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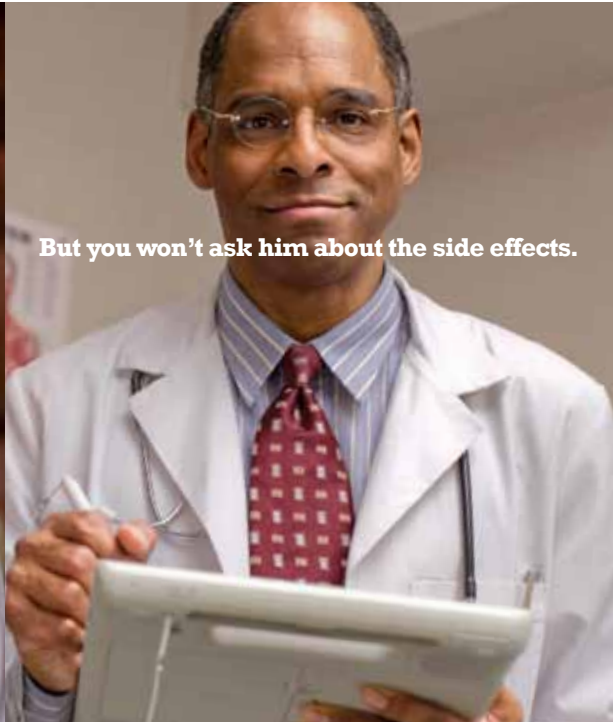
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Original Articles

432 Drug Use Trend for Arthritis and Other Rheumatic Conditions and Effect of Patient's Age on Treatment Choice

Rishi J. Desai, Santosh J. Agarwal, Rajender R. Aparasu

439 The Increasing Impact of Human Immunodeficiency Virus Infections, Sexually Transmitted Diseases, and Viral Hepatitis in Durham County, North Carolina: A Call for Coordinated and Integrated Services

Marc Kolman, Mary DeCoster, Rae Jean Proeschold-Bell, Genevieve Ankeny Hunter, John Bartlett, Arlene C. Seña

447 Seasonality of Poor Pregnancy Outcomes in North Carolina

Marie Lynn Miranda, Rebecca Anthopolos, Sharon E. Edwards

Policy Forum

Agricultural Health

INTRODUCTION

454 Agricultural Health
Thomas C. Ricketts III

ISSUE BRIEF

455 Harvest of Need: Addressing Health and Safety Challenges on North Carolina's Farms
Robin Tutor-Marcom, Tom Irons

INVITED COMMENTARIES AND SIDEBARS

461 Injury and Death on the Farm: Improving Prevention Through Improved Surveillance
Sheila Higgins, Tanya Barros, Herbert G. Garrison

463 Be Seen and Be Safe Highway Safety With Farm Equipment Program [sidebar]
Norman Harrell

466 Living and Working Safely: Challenges for Migrant and Seasonal Farmworkers
Thomas A. Arcury, Sara A. Quandt

467 The North Carolina Gold Star Grower Program [sidebar]
Regina Cullen

471 Mountain Pesticide Education and Safety Outreach Program: A Model for Community Collaboration to Enhance On-Farm Safety and Health

Jim Hamilton, Jill Sidebottom

474 North Carolina's Preparedness to Respond to On-Farm Emergencies

Annette G. Greer, William Meggs

477 Consequences of Respiratory Exposures in the Farm Environment

Ricky L. Langley

481 Aging Farmers Are at High Risk for Injuries and Fatalities: How Human-Factors Research and Application Can Help

Anne Collins McLaughlin, John F. Sprufera

484 Health and Safety on North Carolina Farms

Larry Wooten

DEPARTMENTS

430 Tar Heel Footprints in Health Care

488 Running the Numbers

492 Spotlight on the Safety Net

Correspondence

493 North Carolina's Nursing Workforce: Economic and Sociological Concerns
Allen J. Smart

494 Reply to Smart
Margaret C. Wilmoth

Reader Services

495 Classified Advertisements

496 Advertiser Index

Tar Heel Footprints in Health Care

A periodic feature that recognizes individuals whose efforts—often unsung—enhance the health of North Carolinians

