

# Harvest of Need: Addressing Health and Safety Challenges on North Carolina's Farms

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Agriculture is North Carolina's leading source of revenue and its most dangerous industry. This issue brief, along with the commentaries and sidebars in the associated policy forum, addresses the complexity of agricultural health and safety in North Carolina and concludes that the following activities are crucial to reducing the incidence of agricultural illness, injury, and death in the state: (1) positive promotion of safe and healthy farms, (2) increased funding for existing programs, (3) creation of a task force to develop a dedicated, comprehensive surveillance system for agricultural illness, injury, and fatality, (4) increased emphasis on and funding for training of health care professionals and emergency response personnel in agricultural health and safety, (5) funding to expand farm health and safety programs to all 100 counties, and (6) strong collaborations to further develop and strengthen a seamless, holistic system for addressing the state's agricultural health and safety needs.

**A**griculture is North Carolina's leading source of revenue and its most dangerous industry. In 2009, agriculture generated \$69.6 billion in revenue [1, 2], while the annual fatality rate was 32.6 deaths per 100,000 full-time equivalents (FTEs); the average annual fatality rate for all North Carolina industries was 3.3 deaths per 100,000 FTEs [3, 4]. The rate of nonfatal occupational injuries also outranked rates for other industries during the same time frame [5]. Despite the importance of agriculture to North Carolina's economy and to the well-being of its people, extremely limited resources have been invested to address the health and safety needs of this industry.

The need for resources to address these issues is magnified when we realize that the true burden of agricultural injury or fatality is actually unknown and that the already alarming rate of injuries and fatalities is likely an underestimation. As outlined by Higgins and colleagues [3] in the policy forum of this issue of the NCMJ, the state has no thorough means for conducting farm surveillance, and, further, there are policies that preclude reporting of injury and fatality data by farms with fewer than 11 employees. There is also no surveillance for agricultural illness. This issue brief, along with the commentaries and sidebars in the associated policy

forum, will address the complexity of these and other issues associated with agricultural health and safety. It will also address current and needed strategies to prevent illness, injury, and fatality on North Carolina farms.

To grasp the issues associated with agricultural health and safety, it is first important to understand how agricultural statistics are grouped for reporting by the US Bureau of Labor Statistics, as well as how the National Institute for Occupational Safety and Health (NIOSH) defines the agricultural sector. The Bureau of Labor Statistics combines agriculture (ie, farming), fishing, forestry, and hunting when collecting data on fatal and nonfatal occupational injuries, whereas NIOSH includes agriculture (ie, farming), forestry, and fishing operations that are "primarily engaged in growing crops, raising animals, harvesting timber, and harvesting fish and other animals on a farm, ranch, or from their natural habitats" [6]. A farm, as defined by the US Department of Agriculture, is "any establishment from which \$1,000 or more of agricultural products were sold or would normally be sold during the year" [7pVIII]. For concision, this issue of the NCMJ focuses on farms rather than on forestry or fishing.

Understanding the farm context within the agricultural sector is not sufficient to capture the full picture of farm activity; it is important to know about farm composition, production, and demographic characteristics. North Carolina has more than 52,900 farms [2, 7, 8], with nearly 91% operated by family, family incorporations, or individuals and less than 1% operated by nonfamily corporations. Nearly 70% are smaller than 100 acres, with just more than 3% bigger than 1,000 acres [7, 8]. The state's farms produce more than 80 different commodities, including crops, livestock, and fish; leading commodities are broilers, hogs, greenhouse/nursery/horticulture items, Christmas trees, tobacco, and soybeans [7, 8]. The diversity of commodities is especially important as it is the norm that one farm

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will produce multiple commodities, each of which includes its own unique health- and safety-related issues. The average age of a North Carolina farm operator is 57.3 years, with nearly 59% aged 55 years or older. While farm operators are primarily white men, the number of women operators has increased by 15.9%, from 16,935 in 2002 to 20,146 in 2007, with the number of minority operators remaining virtually unchanged during this period [7, 8].

