July 31, 1967, yielded the information shown in Table II.

TABLE II.—WESTERN PRODUCER INSURANCE SERVICE, 1965 - 67

Total claims paid.....	4903
Deaths—8 were in children.....	36
Major amputations—leg 2, hand 1.....	3
Minor amputations—finger, thumb, toes.....	26
Injuries to vertebrae.....	7

After subtracting the 72 major claims from the total, the remaining 4831 cases are shown, with the cause of disability expressed as percentage, in Table III.

TABLE III.—WESTERN PRODUCER ACCIDENT INSURANCE

Organ	Fractures %	Soft tissue injuries %	Total %
Ribs.....	6	4	10
Back.....	3	16	19
Leg—hip and thigh....	1	3	4
Leg—knee and shin....	11	9	20
Leg—ankle and foot...	3	5	8
Arm—shoulder and upper arm.....	1	1	2
Arm—elbow and forearm.....	13	3	16
Arm—wrist and hand..	7	6	13
Burns.....		5	5
Other.....	1	2	3
	46	54	100

Nearly half the claims are for fractures, while among soft tissue injuries one of the commoner claims was for "severed tendon" of hand or foot. Although these claims were all paid in settlements concerned with accidents and injuries to farmers and members of their families, it is not possible to say they were all strictly connected with specific farming operations. Some injuries which might well be classified as traffic or home accidents, according to the method of analysis, can well occur in farm surroundings and be legitimate claims on the policies offered. The high incidence of fractures of the forearm and hand, and of the leg, and of soft tissue injuries of the back and tendons, appears to be worthy of note. A substantial number of the deaths were in children.

FATAL FARM ACCIDENTS

Reports of fatal farm accidents have been made by the Royal Canadian Mounted Police to the Provincial Department of Public Health for many years. In these reports considerable

TABLE IV.—FATAL FARM ACCIDENTS IN SASKATCHEWAN, 1955 - 67

Year	Total fatalities	Age			Long hours (over 8 hours)	Type of accident					
		18 and under	19 - 59	60 and over		Tractor overturn	Runover tractor or implement	Caught between machines	Caught in machine	Underneath machine	Other
1955.....	28	7	17	4	7	15	4	2	—	1	6
1956.....	29	4	17	8	7	10	2	4	4	3	6
1957.....	19	5	9	5	4	11	3	—	1	1	3
1958.....	20	6	9	5	3	6	9	1	2	—	2
1959.....	24	9	8	7	3	14	9	—	1	—	—
1960.....	11	3	6	2	3	5	1	2	—	—	3
1961.....	14	4	6	4	1	5	5	—	3	—	1
1962.....	20	7	11	2	1	4	6	3	4	—	3
1963.....	16	4	11	1	1	4	2	2	2	2	4
1964.....	13	5	6	2	4	5	5	1	—	—	2
1965.....	24	4	11	9	1	7	7	—	3	5	2
1966.....	16	4	7	5	1	4	7	1	1	1	2
1967.....	13	7	4	2	1	5	4	—	—	3	1
Total.....	247	69	122	56	37	95	64	16	21	16	35

detail is recorded about conditions surrounding the accident, including information about the operator, the machine and the environment.

Between 1955 and 1967, 247 reports on fatal accidents were submitted (Table IV).

It is not known how comprehensive a picture of farm accidents is given by these reports. There are noticeable discrepancies between these figures and the fatalities recorded in the summary of Saskatchewan Accident Facts. There may well be some inconsistency in interpreting exactly what is meant by the term "farm accident". These reports of fatalities do not include accidents on rural roads or around the rural home, but are, as far as possible, confined to information about fatalities due to the operation of farm machinery or to farm operations in general. It is obviously not always easy to draw a clear line of distinction between these different types of accidents, and these 247 reports do include, for example, records of four children who were suffocated in grain, and of one man who was killed by lightning while operating his tractor in the field.

During 1968, with reports to the end of May, five further fatal accidents have been reported. The indications are that, after the harvest, the average number of fatalities in Saskatchewan will be reached again.

Much of the information on these fatal accident reports is not of immediate interest to physicians and health workers. It is, however, of value to agriculturists, engineers and others concerned with farm operations, and these reports have been made available to the Barber Royal Commission on Farm Machinery, whose report is pending. Some aspects of these reports on fatalities of more direct medical interest are considered below.