Tami Thompson



After her father died, Tami Thompson left her job in medical technology at a rural physician's office and, along with her husband, returned to the small farm she grew up on, raising goats and cows. To help sustain the farm, Mrs. Thompson and her husband became involved in agritourism by hosting educational field trips for children, to get them excited about farms. Mrs. Thompson quickly realized the dangers that can exist on a farm and that her visitors, especially the children, were usually unaware of those dangers. That is when Mrs. Thompson began attending classes and workshops on agricultural safety held by organizations such as the North Carolina Cooperative Extension, AgriSafe, and the North Carolina Agritourism Association.

Today, after lots of hard work and perseverance, Lazy-O Farm, in Smithfield, North Carolina, is the first farm in the state to be a Gold Star Certified Safe Farm. It is also the first-known farm in the United States to have adopted the health and safety guidelines created by the National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS).

Mrs. Thompson is now using her experiences from becoming a Certified Safe Farm and from implementing the NCCRAHS guidelines to help other farm owners. Lazy-O Farm hosts tours and gives presentations to teach other farmers how to put safety precautions in place. Most recently, the farm has been involved in activities such as the Progressive Agricultural Safety Day and the Southeast District Agritourism Tour.

Mrs. Thompson has worked with many people over the years on the path to becoming a Gold Star Certified Safe Farm. One of her colleagues from AgriSafe, Barbara Gallagher, RN, says that Mrs. Thompson is successful because of her determination and persistence. She says, "Any task we ask [Mrs. Thompson] to do gets done. She makes work fun, instead of a chore." Another colleague, from the North Carolina Cooperative Extension, Bryant Spivey, says that Mrs. Thompson is "a very hard worker and very committed" and that she "isn't afraid to do anything—she's a very tough person."

Mrs. Thompson is also involved in many organizations and activities in her community. She is chairperson of the youth livestock program, vice president of the goat producers association, district supervisor of the Johnston County Soil and Water Conservation, and treasurer of the North Carolina Agritourism Association, and she participates in Johnston County 4-H and Prevent Blindness North Carolina.

Mrs. Thompson credits her husband with helping her in all that she has accomplished, saying, "I couldn't do anything without my husband, David. We are a two-person team and cannot function without each other." NCMJ

Contributed by Rachel E. Williams, MPH, research assistant, North Carolina Institute of Medicine, Morrisville, North Carolina (rachelemilywilliams@gmail.com; present affiliation: research associate, SciMetrika, Durham, North Carolina).



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Drug Use Trends for Arthritis and Other Rheumatic Conditions and Effect of Patient's Age on Treatment Choice

Rishi J. Desai, Santosh J. Agarwal, Rajender R. Aparasu

BACKGROUND Little is known about the influence of the patient's age on selection of treatment for arthritis and other rheumatic conditions (AORCs). The aim of the present study was to examine drug use trends in patients with AORCs in ambulatory care and to study age-specific drug use.

METHODS Data from the National Ambulatory Medical Care Survey and the outpatient department component of the National Hospital Ambulatory Medical Care Survey were used to examine ambulatory visits for AORCs during 2001-2005. Use of nonsteroidal anti-inflammatory drugs (NSAIDs), analgesics (narcotics and nonnarcotics), steroids, and disease-modifying antirheumatoid drugs (DMARDs) was measured as the proportion of visits that resulted in a prescription. Age-specific drug use trends were determined separately for adult (19-64 years) and for elderly (≥ 65 years) patients.

RESULTS According to the national surveys, there were 208 million ambulatory visits for AORCs during the study period. Use of NSAIDs, analgesics, steroids, and DMARDs was found to be 33.3%, 23.5%, 15.7%, and 4.3%, respectively. Analgesic use increased from 18.3% in 2001 to 26.7% in 2005. DMARDs and NSAIDs were prescribed 1.2 times more to adult patients than to elderly patients. Steroids and analgesics were prescribed 1.3 and 1.2 times more, respectively, to elderly patients than to adult patients.

