

# Injury and Death on the Farm: Improving Prevention Through Improved Surveillance

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**Work-related injury data suggest that agricultural workers in North Carolina are experiencing high rates of injury and death compared with workers in other occupations. However, current occupational injury data sources are insufficient to calculate accurate injury and mortality rates. We propose recommendations to improve existing farm injury surveillance, to guide prevention.**

**A**griculture is one of the most hazardous industries in North Carolina and the United States [1]. In 2009, the annual fatality rate for the agriculture, forestry, fishing, and hunting industry sector in North Carolina was 32.6 deaths per 100,000 full-time equivalents (FTEs), the highest rate among all industry sectors and nearly 10 times higher than the average state fatality rate, of 3.3 deaths per 100,000 FTEs [2]. For the same year nationally, agriculture, forestry, fishing, and hunting had the highest rate among all industry sectors, with a fatality rate below that of North Carolina, at 27.2 deaths per 100,000 FTEs [3]. Likewise, the agriculture, forestry, fishing, and hunting sector had the highest rate for nonfatal injuries in 2009, compared with all other industry sectors, both in North Carolina and nationally [4, 5].

As with any public health problem, an important first step in preventing farm-related injuries from happening is to effectively document and track those individuals injured and to obtain detailed information about the causes. In North Carolina, current data sources give us a snapshot of what is going on, but our state lacks sufficient information about the true scope of the problem. In this commentary, we present an overview of available sources of farm injury surveillance data, summarize their strengths and weaknesses, and propose recommendations for improving farm injury and death surveillance.

## Farm Injury Surveillance in North Carolina

An effective farm injury surveillance system would be able to provide us with reasonably complete information on the “who, where, and how” of farm injury and death. In simple terms, the system would contain data elements that would readily identify a farm injury, capture most cases that occur, provide descriptive detail about how the farm injury happened, and indicate when and where the injury occurred. Additionally, timely case information would allow for iden-

tification of emerging issues and timely public health or regulatory response. At present, however, in North Carolina, this is not the case. Information on farm injuries and fatalities is scattered across multiple databases and is not collected systematically or comprehensively. Many of these databases are primarily administrative, and their use for public health surveillance is secondary. Additional barriers include policies that exclude small farms from data sources. Identification of all those working on a farm can be difficult. Farmers who are self-employed or who work part-time, farm family members, and migrant farmworkers may be omitted from farm injury data sources.

Sources of surveillance data currently available for farm injuries and deaths in North Carolina include the core databases listed in Table 1. Those available for estimating farm injury deaths include the Census of Fatal Occupational Injury (CFOI), the state death certificate file, and the Office of the Chief Medical Examiner–Medical Examiners Information System (OCME-MEIS). These sources are set up to capture most fatalities. The CFOI comprises aggregate (not case-level) data and contains nonspecific descriptive detail; final counts are available approximately 16 months after the event year. OCME-MEIS data contain codes to help identify farm injury data and contain descriptive detail, some of which may require manual extraction. Typically, case investigations are completed within 3 months of the death, although some coded information is not available within that time frame. Death-certificate data contain codes to help identify farm injury and contain descriptive detail, some of which may require manual extraction. Complete data are available approximately 8 months after the event year.

Data sources available for estimating nonfatal farm injuries include the hospital discharge database, the North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT), the North Carolina Trauma Registry, the Survey of Occupational Illnesses and Injuries (SOII), and the workers’ compensation claim file. SOII is a