In addition to operators, 42,250 farmworkers were employed at peak harvest in 2010, according to estimates by the North Carolina Employment Security Commission. This number includes migrant and seasonal farmworkers, as well as individuals working on farms for more than 150 days [9, 10]. As described by Arcury and Quandt [9] in the policy forum, limited information is available with regard to farmworker demographic characteristics. While the majority are Latino, farmworkers may also be white, African American, or Afro-Caribbean, and a recent increase in the number of Southeast Asian farmworkers has also been observed. Farmworkers may be single men or women or may have families, and they range in age from 12 years to more than 60 years. The diversity of ethnic backgrounds has resulted in language-related barriers to the communication of health and safety issues [9].

While it is often the tendency to address issues independently, it is hoped that this issue brief will provide readers with a holistic overview of health and safety issues in the farm environment, as well as give attention to the unique needs of special populations (ie, migrants, older individuals, children, and disabled individuals) working and/or living on farms. The rationale for this approach is this: farm activities are not contained in a bubble. For individuals working and/or living on a farm, there is nothing that can totally isolate them from exposures within the farm environment. A farm spouse or child who does not routinely work on the farm may be needed to assist with moving farm equipment, feeding animals, or harvesting crops by hand. Similarly, children may play, ride an all-terrain vehicle or horse, or walk to a relative's or neighbor's house in areas that are adjacent to or in agricultural production areas.

Federal laws currently permit youth under the age of 16 to work on a farm, with limitations on activities that are especially dangerous being included in Agricultural Child Labor Hazardous Occupations Orders. The US Department of Labor is currently proposing significant changes to the Agricultural Child Labor Hazardous Occupations Orders. Without Congressional action, family farms will continue to be exempt from the rules, as will youths 16 and 17 years of age [11]. With this background and perspective in mind, let's look at some specific issues related to agricultural health and safety.

As noted in the section on demographic characteristics, and as discussed by McLaughlin and Sprufera [12] in the policy forum, North Carolina has an aging farm workforce. Unlike individuals in other occupations, farmers do not have

a set retirement age, and, per a common adage, old farmers don't retire, they just fade away. This fact, accompanied by the limited number of younger farmers (fewer than 17% are younger than 44 years [6, 7]) available to take over farming operations, adds to the burden of an aging workforce. Research conducted on older farmers indicates that older individuals are at greater risk of injury and that their injuries are more likely to be life-threatening [12, 13]. This risk is attributed to routine declines in "physical, cognitive, and motor abilities" [12p482] associated with aging, as well as to "hidden hazards, risk attitudes, workload, and equipment age" [12p481]. For example, an older farmer may be unaware of an unforeseen danger in a given work situation, may believe that he or she can do a task in a certain way because they have always done it that way, may feel compelled to complete a task before it rains, or may not be able to afford to purchase new equipment. At present, North Carolina has no known programs that specifically target reduction of injury or fatality among aging farmers.

Exposures or work conditions leading to physical impairments in the farm environment are too great to enumerate here; they include, but are not limited to, noise, veterinary biological and therapeutic pharmaceuticals, machinery, vibration, zoonotic diseases (animal to human disease transmission), animal management, cold, heat, sun, pesticides, plants, musculoskeletal stressors, and other environmental contaminants. Research has shown that farmers are more likely to have noise-induced hearing loss than are their non-farmer peers of similar age [14,15]. Noise-induced hearing loss comes as a result of repetitive exposures to machinery and animals, without the use of appropriate hearing protection. While efforts are being made, by the North Carolina Agromedicine Institute's AgriSafe-NC program and by the North Carolina Farm Bureau, to increase the use of hearing protection, significantly more work is needed in the area of hearing conservation.

Machinery-related incidents are the leading cause of on-farm fatalities, with tractor incidents accounting for the majority of fatalities [16]. Tractor incidents that produce harm may include bypass starting, front-end loader incidents, rollovers, extra riders, runovers, improper hitching, falls, crushing or caught between, improper maintenance, or entanglements in power takeoff shafts, with tractor rollovers being the leading cause of tractor-related fatalities [17]. Tractor rollovers occur when tractors become unstable because of a change in the center of gravity, such as when mowing on a hillside or a ditch bank. A tractor rollover can occur in as little as three-quarters of a second [18], precluding an operator's ability to respond in time to prevent the rollover. With the use of a rollover protection system, which includes a roll bar and a seat belt, tractor rollover fatalities are more than 99% preventable [18]. While many older tractors are not equipped with a rollover protection system, North Carolina Farm Bureau provides a cost-share incentive for members to install them. Farmers in Sampson, Johnston,