LIMITATION The findings do not translate to population-based prevalence measures, as the unit of analysis was the patient visit.

CONCLUSIONS NSAIDs remain the most frequently prescribed drug class for AORCs; however, there has been increased use of analgesics in recent years. The study findings suggest that the patient's age plays a role in the choice of drugs prescribed for AORCs.

Arthritis is a painful disease that manifests in the form of multiple rheumatic conditions, such as osteoarthritis, joint disorders, arthropathies, carpal tunnel syndrome, and rheumatoid arthritis [1]. Disability and work limitation are the main effects of arthritis and other rheumatic conditions (AORCs) in adults [2]. On the basis of data from the 2003-2005 National Health Interview Survey, the prevalence of arthritis in US adults is estimated to be 21.6% (46.4 million adults) [2]. Estimates based on data from the 2003 Medical Expenditure Panel Survey reveal that the direct, indirect, and total costs attributable to AORCs are \$80.8 billion, \$47 billion, and \$321.8 billion, respectively. In 2003, mean medical spending was \$6,978 per adult with AORC, and prescription bills averaged \$1,635 per person per year [3]. The public health burden of arthritis will continue to increase as the baby boomers age. According to the 2002 North Carolina Arthritis Report, the prevalence of arthritis in North Carolina is one of the highest in the nation [4]. The economic, clinical, and human burdens could potentially be reduced with timely medical attention and medication management.

Medication management is the mainstay of treatment of AORCs, and the main drug classes used are nonsteroidal anti-inflammatory drugs (NSAIDs), analgesics, steroids, and disease-modifying antirheumatic drugs (DMARDs). However, the treatment guidelines for different arthritic conditions differ. For patients suffering from rheumatoid

arthritis, guidelines suggest that DMARDs should be started within the first 3 months, to arrest the progression of the disease [5]. On the other hand, acetaminophen (nonnarcotic analgesic) is the agent of first choice for treatment of osteoarthritis, and NSAIDs are recommended if pain is not well-controlled with acetaminophen [6]. Steroid injections are reserved for treatment of patients with osteoarthritis of the knee who have effusion or local inflammation in osteoarthritis, according to the American College of Rheumatology recommendations for treatment of osteoarthritis [6]. Steroid use is generally recommended for treatment of rheumatoid arthritis if the patient is at risk of gastrointestinal bleeding from treatment with NSAIDs [5].

Some previous studies have examined drug use trends, but most have focused on specific and more-prevalent conditions of AORCs—mainly osteoarthritis and rheumatoid arthritis [7-9]. AORCs include more than 100 conditions, so drug use for less-prevalent arthritic conditions is often not accounted for in those studies. Only 1 study, by Hootman and colleagues [10], comprehensively evaluated the drug

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use trends for AORCs in ambulatory settings during a 1-year period. The purpose of the present study is to evaluate drug use trends for AORCs during a 5-year period. The majority of health care services for the treatment of AORCs are accessed through ambulatory care; therefore, data from the 2001-2005 National Ambulatory Medical Care Survey (NAMCS) and from the outpatient department component of the 2001-2005 National Hospital Ambulatory Medical Care Survey (NHAMCS) were used to examine drug use trends.

It has been shown in the literature that the patient's age influences the choice of pharmacotherapy prescribed by rheumatologists [11, 12]. This phenomenon is well-recognized in the delivery of health care and is studied extensively in fields such as oncology and cardiovascular diseases [13, 14]. Age-based variation in prescribing drugs is not well-documented in rheumatology. The present study evaluates the drug use trends at visits for AORCs by use of ambulatory care data. Analysis focused on 2 groups, adults (19-64 years) and the elderly (≥ 65 years), to evaluate the drug use trends. We hypothesize that the prescription of NSAIDs, analgesics, steroids, and DMARDs will be different between adults and the elderly because of the pharmacodynamics and pharmacokinetics of these medications.