1. Age Distribution of Fatal Accidents

The age distribution of people killed in farm accidents is presented in Table IV. Sixty-nine (28%) of the fatalities occurred in children or

adolescents. Of these, 40 (16%) were under the age of 11. No fewer than 17 of these were children 2 years of age or younger, the majority being involved in runover accidents in the yard or field.

Fifty-six (23%) fatalities occurred in men over 60, the oldest being 88. Twenty fatalities occurred in men over 70 years of age. Fatalities in what might be regarded as the normal adult working years, ages 20 to 60, accounted for slightly less than half the total.

2. Sex

As might be expected, the great majority of fatal accidents on the farm occurred to males. Two women operating tractors were killed and nine of the children fatally injured were girls, seven being under 5 years of age.

3. Long Hours of Work

A working day of over eight hours in length was disclosed in reports of 37 of the fatalities (15%). In some instances, therefore, fatigue may have played a part, but there is little overall evidence on record to show that it was a major factor in the cause of farm accidents as a whole.

4. Concurrent Medical Problems

In 29 reports of fatalities some type of concurrent medical problem was indicated to be present. This information is shown in Table V. Fourteen of these patients were over 60 and 26 were over 40 years of age. They appear to show evidence of medical conditions likely to be found in men in this age group. There is, however, nothing to indicate that such conditions were absent in the case of many of the other fatalities, while the evidence that the medical condition present played a part in the causation of a specific accident is often questionable. In 11 of the 29 cases it appeared possible that the medical condition was a major cause, and

TABLE V.—CONCURRENT MEDICAL CONDITIONS
RECORDED IN 29 FATAL FARM ACCIDENTS

Condition	Number	Age
Cardiovascular disease	8	
High blood pressure	3	58, 63, 65
"Partial stroke"	1	58
Heart disease	4	54, 59, 68, 75
Locomotor disorder	6	
Back disorder	1	57
Arthritis	1	76
"Crippled"	1	53
Amputations— (2 hand, 1 foot)	3	41, 56, 70
Poor sight	2	64, 68
Asthma	1	48
Diabetes	1	44
Epilepsy	1	20
Mental retardation	1	32
Alcohol	2	28, 45
Old age	4	77, 78, 83, 88
Unspecified ill health	3	41, 53, 61

29

in 12 the medical condition may have played some part, while in 6 it appeared to have been unconnected with the accident. However, as a somewhat tentative conclusion, the information available suggests that disorders likely to reduce alertness, produce transient impairment of consciousness or impair mobility are likely to increase the dangers of working with farm machinery, particularly for older men.

5. Previous Accidents

There is a history of previous accidents in 15 instances, including two with amputations. Three other persons who had no previous accident record were recorded as being "careless around machinery". In one case thick gloves required because of a previous farm injury were the cause of a fatal power take-off entanglement. In two of the accidents to small children there was a history that the parent responsible for the accident had had a road accident.

In general, a retrospective review of information available about fatal accidents does not suggest that long hours of work, accident proneness or medical disease in the operator are major factors. Increased dangers to the old and the young are evident. The very great danger of tractors overturning is emphasized by these figures; in this respect it is important to note that 19 of the 95 fatalities due to tractors overturning occurred in tractor operators under 17 years of age, the youngest being 8 years old.

INJURIES DUE TO FARM ACCIDENT

The size of the problem of injury on the farm is indicated in a general way in the Saskatche-

wan Accident Reports and in *The Western Producer* Accident Insurance Claims. The following comments are confined to the major injuries of spinal cord lesion and amputation, as seen in a rehabilitation program. A proportion of the very numerous hand injuries was also seen, but it has not been possible to tabulate this information effectively. Hospital records in general rarely give much information about the cause of injuries, and special efforts to collect detailed information usually have to be set up. In this respect the Regina Rehabilitation Centre, during the formative years of its amputation program beginning in 1961, was fortunate in having an administrator who had himself been a farmer and who took a particular interest in obtaining factual detail about farm accidents.

Spinal Cord Lesions

In the Province of Saskatchewan the records of the Canadian Paraplegia Association show that there are 327 cases of paraplegia. These figures include many patients whose condition is the result of disease such as multiple sclerosis or transverse myelitis. Trauma was the cause of paraplegia in 121 cases (Table VI).

TABLE VI.—CAUSES OF TRAUMATIC SPINAL CORD LESION

Cause	Number
Road accident	71
Farm accident	19
Industrial accident	17
Gunshot wound	9
Home accident	5

Although not numerous when compared to road accidents, farm accidents were still the second highest cause of traumatic paraplegia, and the leading cause of injury in the small number of children with paraplegia of traumatic origin.

