

# Farm Tractor Fatalities: The Failure of Voluntary Safety Standards

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**Abstract:** There are no governmental standards for operator protection which require compliance by farm tractor manufacturers. To see how the Wisconsin farming population fares under voluntary safety standards, death certificate data were used to determine rates of tractor-associated fatal injuries. The injury death rate associated with tractors on farms increased from 10.9 per 100,000 male farm residents during 1961-1965 to 13.6/100,000 during 1971-1975 ( $p < .05$ ). Deaths associated with overturning tractors were most common; with death rates of 6/100,000 male farm residents for 1961-1975. The rise in tractor-associated

death rates shows that voluntary safety standards are not protecting the farm population.

Rollover protective structures (ROPS) are designed to protect operators when tractors overturn but under voluntary safety standards these ROPS are sold only as optional accessory devices. Current Occupational Safety and Health Administration regulations which require ROPS for employees operating tractors do not protect self-employed farmers and their families. It is recommended that the government require all tractors sold to be equipped with ROPS as is currently the case in England and Sweden. (*Am. J. Public Health* 69:146-149, 1979)

## Introduction

Nationally, the agriculture industry has one of the highest occupational injury death rates; 1976 rates were 54/100,000 workers compared to 14/100,000 for all occupations combined.<sup>1</sup> The total number of deaths in 1976 was 1,900, second only to the construction industry.<sup>1</sup> In Wisconsin, farming occupies only 7 per cent of the male work force, yet accounts for more than 20 per cent of work-related fatal injuries.<sup>2</sup> Tractors are associated with 40 per cent of all work- and nonwork-related fatal injuries on Wisconsin farms.<sup>3</sup> More than one-half of these deaths result when tractors overturn and crush the operator.<sup>1</sup>

Unlike highway vehicles or consumer products, farm tractors do not have to meet federal government standards designed to protect their owner-users. For example, rollover protective structures (ROPS)\* that could prevent many deaths are added to tractors only voluntarily by manufacturers, often as an optional "accessory" available to the buyer. This lack of protection is especially critical because of the prominent role of tractors in agricultural work and agricultural fatalities.

The Occupational Safety and Health Administration (OSHA) did impose standards in 1976 requiring ROPS on all tractors used by employees, but this standard does not apply to the many tractor operators who are self-employed or farm family members. Furthermore, special legislation amended 1976 appropriations for OSHA to ensure that farms employing fewer than 10 workers (excluding family members) would not be inspected for compliance with standards. Only 30-50 per cent of farms in Wisconsin are estimated to hire *any* non-family labor.\*\* This, coupled with the constraints against inspection, means that most Wisconsin farms and tractor operators are excluded from the only federal government protection offered.

In this study, the experience of Wisconsin farmers with regard to fatal tractor-associated injuries was examined to determine the effects of voluntary safety standards.

## Methods

The study group included the 415 male farm residents in Wisconsin who were fatally injured on farms in events associated with tractors during 1961-1975. The data sources for the years 1971-1975 were death certificates for deaths occurring on farms with references to tractors or tractor parts (e.g., power take-offs). Farm injury death certificates for years 1961-1970 had been previously abstracted by state vital records personnel, and data were available from their worksheets. Age, cause of death, injury event, and interval from injury to death were recorded for all deaths.

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\*ROPS are rollbar devices or crushproof cabs which can protect the operator from injury if the tractor rolls over, as may happen on unlevel terrain, during a sharp turn at high speed, or as a result of improperly attached implements, and other similar instances.

**TABLE 1—Injury Death Rates Associated with Tractor Use on the Farm, Wisconsin Male Farm Residents**

Time Period	Male Farm Population*	Number of Deaths	Death Rate per 100,000
1961–1965	1,268,000	138	10.9
1966–1970	1,153,000	135	11.7
1971–1975	1,047,000	142	13.6**

\*5-year totals for Wisconsin male farm residents.

\*\*Increase over 1961–1965 rates,  $p < .05$ .

During the study period, 37 deaths to women and female children and 46 deaths to male non-farm residents were also associated with tractors. These deaths were not included in the analysis because of their small yearly numbers: 2.5 per year for women and 3.4 per year for non-residents. Information from death certificates was limited to tractor-associated deaths occurring on farms; no information was obtained on deaths involving tractors on property associated with private homes or on government land. Some information was available, however, on 45 fatal tractor crashes on public roads during 1971–1975 from the Wisconsin Department of Transportation Accident Data Section. These deaths were not included in the analysis of the farm resident series because no residency data were available.