Methods

Data source. Data from the NAMCS and the NHAMCS were used to capture ambulatory-care-related visits for AORCs in the United States. Only the outpatient department portion of the NHAMCS was used for the present study, since the medical care provided in these settings is similar to the care provided in office-based settings. The clinical nature of the visits in both surveys was collected using similar instruments. The present study was considered exempt by the institutional review board at the University of Houston, since the secondary analysis is based on public-use data files that protect the identity of patients.

The NAMCS is a national probability sample survey of visits to office-based physicians, whereas the NHAMCS is a national probability sample survey of visits to hospital outpatient and emergency departments. These surveys are conducted by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS), and they are components of the National Health Care Survey, which measures health care use across a variety of health care providers [15, 16]. The NAMCS visits are sampled by use of a multistage clustered probability sample design that is based on geographic locations (primary sampling units), provider specialty, and number of visits to individual physicians. The NHAMCS visits are sampled on the basis of geographic locations (primary sampling units), hospitals within these areas, and clinics in the outpatient and emergency departments of these hospitals. The basic sampling unit for both the NAMCS and the NHAMCS is a single patient visit.

Data for the present study were derived from 5 survey

TABLE 1.
Demographic Characteristics of Patients Making Visits for Arthritis and Other Rheumatic Conditions (AORCs) in the United States

Variable	AORC visits
Age category	
Adults (19-64 years)	63.7 (61.2-66.2)
Elderly (>65 years)	36.3 (36.0-39.6)
Sex	
Female	62.1 (60.4-64.0)
Male	37.8 (36.0-39.6)
Race	
White	86.8 (85.0-88.6)
Black	10.1 (8.4-11.7)
Other	31.0 (2.3-4.0)
Main reason for visit	
Chronic problem	50.9 (49.1-54.7)
New problem	36.3 (34.0-38.5)
Preventive care/pre- or postsurgery	9.1 (7.8-10.4)
Unknown	2.7 (1.8-3.6)
Payment type	
Private insurance	50.2 (47.7-52.8)
Medicare	30.7 (28.5-32.9)
Medicaid	6.2 (5.2-7.2)
Other source ^a	9.4 (8.0-10.9)
Unknown	3.5 (2.6-4.4)
Region	
South	38.5 (32.9-44.0)
Midwest	21.6 (17.7-25.5)
West	21.3 (18.2-24.5)
Northeast	18.5 (14.9-22.1)
MSA	
MSA	81.5 (74.8-88.1)
Non-MSA	18.5 (11.9-25.2)
Prescription of any medication	
Yes	69.8 (67.1-72.5)
No	30.2 (27.5-32.9)

Note. Data are % (95% confidence interval). MSA, metropolitan statistical area.

^aOther payment sources include self-pay, no charge, worker's compensation, and other, unmentioned sources.

years (2001-2005). The NAMCS and the NHAMCS collected information on up to 6 medications in 2001 and on up to 8 medications during 2002-2005 that were prescribed at the end of a visit, including both a new and a continuing prescription. Information was collected on up to 3 diagnoses related to the visit. The staff collected the data using a visit encounter form for both surveys.

Operational definitions and analysis. The present study focused on the outpatient ambulatory care visits by adults (≥ 19 years) who received a primary diagnosis of AORCs. Visits for AORCs were defined using *International*

Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes, on the basis of the list provided by the 1995 National Arthritis Data Workgroup [10]. The list of ICD-9-CM codes used is provided in Table A1 of the Appendix (available only in the online edition of the NCMJ). Drugs were classified into 4 drug categories (NSAIDs, analgesics, steroids, and DMARDs) on the basis of the current pharmacotherapeutic options available for the treatment of AORCs. NSAIDs, analgesics, and steroids were defined using National Drug Code classifications. DMARDs were defined using the Ambulatory Care Drug Database System and the American Hospital Formulary System [10]. A list of drug definitions is provided in Table A2 of the Appendix (available only in the online edition of the NCMJ).