Many catastrophes on the farm occur to single-handed operators far from help. It seems likely that some farm accidents might result in paraplegia rather than in a fatality if they occurred in industry or other circumstances where immediate help was available.

Amputations

The cases described here are based on the amputation program operated at the Rehabilitation Centre in Regina, and probably represent not more than half of the cases in the province. When a prosthetic program was started in 1961, the number of amputations due to farm injuries was striking. In the period 1961-67 more than 300 amputees were seen in the Regina Rehabili-

tation Centre, including cases of congenital, traumatic and vascular origin. Of these, 53 cases, about half of all the cases of traumatic amputation, were due to farm machinery accidents. Child amputees on the program numbered 54, and of these 20 were congenital in origin and 5 due to disease; of the 29 amputations in children due to trauma, no fewer than 19 were due to farm machinery.

The causes of amputation are shown in Table VII and the distribution of the levels of the lesion in Table VIII.

TABLE VII.—CAUSES OF AMPUTATION DUE TO FARM MACHINERY

<i>Machine</i>	<i>Adults</i>	<i>Children</i>	<i>Total</i>
Grain auger.....	2	8	10
Power take-off.....	7	1	8
Belts (combine 5).....	8	1	9
Fall under implement.....	2	2	4
Hay baler.....	2	2	4
Hay mower.....	1	2	3
Feed cutter.....	1	1	2
Thresher.....	2	—	2
Combine cylinder head.....	1	1	2
Miscellaneous.....	5	1	6
Unknown.....	3	—	3
	34	19	53

Amputations due to farm machinery possibly represent a more serious problem than their numbers indicate. There were many high amputations in arm or leg, particularly in children; the nature of the stump and overlying wound made satisfactory prosthetic fitting difficult, and the results in the above-elbow group were particularly disappointing. Grain augers, power take-off appliances and belts caused half of the problems. When one recalls that these figures probably represent about half of the picture for the whole province, it is apparent that unshielded grain augers deprived many more Saskatchewan children of their limbs than did the widely publicized drug thalidomide.

TABLE VIII.—LEVELS OF AMPUTATION DUE TO FARM MACHINERY

Leg.....	28
Above knee.....	12
Below knee.....	16
Arm.....	25
Above elbow.....	7
Below elbow.....	11
Hand.....	7

DISCUSSION

Even in Saskatchewan farm accidents do not approach road accidents in frequency as a cause of death. Nevertheless, the information presented shows that injuries on the farm are a major cause

of disability. The economic losses in even minor injuries, in circumstances in which the operator is often singlehanded, represent personal and community problems of considerable magnitude, mitigated only to a limited extent by the traditional family feeling and neighbourliness of prairie people. How much of this disability is preventable is extremely difficult to determine. By its nature farming is an occupation in which work must be done at the optimal moment, under conditions of pressure and limited time. These circumstances may make accidents to some degree inevitable, but they also render the personal and economic consequences more devastating.

Review of some of the tragic circumstances associated with loss of life and limb suggests that much more could be done at the present time. Tractors rolling over and crushing the operator cause 40% of all deaths, and virtually all of these are preventable by roll bars, overhead frames, or cabs strong enough to stop the machine from rolling through two right angles. Relative prosperity amongst farmers in the period 1962-66 has enabled many operators to renew their equipment, and tractors with cabs are now a common sight. Nevertheless, the unprotected tractor is still the rule rather than the exception. It is surely essential that cabs be strong enough to protect operators in case of accident, and vital to encourage the provision of roll bars or safety frames on all tractors. Financial inducement in the form of lower insurance premiums if roll bars were fitted might have considerable effect. As Stephanson¹⁹ has pointed out, several countries will soon require protective frames by law.

Fatality statistics show the dangers of farm operation to young and old. Traditionally, the farm is a place of enchantment for the young, but modern farm machinery can be as complex and dangerous as a locomotive, and its proximity is no place for the untrained and inexperienced. The deaths of 14 2-year-olds by runover accidents, usually by parents or siblings in the farmyard, remind us that human error is always present. It may be worthy of note that visibility of the immediate vicinity of a vehicle's wheels from the driver's seat is usually extremely limited in the larger items of equipment, and possibly some systematic experimentation in the placement of mirrors would increase safety and ease of operation.