Mortality rates for male farm residents were calculated using estimates of the Wisconsin male farm population based on 1960 and 1970 census information. Interpolation between 1960 and 1970 populations and extrapolation from 1970 populations were based on yearly reported changes in the national farm population.<sup>4</sup>

Tests of statistical significance were done using a comparison of counts for small proportions.<sup>5</sup>

## Results

Death rates from tractor-associated injury increased from 10.9/100,000 male farm residents in 1961–1965 to 13.6/100,000 in 1971–1975 ( $p < .05$ , Table 1). During this period, although the male farm population decreased steadily, the number of these deaths stayed fairly constant at 28 per year.

### Event-Specific Death Rates

Death rates classified by type of events associated with fatal injuries are shown in Table 2. Four events accounted for 75 per cent of all injuries. Overturns were by far the most common event, accounting for over one-half the deaths in the series. Overturn death rates remained stable during this period at around 6/100,000 male farm residents. Almost all the overturn deaths were associated with crush injuries to the chest, abdomen, and pelvis, or fractures of the skull and neck. However, some subjects were pinned under tractors that overturned into waterways and, as a result, died of drowning.

Next to deaths from overturns, power take-off devices (PTOs) accounted for a sizable proportion of fatal injuries,

reaching 13 per cent during 1971–1975. PTOs are rapidly rotating shafts which transfer power from the tractor attached at one end to a piece of farm machinery at the other end. Clothing or body parts can become entangled, resulting in amputation or avulsion of body parts, strangulation, and massing crushing injuries. Death rates from PTOs doubled during the study period ( $p < .05$ ).

The two additional events—falling from tractors or being run over by tractors—each accounted for more than 10 per cent of deaths. Deaths which occurred when drivers or passengers fell from the tractor into the path of machinery or wagons being towed were classified as fall-related.

### Age-Specific Death Rates

Deaths occurred among farm residents ranging in age from less than one year to over 90. Age-specific death rates for years 1971–1975 are shown in Table 3. Rates for 1961–1970 were not significantly different.

The 10–19 year-old age group, comprising 20–25 per cent of the male farm population, had the highest absolute number of tractor-associated deaths on farms, but the highest tractor death rates were found in the oldest age group.

### Tractor Fatalities on Public Roadways

Forty-five fatalities from tractor crashes occurring on public roads were noted for years 1971–1975. There was some overlap between roadway tractor deaths reported to the Wisconsin Motor Vehicle Accident Section and those reported as farm deaths to the State Bureau of Health Statistics. We estimate that 36 of the 45 road deaths during this five-year period, or over seven deaths a year, were not included in the farm death series.

On roads, as well as on farms, overturns predominated over other injury events: 31 of the deaths were associated with overturned tractors. Although other studies cite automobile-tractor collisions on roads as being most common,<sup>6, 7</sup> Wisconsin data show 32 of the events involved only tractors.

## Discussion

Hazards of farm tractors have been widely recognized since tractors replaced horses as the primary power source for farming. In hearings on the safety of agricultural tractors held in 1970 by the U.S. Department of Transportation (DOT), farm equipment manufacturers, maintaining that tractors had become increasingly safe to operate, strongly supported continuing voluntary safety standards instead of government regulation.<sup>8</sup> The DOT report based on the hearings was in agreement and recommended to Congress that federal safety standards *not* be established.<sup>9</sup> In Wisconsin, however, death rates associated with tractor use show a progressive increase from 1961 to 1975, indicating that the current system of voluntary safety standards has not been sufficient to protect tractor operators. Today, essential safety devices, such as rollover protective structures (ROPS), are sold as optional accessories on many tractors. Other safety devices, such as power take-off shields, are standard equipment but can be removed easily or otherwise circumvented.

**TABLE 2—Event-Specific Death Rates for Tractor Use on the Farm, Wisconsin Male Farm Residents**

	1961–1965		1966–1970		1971–1975	
	Deaths	Rate*	Deaths	Rate*	Deaths	Rate*
Tractor Overturns	80	6.3	73	6.3	64	6.1
PTO Entanglement	9	.7	14	1.2	19	1.8***
Falls from Tractor	16	1.3	12	1.0	17	1.6
Run over by Tractor	17	1.3	15	1.3	17	1.6
Other Events**	16	1.3	21	1.8	25	2.4
All Events	138	10.9	135	11.7	142	13.6

\*Per 100,000 male farm residents per year.

\*\*Other events include deaths described as "tractor accidents"; burns; carbon monoxide poisoning; being crushed between tractor and other object; falling from second story of barn with tractor.

\*\*\*Increase over 1961–1965 rates,  $p < .05$ .

Manufacturers can choose not to include safety devices on tractors they sell—and they continue to do so.

The lack of protection for tractor operators does not result from undeveloped technology nor from ignorance. ROPS were developed as early as 1959 with design standards approved by the American Society of Agricultural Engineers in 1967. A 1961 study of tractor overturns in multi-vehicle crashes on the road estimated that 75 per cent of fatalities would have been prevented if the operators had had overturn protection.<sup>6</sup> Unfortunately, not only is rollover protection an optional accessory item on most tractors; rollbars sold with some tractors can be unbolted easily. The combination of these factors results in very low ROPS use: in an informal summer field survey in four counties in southwestern Wisconsin in 1977, only 9 per cent (five of 58) of the tractors were equipped with ROPS.