and Duplin Counties who participate in the Certified Safe Farm Program are eligible for farm safety improvement cost-share funds to assist with rollover protection system installation. The Certified Safe Farm Program was developed at the University of Iowa and is being adapted to North Carolina through a collaborative effort between the University of Iowa; North Carolina State University; North Carolina Cooperative Extension Service; Johnston, Sampson, and Duplin Cooperative Extension offices; and the North Carolina Agromedicine Institute, with funding from the North Carolina Tobacco Trust Fund Commission (NCTTFC).

Tractor safety education sessions and demonstrations are conducted intermittently across the state—as funds, manpower, and equipment allow—by Cooperative Extension, Farm Bureau, the North Carolina Agromedicine Institute, and other organizations interested in farm safety. The Agricultural Safety and Health Bureau—North Carolina Department of Labor (ASH-NCDOL) developed a series of videos in English and Spanish to educate farmers and farmworkers on dangers associated with tobacco harvesters, tobacco balers, and forklifts. The bureau also partners with farms and other agencies across the state to conduct on-farm safety trainings and to develop best practices for managing farm labor issues. An example of their collaboration with farms is described in the “North Carolina Gold Star Grower Program” sidebar later in this issue [19].

In addition to tractor and other farm-equipment-related incidents occurring on the farm, farm equipment motor vehicle (FEMV) incidents are of increasing concern as development encroaches into rural areas. Farmers must move farm equipment on increasingly busy rural roads traveled by individuals who are unfamiliar with signage or issues associated with farm equipment movement. As shared by Wooten, while the rate of FEMV incidents is extremely minimal, when an incident does occur, it is fatal or results in significant injury more than 51% of the time [2, 20].

Following the death of a Wilson County farmer in 2003, cooperative extension agents in 7 counties partnered with the North Carolina Highway Patrol to improve FEMV safety by providing education, equipment lighting, and visibility equipment to farmers through the Be Seen and Be Safe program. The program, described in the sidebar by Harrell, was funded by the NCTTFC and has been found to be successful in decreasing crashes by 28% in participating counties [21]. A 2010 FEMV conference held by the North Carolina Agromedicine Institute, in partnership with stakeholders, indicated that funds and efforts were needed to expand the Be Seen and Be Safe program across the state. Education of the nonfarm public, relative to FEMV issues, including recognition and meaning of slow moving vehicle and tractor roadway marking signs, was also felt to be important.

Following a fatal accident in 2008 involving migrant farmworkers, the ASH-NCDOL issued a hazard alert to encourage farms to reevaluate their farm equipment and transport practices. The alert includes information on North Carolina

statutes and the Migrant and Seasonal Agricultural Worker Protection Act (29 CFR 500), enforced by the Wage and Hour Division of the US Department of Labor [22].

While exposure to cold is not of major concern, hot and humid summers can frequently result in heat-related illness or death. In 2008, the Centers for Disease Control and Prevention discussed the issue of heat exposure in its June 28 issue of *Morbidity and Mortality Weekly Report*, including the fatal case of an H-2A visa worker (contract migrant worker) who was working in tobacco in North Carolina and who died from heat stress. According to the report, while the individual had been trained in pesticide exposure, no training had been provided on the dangers of heat stress. For the period between 1992 and 2006, North Carolina had the highest annualized rate of heat-related deaths nationally [23].

In response to heat-related illness and fatality issues, the ASH-NCDOL developed educational materials for farms to use to educate employees about the dangers associated with heat exposure, as well as the precautions that can be taken to avoid them. Contract sites of the North Carolina Farmworker Health Program’s Office of Rural and Community Care, federally qualified migrant/community health centers (through migrant outreach staff), Student Action with Farmworkers, AgriSafe of North Carolina, the North Carolina Agromedicine Institute, AgriSafe of CommWell Health, and others, routinely provide heat-related education across the state. Ongoing efforts must be made to ensure that farmers, farmworkers, health care providers, and farm support agencies are educated in the signs and symptoms of heat-related illness and that all individuals on the farm take necessary precautions to prevent heat-related illness or fatality.