Grain augers and power take-off appliances without adequate shielding cause many traumatic amputations and some loss of life. Although ease of operation is vital when farm operations have to be carried through in limited

time, shielding of these dangerous moving parts should not present insuperable engineering problems. The engineering and ergonomic aspects of this problem deserve urgent consideration.

When moving parts become clogged during the operation of machinery, and adjustment is required, conveniently placed switches to stop or start sources of power are an important safety consideration.

The problem of farm accidents is only one aspect of the much larger problem of accidents in general, and of the complex man-machine environment of modern times. Much of this problem appears to lie outside the usual sphere of activity of the physician. However, the treatment of accidental injury occupies an enormous amount of the time and talent of the medical profession, and the obligation to play a greater part in prevention is a very real one. It may well be that in Western Canada the injury and fatality rate is very low compared to the "passenger miles" driven by tractors and other implements. If this is so, the spread of mechanized farming to parts of the world where the population is unfamiliar with machinery is likely to lead to an even more devastating situation than we already have. The information available suggests that a good deal can be done now, both in design of apparatus and in customs of use. The physician practising in rural communities has great influence, and when supplied with proper information can perhaps do much to assist in public acceptance of means of preventing accident. Public health physicians and nurses can co-operate with engineers, agriculturists, legislators and psychologists in preventing accidents, as they have in the past co-operated with sanitarians and educators in the prevention of infection. Systematic investigation of the causes and circumstances of accident may

provide information of great value in prevention, provided it is effectively collected and distributed. Informed and sound recommendations of public bodies need support if they are to be effective. In this respect physicians can do much to improve an accident situation which, if nothing is done, is likely to get worse.

It is a pleasure to acknowledge the co-operation of the members of staff of the Department of Public Health in the compilation of this report, particularly of the Sections of Health Education, Medical Rehabilitation and Occupational Health. We are grateful, too, for the continuing help of the Saskatchewan Safety Council, and for the very considerable assistance rendered by Mr. G. F. Donaldson, Research Officer for the Barber Royal Commission on Farm Machinery. Mr. C. Millions, formerly Administrator of the Regina Physical Rehabilitation Centre, provided much help in the analysis of farm machinery amputations. The faithfully compiled R.C.M.P. reports on fatalities were invaluable, and we would like to record our gratitude to this organization for collecting data, often in harrowing circumstances. The reports of claims made available by *The Western Producer* Accident Insurance Service were also of great value.

REFERENCES

1. Editorial: *Canad. Med. Ass. J.*, 93: 227, 1965.
2. MACCHARLES, C. W.: *Canad. J. Public Health*, 58: 289, 1957.
3. Editorial: *Ibid.*, 58: 317, 1967.
4. SCHWENGER, C. W.: *Ibid.*, 58: 417, 1967.
5. ABBOTT, E. L. AND SMITH, C.: *Ibid.*, 52: 1, 1961.
6. WILLIAMS, N.: *Canad. Med. Ass. J.*, 90: 1099, 1964.
7. Canadian Neurosurgical Society, Subcommittee: *Ibid.*, 97: 1364, 1967.
8. IMRIE, R. J.: *Canad. J. Public Health*, 55: 275, 1964.
9. KEDDY, J. A.: *Canad. Med. Ass. J.*, 91: 675, 1964.
10. SCHMITT, N., HOLE, L. W. AND BARCLAY, W. S.: *Ibid.*, 94: 228, 1966.
11. Editorial: *Ibid.*, 90: 646, 1964.
12. Canadian Chamber of Commerce: A matter of life or death: survey of Canadian farm accidents, Montreal, c.1964.
13. Saskatchewan Department of Public Health. Research and Statistics Branch: Saskatchewan Accident Facts, 1st, 1960, Regina, 1961.
14. *Idem*: Saskatchewan Accident Facts, 2nd, 1961, Regina, 1962.
15. *Idem*: Saskatchewan Accident Facts, 3rd, 1962, Regina, 1963.
16. KNAPP, L. W., JR. AND TOP, F. H.: *Occupational Health; A Journal for Occupational Health Nurses (London)*, 19: 129, 1967.
17. REES, W. D.: *Brit. Med. J.*, 2: 63, 1965.
18. DERVILLEE, E.: *Concours Méd.*, 85: 1037, 1963.
19. STEPHANSON, B. T.: *Agricultural Institute Review*, 21: 17, January-February 1966.