The drug use trends for AORCs were analyzed by evaluating prescribing practices in outpatient visits. National weighted estimates of ambulatory care visits were calculated using survey sample weights, to account for the multistage sampling design of the NHAMCS and the NAMCS. These weights were calculated for each visit by the NCHS on the basis of the reciprocal of sampling probability of a

health care facility, physician, and patient visit; they were also adjusted for nonresponse bias. Nonresponse bias arises when physicians or hospitals do not provide data, when physicians do not see any patients during the sample week, or when physicians fail to provide a patient record form for a visit. The NCHS weighting system accounts for nonresponse bias by assigning extra weights, from nonresponding cases to responding cases [15, 16]. The patient weights were derived by taking into account each visit's contribution inversely proportioned to the likelihood of that visit being sampled from all community-based visits. Patient weight can be interpreted as the total number of visits in the population that the sample visit represents, and it allows for extrapolation to national patterns of practice.

Estimates were considered to be reliable only if the relative standard error was below 30% and the unweighted sample size was more than 30 observations. The survey design variables in the NAMCS and the NHAMCS were used to calculate the 95% confidence interval (CI) and the standard error. The rates of drug prescription were calculated as the proportion of total visits for AORCs that resulted in a

TABLE 2.
Visits for Arthritis and Other Rheumatic Conditions, by Primary Diagnosis and Age Group, 2001-2005

ICD-9-CM code	Diagnosis	All patients	Adults (19-64 years)	Elderly (≥65 years)
274	Gout	2.7 (2.0-3.4)	2.4 (1.7-3.2)	3.1 (2.0-4.3)
446	Polyarteritis nodosa and allied conditions	0.5 (0.2-0.7)	...	0.9 (0.4-1.5)
711	Arthropathy associated with infections	0.2 (0.0-0.5)
714	Rheumatoid arthritis and other inflammatory polyarthropathies	6.4 (4.4-8.5)	6.8 (4.2-9.3)	5.9 (4.1-7.6)
715	Osteoarthritis and allied disorders	27.0 (24.7-29.4)	20.5 (18.1-22.9)	38.5 (35.0-42.0)
716	Other and unspecified arthropathies	8.1 (6.9-9.3)	7.8 (6.4-9.1)	8.7 (6.9-10.4)
719	Other/unspecified joint disorders (excluding 719.1)	20.0 (18.1-21.9)	22.9 (20.6-25.1)	15.0 (12.5-17.5)
720	Ankylosing spondylitis and other inflammatory spondylopathies	0.7 (0.3-1.1)	0.8 (0.4-1.2)	...
721	Spondylosis and allied disorders	4.0 (3.0-5.0)	3.6 (2.4-4.7)	4.9 (3.4-6.3)
725	Polymyalgia rheumatica	1.7 (0.9-2.5)	...	3.8 (2.1-5.6)
726	Peripheral enthesopathies and allied conditions	16.0 (14.5-17.5)	19.7 (17.6-21.8)	9.5 (7.6-11.3)
727	Other disorders of synovium, tendon, or bursa	8.9 (7.6-10.2)	10.2 (8.6-11.7)	6.7 (5.0-8.3)
728	Disorders of muscle, ligament, fascia (excludes 728.4 and 728.5)	3.7 (3.0-4.3)	4.4 (3.5-5.2)	2.4 (1.5-3.3)

Note. Data are % (95% confidence interval). Cells without data represent an unweighted frequency <30%. Calculation of weighted estimates and percentages would be inappropriate, as they do not meet the National Center for Health Statistics criteria required for reliable estimation. ICD-9-CM, *International Classification of Diseases, Ninth Revision, Clinical Modification*.