Pesticides are used across the state in the production of crops. Pesticide usage is governed at the state and federal levels, with the North Carolina Department of Agriculture & Consumer Services’ (NCDA&CS) Structural Pest Control and Pesticides Division (SPC&PD) responsible for enforcement [24]. The division conducts routine inspections, responds to citizen complaints, and works closely with other state agencies to provide technical assistance on issues such as the environmentally safe use and disposal of pesticides, the Worker Protection Standard, and risk mitigation measures for soil fumigants. The division also administers the Pesticide Environmental Trust Fund (PETF), which provides assistance with pesticide-related projects that benefit the general public, such as the North Carolina Acute Pesticide Illness and Injury Surveillance Program; pesticide container recycling program; the Pesticides and Farmworker Toolkit, recently developed by the Department of Environmental and Molecular Toxicology at North Carolina State University; and the North Carolina Agromedicine Institute’s Pesticide Related Illness and Health Effects course, which is available online through AHEConnect. Most importantly, the PETF provides the only recurring funds for work in agromedicine at East Carolina, North Carolina State, and North Carolina

Agricultural and Technical State Universities, each of which receives 2% annually (\$10,000-\$12,000 per year) of the receipts from pesticide project registration fees and assessments. Funding is also provided for an agromedicine information specialist at North Carolina State University.

In 2006, the North Carolina General Assembly approved the Mandatory Reporting Rule (G.S. 130A-5(2)) of acute pesticide related illness or fatality. The rule requires that physicians report illnesses within 48 hours, and deaths immediately, to the North Carolina Division of Public Health Occupational and Environmental Epidemiology branch. Per the statute, "acute pesticide illness" means any confirmed or suspected case of systemic, ophthalmologic or dermatologic illness or injury resulting from inhalation, ingestion, dermal exposure or ocular contact with a pesticide, where symptoms occur within eight hours of exposure" [25]. Reports are investigated by the branch, in collaboration with the NCDA&CS SPC&PD, as appropriate. Pesticide surveillance activities associated with the mandatory reporting rule are currently supported by the US Environmental Protection Agency and the NIOSH SENSOR program. In addition to pesticide reporting requirements, all farm incidents in which 3 or more people are hospitalized or any farm incident in which there is 1 farm fatality must be reported to the North Carolina Department of Labor within 8 hours [26].

A concern associated with the ability of physicians to comply with the Mandatory Reporting Rule is that research has shown that health care professionals across both the state and the nation have extremely limited knowledge of pesticide exposure. A study conducted by Tutor and colleagues in 2007, among 193 staff in 9 health departments in eastern North Carolina, found that "staff completed an average of less than 0.17 pesticide education courses, [had] minimal knowledge of resources, and conduct limited pesticide exposure surveillance/education," and that "pesticide exposure surveillance and prevention activities were reported by less than 30 percent of all staff" [27].

In 2008, Governor Mike Easley directed the North Carolina Division of Public Health to convene the Governor's Task Force on Preventing Agricultural Pesticide Exposure. The purpose of the task force was to look at existing regulations and practices relevant to agricultural pesticide safety and use across the state [28]. Following expert testimony, public comments, and task force member discussion, the group submitted 17 recommendations to the governor, in 3 main areas: training, compliance, and health care. While funding was necessary to implement 9 of the recommendations, no funding was approved by the state legislature, because of budget shortfalls. Of the overall recommendations, only those in the compliance area having to do with additional recordkeeping requirements and antiretaliation efforts relative to reporting suspected pesticide exposures were enacted into law. The SPC&PD also convened an interagency pesticide task work group, which meets to promote communication and coordination between government agencies.