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**TABLE 1.**  
**Databases Available for Farm Injury Surveillance in North Carolina**

| Database                                                                | Source                                                                             | Features                                                                                                                                                                |
|-------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Census of Fatal Occupational Injury                                     | Bureau of Labor Statistics                                                         | Collects all work-related deaths in the state                                                                                                                           |
| Death Certificate File                                                  | State Center for Health Statistics, North Carolina Division of Public Health Death | Compiles death certificates as official cause of death for all persons who die in North Carolina                                                                        |
| Hospital Discharges                                                     | State Center for Health Statistics, North Carolina Division of Public Health       | Compiles information on all hospital discharges                                                                                                                         |
| North Carolina Disease Event Tracking and Epidemiologic Collection Tool | University of North Carolina at Chapel Hill                                        | Compiles emergency department data from 98% of hospitals in North Carolina; the database also contains data from Carolinas Poison Center and emergency medical services |
| North Carolina Trauma Registry                                          | North Carolina Division of Health Service Regulation                               | Compiles data on trauma-related hospital admissions, deaths, and transfers from all level I, II, and III trauma centers in North Carolina (15 hospitals)                |
| Office of Chief Medical Examiner–Medical Examiners Information System   | North Carolina Division of Public Health                                           | Compiles data on investigations of deaths that are unattended, suspicious, or the result of violence (homicide, suicide, or accident)                                   |
| Survey of Occupational Illnesses and Injuries                           | Bureau of Labor Statistics                                                         | Compiles numbers and rates of nonfatal injury and illness from a survey administered to state and private industry                                                      |
| Workers' Compensation Claim File                                        | North Carolina Industrial Commission                                               | Compiles data on work-related illness                                                                                                                                   |

major source for obtaining estimates of nonfatal injury and illness for state-based occupational surveillance. This database contains summary data, and while it contains a broad range of frequency and descriptive information, there are several issues that affect completeness, especially as the information relates to farm injury. The database represents a random sample (not a census), excludes the self-employed and households, and, most importantly, excludes farms with fewer than 11 employees. This is significant, since most farms (91%) in North Carolina are small [6]. Consequently, this source would likely produce a significant underestimate of farm injury cases.

Workers' compensation data in North Carolina contain basic information about work-related injuries, and there are no reporting capabilities regarding the injury or its cause. Agricultural employers with fewer than 10 regular employees are exempt from providing workers' compensation coverage, so this source may produce an underestimate of farm injury cases.

NC DETECT, which contains data from emergency departments, has the potential to be a valuable database for nonfatal farm injury surveillance. Compared with hospital discharge data or specialized registries, such as trauma registries, emergency department data represent a more comprehensive source for identifying trends in acute injury and illness. For example, hospital discharge databases represent only those patients who have been admitted to hospitals (approximately 13.6% of the emergency department visits in North Carolina). Trauma registries capture data from only a limited number of hospitals (15 in North Carolina) [7].

It can be challenging to search emergency department data in NC DETECT for work-related injury because of the lack of occupational information in the data. Sometimes the data element "expected payer" is used as a proxy and work-

related cases are identified through "workers' compensation" as payer. The accuracy of this proxy, however, has not been fully validated and is likely problematic, because of coverage limits of workers' compensation in North Carolina, as described elsewhere. *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis and external cause of injury (E codes) are helpful in identifying farm injury cases in the NC DETECT emergency department data, and triage notes and chief complaint can be searched, for additional detail about an injury. NC DETECT receives emergency department data every 12 hours, but the ICD-9-CM codes associated with each emergency department visit usually come in updates weeks after the initial visit was received.

Lastly, hospital discharge data appear to be a good complement to emergency department data, but they do not provide a complete picture of farm injury on their own. As described, typically, patients admitted to the hospital represent a small percentage of emergency department visits, so farm injuries not resulting in hospital admission will not be captured in the hospital discharge database. North Carolina Trauma Registry data are limited to a subset of hospitals but are useful for farm injury surveillance, because the registry contains occupational information and descriptive data elements, including cause and mechanism of injury. It also helps us to examine the most severely injured individuals who survive. Data are available approximately 6 months after the incident.