TABLE 3.
Proportion of Visits for Arthritis and Other Rheumatic Conditions that Resulted in a Prescription during 2001-2005 (N = 208 million), by Age Group

Prescription	All patients	Adults (19-64 years)	Elderly (≥65 years)	P ^a
NSAIDs	33.3 (31.2-35.4)	35.1 (32.8-37.4)	30.1 (26.6-33.5)	.01
Analgesics	23.5 (21.7-25.4)	22.3 (20.2-24.4)	25.7 (22.8-28.7)	.04
Steroids	15.7 (13.8-17.5)	14.1 (12.4-15.8)	18.4 (15.4-21.5)	.001
DMARDs	4.3 (2.8-5.8)	5.0 (3.1-7.0)	3.0 (1.8-4.3)	.01

Note. Data are % (95% confidence interval). DMARDs, disease-modifying antirheumatoid drugs; NSAIDs, nonsteroidal anti-inflammatory drugs.

^aBy comparing adult patients with elderly patients on the basis of receipt of the respective medication during the 5-year period. Statistically significant at $\alpha = .05$.

prescription. The proportion hence obtained was converted into a percentage scale and reported. A subgroup analysis was conducted to examine age-specific drug prescription rates. Accordingly, the study population was divided into 2 age categories: adults (19-64 years) and the elderly (≥65 years). Age-specific drug prescription rates were calculated as the proportion of total visits made by patients in the age group for AORCs that resulted in a prescription. Statistically significant time trends in prescription use, by drug class, were identified using the logistic regression model, with 2001 serving as the reference year and indicator variables for 2002-2005 included as the only covariate. Statistically significant differences in drug prescription rates between age groups, by drug class, during a 5-year period were identified using a χ^2 test. SAS version 9.1 (SAS Institute, Cary, NC) survey procedures were used for analysis to account for the multistage clustered survey design of the NAMCS and the NHAMCS. An α level of .05 was selected to define significance in all statistical analyses.

Results

Primary diagnosis of AORCs accounted for a total of 208 million estimated visits by patients aged 19 years and older in ambulatory health care settings during 2001-2005; this represented 4.4% of the total visits in ambulatory health care settings during that period. A total of 63.7% of the AORC-related visits were made by adults. Women were approximately 1.6 times more likely to make visits than were men. More than 4 in 5 visits were made by white individuals. In approximately one-third of the visits, a new AORC-related problem was diagnosed, and approximately half the visits were reimbursed by private insurance; the next most-common sources of reimbursement were government sponsored Medicare and Medicaid. More than one-third of the visits occurred in the Southern region, and approximately four-fifths occurred in metropolitan areas. Nearly 70% of the visits resulted in at least 1 prescription (Table 1).

In the study sample, the most common AORCs during 2001-2005 were osteoarthritis and allied conditions (27% of the total visits), which were followed by other unspecified joint disorders (20%) and peripheral enthesopathies

and allied conditions (16%). A higher proportion of elderly patients were diagnosed with osteoarthritis (38.5%), compared with adult patients (20%). Table 2 shows the breakdown of AORC-related visits according to primary diagnosis at time of visit.

NSAIDs were found to be the most prescribed drug class during each of the 5 years (Table 2). The overall prescription rate for NSAIDs was 33.3% (95% CI, 31.2%-35.4%) during the study period. Analgesics and steroids were the second and third most frequently prescribed classes of drugs. An analgesic was prescribed at 23.5% (95% CI, 21.7%-25.4%) of visits for AORCs, and a steroid was prescribed at 15.7% (95% CI, 13.8%-17.5%) of visits for AORCs. DMARDs were the least frequently prescribed drug class, with a prescription rate of 4.3% (95% CI, 2.8%-5.8%) (Table 3). There was no significant trend in the use of NSAIDs for AORCs during the study period. Analgesic use increased from 18.3% in 2001 to 26.7% in 2005 ($P < .01$). The rate of prescription for DMARDs showed no clear pattern during the study period (Table 4).