The work group has 2 subcommittees, 1 of which is charged with improving training resources for farmworker contractors or crew leaders; the other is charged with determining current trends and the strengths and the weaknesses of pesticide education and educational materials provided across the state. The latter of the 2 subcommittees is particularly interested in identifying best practices in pesticide education that can be replicated for widespread use. One best-practice model that has been identified is the Mountain Pesticide Education and Safety Outreach program, discussed by Hamilton and Sidebottom. The program demonstrates how "a collaborative effort among Christmas tree growers, Cooperative Extension, farmworkers, farmworker health outreach staff, and others [can] reduce pesticide exposure and on-farm injuries" [29]. The model also demonstrates how collaborative efforts can eliminate barriers of language and distrust, which often prevent the success of prevention and intervention efforts among the agricultural community.

While pesticide training is widely viewed to be an important strategy for reducing pesticide exposure, use of personal protective equipment (ie, chemical-resistant clothing, gloves, shoe covers, and respirators), as required on individual pesticide labels, is also important. While most farmers report reading the pesticide label for application rates and methods, the majority do not report reading the first portion of the label, which includes human health effects, personal protective equipment, and what to do in case of a pesticide exposure. Even if the pesticide label is read for recommended personal protective equipment, farmers are often reluctant to use protective equipment, for numerous reasons, including cumbersome, heat, and, in the case of respirator use, interference with vision and communication. Despite these issues, the US Environmental Protection Agency is moving farmers toward increased compliance with personal protective equipment usage requirements.

In 2010, the US Environmental Protection Agency implemented stringent risk mitigation measures for soil fumigants used in the production of tobacco, peanuts, tomatoes, and some other vegetable crops. One segment of the risk mitigation measures requires that, depending on the fumigant being used, up to 2 individuals per farm must be medically cleared, fit tested, and trained to use a full-face air purifying respirator [30]. This requirement posed a significant challenge for farms, especially as the majority of them are not subject to Occupational Safety and Health Administration rules and have never completed medical clearance for and/or used respirators. Farms were further challenged because of the limited number of health care providers in rural areas of the state who were trained in occupational health. At the request of the North Carolina Strawberry Association, the North Carolina Agromedicine Institute was successful in obtaining funding from the NCTTFC to convene a soil fumigant work group, consisting of state and private agencies, to assist farms in implementing risk mitigation measures, including delivery and/or coordination of medical clearance,

respirator fit testing, and training for more than 1,200 individuals across the state. Cost-share funds, to assist farms with services, respirators, and cartridges, were also provided by the NCTTFC and the NCDA&CS PETF. Efforts to identify and/or build occupational health capacity in rural areas are ongoing, as, in addition to overall occupational health needs, farms using fumigants will be required to have medical clearance and respirator fit testing on an ongoing basis.

Although the prevention of pesticide exposure is important, differential diagnosis of pesticide exposure versus heat-related illness versus green tobacco sickness is also essential. While the 3 have similar symptoms (ie, nausea, dizziness, and stomach cramps), it is essential to interview the individual to determine what tasks they have been involved in before experiencing symptoms. Green tobacco sickness occurs when individuals absorb nicotine through their skin from tobacco leaves [9, 31].

Just as an occupational history is important in differential diagnosis of green tobacco sickness, occupational history is also important in determining the etiology of respiratory symptoms in the farm population [32]. Often misdiagnosed as having allergies or an upper respiratory infection, individuals may have been exposed to respiratory irritants within the farm environment, resulting in any of a number of pulmonary illnesses outlined in the policy forum Langley [32]. Engineering controls, personal protective equipment, attention to pesticide labels, and prevention of zoonotic diseases are all important strategies for preventing serious respiratory diseases among agricultural populations [32].

In addition to exposures in the work environment, consideration must be given to other conditions affecting the health and safety of the agricultural work force. These include working conditions, emergency response capabilities, and access to health care. Farmers often work long hours under adverse conditions in isolated areas. Depending on what is occurring with the weather, equipment failures, markets, soil temperature or moisture, animal issues, and business and family demands, farmers may press through fatigue to get the job done [33]. Studies indicate that the risk of farm injuries and fatalities increases when farmers are tired and in a hurry [34].

Incidents often occur when the farmer is working alone or in an isolated area. Prognosis for survival is dependent on emergency preplanning; the skills of the individuals first on the scene, who are often family members or other farmworkers; and the response capability of emergency medical services personnel [35]. As discussed by Greer and Meggs [36] in this issue, emergency preparedness surveys conducted with the farm community and emergency services personnel indicate that the state is severely lacking in farm emergency response capabilities.