In the databases described, there is a gap in capturing those individuals with farm injuries who do not present to the hospital but instead seek other medical attention. According to national data, approximately 89% of ambulatory care visits (injury and non-injury) are made to physician offices or clinics, and only 11% are made to hospital emer-

# Be Seen and Be Safe Highway Safety with Farm Equipment Program

**Norman Harrell**

Ted Keen, a farmer from Wilson County, lost his life when a tractor trailer truck traveling 70 miles per hour rear-ended his tractor in the spring of 2003. This incident was the catalyst for addressing the issue of highway safety with farm equipment. Research data also indicated that this was a need for farmers in Wilson and the surrounding counties. The University of North Carolina Highway Safety Research Center reported that there were approximately 1,500 farm vehicle crashes in North Carolina from 1995 through 1999 [1]. Six counties in the 7-county area comprising Wilson, Nash, Edgecombe, Pitt, Wayne, Greene, and Johnston were among the top 12 counties in North Carolina in farm vehicle crashes during this period. In this 7-county area, there has been a 20.4% increase in population during the last decade. This has led to more motorists on the highways who are less familiar with agricultural equipment. In addition to the increase in population, farm operations have increased in size by 18%, requiring farmers with agricultural machinery to travel greater distances on highways, with larger, less maneuverable equipment. Under these conditions, farmers must implement safety practices that protect themselves and their employees.

To address this situation, in 2004, Cooperative Extension conducted the Be Seen and Be Safe Highway Safety with Farm Equipment program and collaborated with the North Carolina Highway Patrol to offer educational training for farmers and their employees on highway safety with farm equipment. Extension agents received a grant from the North Carolina Tobacco Trust Fund Commission to fund this project.

The objectives of the Be Seen and Be Safe project were to (1) decrease the number of agricultural machinery highway crashes, through farmer education and public awareness, and (2) to increase farmer adoption of safety practices with agricultural machinery on highways.

Farmers need to be proactive in highway safety by increasing visibility of farm machinery on the highway. Taking actions that make agricultural machinery more visible will help motorists to see slow moving vehicles earlier. Extension agents researched and developed a presentation that advocated highway safety and encouraged farmers to be proactive. Sergeant Tom Futrell of the North Carolina Highway Patrol presented information on laws pertaining to farm machinery on highways. Agents developed and distributed a brochure that served as a reference and safety reminder for participants after the meeting. Farmers who attended the safety meetings received a safety kit that included items to increase their visibility on the highways, thus being seen and being safe. These items included a strobe light, a "Slow Moving Vehicle" sign, and 3 FARM (Fewer Accidents with Reflective Material) Saf Kits. More than 1,000 farmers and farmworkers participated in these educational meetings.

Because of the large number of Spanish-speaking em-

ployees who operate farm equipment on highways, farmers asked the extension agents to conduct a Spanish version of the training. Agents used volunteers to translate the presentation, script, and safety brochure into Spanish. This training has been conducted numerous times during multiple years, in an effort to reach Spanish-speaking employees.

At the meetings in each county, participants took a pre- and posttest, to determine knowledge gained from the presentations. In the 7-county area, farmers increased their knowledge by an average of 71%. Three months after the meetings, extension agents mailed all program participants an evaluation survey. Results indicated that 94% of respondents had installed the new slow moving vehicle signs on their farm equipment, 82% had marked farm equipment with reflective tape, 67% had installed the safety strobe light, 49% had purchased additional slow moving vehicle signs, and 92% had shared highway safety information with their employees.

In 2004, the North Carolina Highway Patrol reported 39 crashes involving farm equipment in the project service area. This represented a 21.7% decrease in crashes, compared with an average of 49.8 crashes per year involving farm equipment, as reported by the University of North Carolina Highway Safety Research Center, from 1995 to 1999 for the area.

Farmers responded to this educational program by increasing their visibility and being safe by becoming proactive in highway safety. The counties that have implemented the program's recommendations have benefited by reducing the number of crashes involving agricultural equipment, and the reduction in the number of crashes has saved lives and prevented serious injuries.

Patience is a trait that should be exercised by all highway users, and doing so will allow everyone to go home safely at the end of the day. That patience helps the agricultural industry continue to be North Carolina's number one provider of income, at just over \$72 billion annually. Sharing the road is everyone's responsibility, and being proactive about preventing a possible injury incident is just plain smart. NCMJ

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agency departments [8]. Statewide information on physician clinic or office visits in North Carolina is currently unavailable [7]. This gap is problematic especially as it relates to identifying and describing injury patterns in groups such as migrant and seasonal farmworkers, who are supported by North Carolina's large network of migrant and community health centers and other urgent care settings.