Cabs on tractors protect the operator during overturns and also can prevent falls. They are standard equipment on large four-wheel-drive tractors but are available only as options on smaller tractors. Large, well-protected tractors are generally geared to agribusiness and larger farms where operators may be protected by OSHA regulations. Unfortunately, the unprotected smaller tractors used on smaller farms are exempt from OSHA review.

Protection from PTO entanglement also varies with tractor models. Currently available PTO shields range from those which are both cumbersome and easily removed to an integral mounted PTO shield which is not removable and does not hinder work. The increasing death rates from PTO injuries suggest that adequate protection is not universally available, and that non-removable shields should be required for all PTOs.

The availability of safety devices as optional accessories does not protect all operators. Although the argument against requiring safety devices as standard equipment is that purchasers should be free to decide whether to invest in their own safety, the protection of farm family members, hired workers, and purchasers of used tractors depends on whether safety equipment was chosen by the original purchaser.<sup>10</sup> Although young people are not likely to have a

choice in optional safety equipment on tractors, 29 per cent of fatalities in 1971–1975 occurred to male farm residents under the age of 19. Because children are likely to remain an important part of the farm labor force, the need for mandatory protective equipment is critical.

The high death rate of older age groups is also of concern. Farming is an occupation with no forced retirement age; for many farmers, retirement is not financially possible. It is common for farmers to be working well into their 70s and beyond. The very high tractor death rates for those over age 60 in this study reflect the double jeopardy that injury presents to the aged: increased incidence of injury and decreased probability of recovery from their injuries.<sup>11</sup> For all injury events other than overturns, 32 per cent of subjects over age 60 (7 of 22) in 1971–1975 died more than one day after being injured; in all other age groups, only 8 per cent (4 of 52) of such deaths occurred after one day. All deaths from overturns occurred within one day regardless of age.

The most effective way to reduce deaths and injuries associated with tractors is to equip all tractors with protective devices that work automatically. Automatic protective devices are necessary because experience with other types of injury prevention (such as seatbelt use in automobiles) indicates that most people cannot be persuaded to take active steps toward simple lifesaving precautions.<sup>12</sup> Passive protective equipment that does not require human cooperation is available for tractors: Cabs, PTO shields, and rollbars which cannot be circumvented.\*

During the years 1971–1975, in Wisconsin, there was an average of at least 40 deaths yearly for an estimated 232,000 tractors.\*\* This rate, 14 deaths per 100,000 tractors is comparable to tractor death rates in other states with equally

\*Some rollbars require use of a seatbelt to optimize effectiveness. Seatbelts are not automatic devices if they require buckling.

\*\*Included are an average of 28 deaths to male farm residents on farms, six deaths to women and non-farm residents, and seven deaths on the roadways. There are an unknown number of deaths associated with tractor use on private property or government lands.

**TABLE 3—Age-Specific Death Rates for Tractor Use on the Farm, Wisconsin Male Farm Residents 1971–1975**

Age Group	Number of Deaths	Rate per 100,000 Male Farm Residents
0–9	8	4.1
10–19	33	12.0
20–29	5	5.8
30–39	12	13.0
40–49	17	13.3
50–59	24	18.2
60–69	19	21.7
70+	24	47.5
All Ages	142	13.6

large numbers of tractors.<sup>1</sup> Assuming a 20 year life span for tractors, one tractor in 290 will be associated with a fatal injury. In addition to deaths, there are many more serious and disabling injuries. Considering deaths and injuries with associated high costs due to lost production and medical care, manufacturing all tractors with protective devices would not only be human but also cost-effective.

The data reported in this paper indicate the need for changes in tractor safety policy. First, the OSHA inspection exemption for small farms should be rescinded. Second, all tractors manufactured should have power take-off shields which cannot be circumvented. Third, the United States should follow the lead of Sweden and England; previous to 1970, both countries began to require ROPS on *all* tractors sold.<sup>13</sup> The OSHA Standards Advisory Committee made a similar recommendation for American tractors in 1972 which became instead a requirement for employee-operated tractors only.<sup>14</sup> These alternatives to voluntary safety standards are essential; without them, existing technology may never be applied to protect the farm population from tractor-associated injury and death.

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### Behavior and Environment

*It is already evident that man must apply scientific knowledge to his own behavior in relation to the environment or else incur the inevitable consequences of progressive environmental deterioration to an ultimate point beyond which civilization and life itself can no longer be sustained.*

Lynton Keith Caldwell. *Environment: A Challenge to Modern Society*, Garden City, NY: Anchor Books, Doubleday & Company, Inc., 1971, p. 143.