And now we come to issues with which health care providers should be most familiar: the primary and preventive health care of farmers, farmworkers, and their families. It is estimated that 29% of farmers are un- or underinsured, with

as many as 85% of farmworkers being uninsured [M.Holmes, R. Tutor, unpublished data, 37]. The counties with the highest agriculture receipts, Duplin and Sampson, are among those with the highest numbers of uninsured [38].

Access to primary and preventive health care for farmers and farmworkers is often prevented by work demands. Models for care, such as migrant farmworker outreach programs and AgriSafe-NC, provide opportunities for individuals to receive services in locations that are convenient, familiar, and trusted, as well as at nontraditional times, including nights, weekends, and early mornings. AgriSafe-NC utilizes specially trained, nationally certified AgriSafe providers to conduct occupational health histories and screenings, personal protective equipment fit testing, and preventive farm safety and health education services, for farmers, farmworkers, and their families.

The importance of grassroots services provision is highlighted by health indicators from 650 farmers and farmworkers served by AgriSafe-NC and AgriSafe of CommWell Health during the past year. Of these individuals, more than two-thirds were found to be hypertensive and overweight/obese, with more than 30% having spirometry results consistent with obstructive pulmonary disease and more than 29% having elevated blood glucose (R. Tutor and B. Gallagher, unpublished data). The percentage of obstructive pulmonary disease is felt to be underreported, as individuals with severe hypertension did not complete spirometry. All indicators are greater than those for the state as a whole.

Given the complexity and magnitude of issues, it is imperative that North Carolina invest in improving farm health and safety. This investment must come (1) through positive promotion of safe and healthy farms; (2) through increased funding for existing programs, including the North Carolina Agromedicine Institute, NCDA&CS, North Carolina Division of Public Health, North Carolina Department of Labor, and North Carolina Farmworker Health Program; (3) through convening a task force to develop a dedicated, comprehensive surveillance system for agricultural illness, injury, and fatality; (4) through increased emphasis on and funding for training of health care professionals and emergency response personnel in agricultural health and safety issues, at the professional preparation and continuing education levels; (5) through funding to expand AgriSafe, Certified Safe Farm, and the Be Seen and Be Safe programs to all 100 counties; and (6) through strong collaborations to further develop and strengthen a seamless, holistic system for addressing the state's agricultural health and safety needs. **NCMJ**