### A Challenge Beyond Case Identification

There is another challenge in performing farm-related injury and death surveillance, beyond effectively capturing the number of injured individuals. Generalizable injury and fatality rates require well-defined populations at risk, with each data source. However, not all available data sources include validated denominator population data. There are several national databases that can provide denominator population data, including the Census of Agriculture, the Bureau of Labor Statistics Current Population Survey, and the US Department of Agriculture's National Agricultural Statistical Service (NASS) survey [9]. Other sources that researchers have evaluated include the Decennial Census of Population [10] and the American Community Survey [11]. These denominator sources contain population estimates with different characteristics. For example, NASS contains data on agricultural production and service workers, and the Census of Agriculture collects information on farm operators and hired farmworkers.

### Recommendations for Improved Surveillance

If the goal is to improve surveillance, to more accurately describe the burden of agriculture-related injuries and deaths, how do we make that happen? Available farm injury and death statistics give us a snapshot but are not comprehensive enough, and they likely underestimate the actual number of farm injuries, especially nonfatal injuries. This problem hampers communicating the nature and extent of farm-related injury and death and ultimately affects the capability to design appropriate prevention interventions. The main weaknesses of current data sources include the following: (1) not one database source is reliable for capturing all farm injuries and deaths, and (2) available data sources lack sufficient detail, are not available for use in an efficient time frame, or significantly underreport cases. We propose the following strategies to improve farm injury surveillance.

**Form a dedicated task force.** Farm injury surveillance is deserving of careful evaluation and planning. Since surveillance is complicated, it warrants a group of experts to meet to establish consensus on a sound surveillance system design and to agree on standardized measures, including the definition of a farm injury and the use of denominator data. The task force should consist of representatives from the North Carolina Agromedicine Institute, academia, public health, and the Center for Disease Control and Prevention. Expert assistance should be solicited from outside of our

state, to include the New York Center for Agricultural Medicine and Health and the Canadian Agricultural Injury Surveillance Program [12, 13]. Both programs have models established for farm injury surveillance.

#### ***Establish a centralized farm injury and fatality registry.***

An ideal agricultural surveillance system for farm-related injuries provides a continuous source of data, is centralized, is comprehensive, is accurate but simple in design, is cost-effective and timely, captures essential details of the injury, and is linked to timely public health response and prevention interventions [11, 12]. A farm injury and fatality registry should be established that incorporates these features. A registry is a centralized database that collects comprehensive data and information from a variety of sources about a health condition or a population at risk.

A registry model, which should be examined critically by the task force, would combine select data sources. A news-clipping service (media reports and obituaries) could be considered for real-time identification of farm fatalities [12, 14]. Nonfatal injuries could primarily be identified by NC DETECT and augmented by use of the North Carolina Trauma Registry. To complement these sources of acute injuries, prehospital emergency medical services ambulance-run data should be evaluated for its utility. North Carolina emergency medical services data (Prehospital Medical Information System) show promise, because they are collected electronically in a statewide system, because they include narrative data that provide more detail about injuries, and because they may provide information on additional fatal and nonfatal cases, as not all ambulance runs end at the emergency department (A. Ising, personal communication).

A remaining group of cases to capture is the ambulatory care population that bypasses the hospital emergency department and seeks treatment at community health centers, urgent care centers, or local health departments. Perhaps, to start, providers at migrant and community health centers could be educated about passive reporting.

### Conclusion

Available data indicate that rates of farm-related injury and fatality for North Carolina are higher than national averages. To describe the burden in North Carolina more accurately, health officials and agency stakeholders should work together to strategically enhance existing surveillance efforts. Improved case detection and description would assist in the design of prevention interventions that make an impact. Consensus and action are needed now. NCMJ

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