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## References

1. Walden M. State Agribusiness Values. Agriculture and Agribusiness: North Carolina's Number One Industry. College of Agriculture and Life Sciences, North Carolina State University, 2011. <http://www.ag-econ.ncsu.edu/faculty/walden/ncagsz2011.pdf>. Accessed October 23, 2011.
2. Wooten L. Health and safety on North Carolina farms. *N C Med J*. 2011;72(6):484-486 (in this issue).
3. Higgins S, Barros T, Garrison HG. Injury and death on the farm: improving prevention through improved surveillance. *N C Med J*. 2011;72(6):461-465 (in this issue).
4. Fatal Occupational Injuries in North Carolina. Bureau of Labor Statistics Web site. <http://www.bls.gov/iif/oshstate.htm#NC>. Accessed October 23, 2011.
5. Survey of Occupational Injury and Illness. Table 6: Incidence rates of nonfatal occupational injuries and illnesses by industry and case types. Bureau of Labor Statistics Web site. <http://bls.gov/iif/oshstate.htm#NC>. Accessed October 23, 2011.
6. National Institute for Occupational Safety and Health. NIOSH program portfolio: Agriculture, forestry, and fishing. Centers for Disease Control and Prevention Web site. <http://www.cdc.gov/niosh/programs/agff/sector.html>. Accessed October 23, 2011.
7. 2007 Census Publications: Volume 1, Chapter 1: State Level Data. US Department of Agriculture Web site. [http://www.agcensus.usda.gov/Publications/2007/Full\\_Report/Volume\\_1,\\_Chapter\\_1\\_State\\_Level/North\\_Carolina/index.asp](http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_State_Level/North_Carolina/index.asp). Accessed October 23, 2011.
8. North Carolina Department of Agriculture & Consumer Services. 2011 North Carolina Agricultural Statistics. <http://www.ncagr.gov/stats/2011AgStat/NCHighlights.pdf>. Accessed October 23, 2011.
9. Arcury TA, Quandt SA. Living and working safely: challenges for migrant and seasonal farmworkers. *N C Med J*. 2011;72(6):466-470 (in this issue).
10. North Carolina Employment Security Commission. 2010 Estimate of Migrant and Seasonal Farmworkers During Peak Harvest by County. [http://www.ncwinegrowers.com/docs/ind\\_resources/Migrant-Workers.pdf](http://www.ncwinegrowers.com/docs/ind_resources/Migrant-Workers.pdf). Accessed October 23, 2011.
11. Miller ME. Agricultural Child Labor Hazardous Occupations Orders: Comparison of Present Rules with 2011 Proposed Revisions. [http://www.marshfieldclinic.org/proxy/MCRF-Centers-NCMF-NC-CRAHS-ChildLaborFactSheet\\_Sept\\_2011.1.pdf](http://www.marshfieldclinic.org/proxy/MCRF-Centers-NCMF-NC-CRAHS-ChildLaborFactSheet_Sept_2011.1.pdf). Accessed October 27, 2011.
12. McLaughlin AC, Sprufera JF. Aging farmers are at high risk for injuries and fatalities: how human-factors research and application can help. *N C Med J*. 2011;72(6):481-483 (in this issue).
13. Gelberg KH, Struttman TW, London MA. A comparison of agricultural injuries between the young and elderly: New York and Kentucky. *J Agric Saf Health*. 1995;5(1):81-83.
14. Plakke BL, Dare E. Occupational hearing loss in farmers. *Public Health Rep*. 1992;107(2):188-192. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1403630/>. Accessed October 23, 2011.
15. McCallagh M. What farmers can teach us about hearing protector use. Update [newsletter of the Council for Accreditation in Occupational Hearing Conservation]. 2009; 22(3):1-6 <http://www.caohc.org/updatearticles/fall09.pdf>. Accessed October 23, 2011.
16. Madsen M, Donham KJ, Grafft L, Thelin A. Acute agricultural injuries. In: Donham KJ, Thelin A, eds. *Agricultural Medicine: Occupational and Environmental Health for the Health Profession*. Ames, IA: Blackwell Publishing; 2006:304-309.
17. Maher G. Tractor safety: stay on top of it! North Dakota State University Web site. <http://www.ag.ndsu.edu/pubs/ageng/safety/ae1121w.htm#rearwardcultural>. Published February 1997. Accessed October 23, 2011.
18. Barbosa R. Tractor rollover accidents: causes and prevention. Louisiana State University Web site. [http://www.lsuagcenter.com/en/our\\_offices/departments/biological\\_ag\\_engineering/features/extension/agriculture\\_and\\_environment/ag\\_safety/tractor+rollover+accidents+causes+and+prevention.htm](http://www.lsuagcenter.com/en/our_offices/departments/biological_ag_engineering/features/extension/agriculture_and_environment/ag_safety/tractor+rollover+accidents+causes+and+prevention.htm). Accessed October 23, 2011.
19. Cullen R. The North Carolina Gold Star Grower program. *N C Med J*. 2011;72(6):467 (in this issue).
20. Luginbuhl RC, Jones VC, Langley RL. Farmers' perceptions and concerns: the risks of driving farm vehicles on rural roadways in North Carolina. *J Agric Safety Health*. 2003;9(4):327-348.
21. Harrell N. Be Seen and Be Safe highway safety with farm equipment program. *N C Med J*. 2011;72(6):463 (in this issue).
22. North Carolina Department of Labor. Hazard Alert: Traffic and Transportation Safety for Agriculture Industry. [http://www.nclabor.com/osha/etta/hazard\\_alerts/Traffic.pdf](http://www.nclabor.com/osha/etta/hazard_alerts/Traffic.pdf). Accessed October 23, 2011.
23. Centers for Disease Control and Prevention. Heat-related deaths among crop workers—United States, 1992-2006. *MMWR Morb Mortal Wkly Rep*. 2008;57(24):649-653. <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5724a1.htm>. Accessed October 23, 2011.
24. Pesticides in North Carolina. North Carolina Department of Health and Human Services Web site. <http://epi.publichealth.nc.gov/pests.html>. Accessed October 23, 2011.
25. North Carolina General Assembly. Mandatory reporting rule, SUBCHAPTER 41F - Pesticide-Related Illness or Injury Surveillance, Section .0100 - Physician Reporting of Pesticide-Related Illness or Injury, G.S. 130A-5(2). 2006. [http://epi.publichealth.nc.gov/pest/pdf/Mandatory\\_reporting\\_rule.pdf](http://epi.publichealth.nc.gov/pest/pdf/Mandatory_reporting_rule.pdf). Accessed October 23, 2011.
26. North Carolina Department of Labor. Recordkeeping and Reporting: 29 CFR 1904. [www.nclabor.com/osha/etta/presentations/Record.ppt](http://www.nclabor.com/osha/etta/presentations/Record.ppt). Accessed October 27, 2011.
27. Tutor RP, Zarate MA, Loury S. Pesticide exposure surveillance and prevention skills of staff in eastern North Carolina health departments. *J Public Health Manag Pract*. 2008;14(3):299-310
28. North Carolina Department of Health and Human Services, Division of Public Health. Report to the Honorable Michael F. Easley, Governor of the State of North Carolina from the Governor's Task Force on Preventing Agricultural Pesticide Exposure. <http://epi.publichealth.nc.gov/pest/pdf/PesticideTaskForceReport.pdf>. Published 2008. Accessed October 23, 2011.
29. Hamilton J, Sidebottom J. Mountain Pesticide Education and Safety Outreach program: a model for community collaboration to enhance on-farm safety and health. *N C Med J*. 2011; 72(6):471-473 (in this issue).
30. Implementing new safety measures for soil fumigant pesticides. US Environmental Protection Agency Web site. [http://www.epa.gov/oppsrrd1/reregistration/soil\\_fumigants/implementing-new-safety-measures.html#worker](http://www.epa.gov/oppsrrd1/reregistration/soil_fumigants/implementing-new-safety-measures.html#worker). Accessed October 27, 2011
31. Arcury TA, Quandt SA, Preisser JS, Bernert JT, Norton D, Wang J. High levels of transdermal nicotine exposure produce green tobacco sickness in Latino farmworkers. *Nicotine Tob Res*. 2003;5(3):315-312.
32. Langley RL. Consequences of respiratory exposures in the farm environment. *N C Med J*. 2011;72(6):477-480 (in this issue).
33. Pollock C. Fatigue often leads to farm accidents. *Southeast Farm Press*. April 29, 2010. <http://southeastfarmpress.com/livestock/fatigue-often-leads-farm-accidents>. Accessed October 23, 2011.
34. Rautiainen RH, Lange JL, Hodne CJ, Schneiders S, Donham KJ. Injuries in the Iowa Certified Safe Farm study. *J Agric Saf Health*. 2004;10(1):51-63.
35. Safe Farm: How to Respond to Farm Injuries. <http://www.extension.iastate.edu/Publications/PM1518L.pdf>. Accessed October 23, 2011.
36. Greer AG, Meggs W. North Carolina's preparedness to respond to on-farm emergencies. *N C Med J*. 2011;72(6):474-476 (in this issue).
37. Rosenbaum S, Shinn P. Migrant and Seasonal Farmworkers: Health Insurance Coverage and Access to Care. Kaiser Commission on Medicaid and the Uninsured. <http://www.gwumc.edu/sphhs/departments/healthpolicy/CHPR/downloads/migrant.pdf>. Published April 2005. Accessed October 27, 2011.
38. North Carolina Institute of Medicine and Cecil B. Sheps Center for Health Services Research. North Carolina County-Level Estimates of Non-Elderly Uninsured 2008-2009. [http://nciom.org/wp-content/uploads/2010/08/County-Level\\_Estimates\\_08-09.pdf](http://nciom.org/wp-content/uploads/2010/08/County-Level_Estimates_08-09.pdf). Accessed October 23, 2011.