The subgroup analysis, involving adult and elderly patients, for time trends yielded similar results. Among adult patients, the rate of prescription for analgesics increased from 16.5% in 2001 to 25.7% in 2005 ($P < .01$). Among elderly patients, the prescription trends were broadly similar to those among adult patients. However, in 2005, the prescription rate for analgesics increased to 28.4%, making it the most prescribed drug class among the elderly, overtaking the prescription rate for NSAIDs (27.6%) for that year (Table 4).

Significant differences were revealed when drug prescription rates were compared between age groups, by drug class, during the 5-year period. The present study found that the average prescription rate for NSAIDs for adult patients (35.1%) was higher than that for elderly patients (30.1%). Similarly, DMARDs were also found to be prescribed at a higher rate in adult patients (average prescription rate, 5.0%) than in elderly patients (average prescription rate, 3.0%). Alternatively, elderly patients were more likely to be prescribed a steroid (average prescription rate, 18.4% in elderly patients vs 14.1% in adult patients) or an analge-

sic (average prescription rate, 25.7% in elderly patients vs 22.3% in adult patients) (Table 3).

Discussion

In the present analysis of drug use trends, we observed an increasing trend in analgesic prescriptions from 2001 to 2005. A subgroup analysis of prescription trends on the basis of patient age revealed that NSAIDs and DMARDs are more frequently prescribed for adult patients, while steroids and analgesics are preferred for elderly patients. The findings of the study on the magnitude of ambulatory care visits for AORCs are consistent with those of a previous study by Hootman and colleagues [10]. Women had a rate of visits for AORCs that was 1.6 times higher than that for men, which is consistent with the high prevalence rates of AORCs among women [17]. White individuals account for the majority of visits, indicating possible racial disparities in access to health care, insurance coverage, and awareness of need for treatment. This finding is consistent with the general use of ambulatory medical services [18]. The proportion of women in the elderly group was higher than that in the adult group (67.9% vs 58.9%).

NSAIDs were the most prescribed drug class during the 5-year study period. Some fluctuations in the estimates of prescription rates for NSAIDs between the study years were observed, but they were not statistically significant. The NSAID prescription rate experienced a spike, from 31.0% in 2001 to 36.7% in 2003; the rate fell to 30.9% in 2005 (Table 4). The spike could be attributed to the increased use of the NSAID selective COX-2 inhibitors (coxibs) during that period, as coxibs claimed an increased safety profile, related to the adverse gastrointestinal events of NSAIDs [6].— The lower prescription rate in 2005 could be attributed to the reporting of cardiac adverse events and the subsequent withdrawal of coxibs from the market [5, 19].

Some previous studies that focused on specific conditions of AORCs have reported similar findings. One study that focused on osteoarthritis reported a 32.6% use rate for NSAIDs during 1995-1998 [7]. The average annual prescription rate for NSAIDs was 35.2% among the osteoarthritis subpopulation (data not shown). In the present study, 27% of all visits for AORCs included a primary diagnosis of osteoarthritis. NSAIDs are used widely in the treatment of osteoarthritis, so the high prescription rates for NSAIDs reflect their high rate of use in patients with osteoarthritis in the study population. Another study, which focused on rheumatoid arthritis, reported an increase in NSAID use from 1995 to 2002, and then a decrease from 2002 to 2004 [8].

In the early 2000s, numerous publications critically assessed the appropriateness of NSAIDs, in the wake of pharmacoepidemiological evidence of their adverse effects [20, 21]. This raised concerns about the use of NSAIDs, and as a result, physicians looked for alternatives. The significant increase in the prescription rate for analgesics may represent physicians' response to the publication of epide-

miological evidence on the risks associated with the use of NSAIDs. A definite pattern in the trend of DMARD use could not be determined, and their use was found to be the lowest, with an average prescription rate of nearly 4% of all visits for AORCs. DMARDs are recommended as the first-line agents for the treatment of rheumatoid arthritis [22, 23]. In the study population, only 6.4% of visits had a primary diagnosis of rheumatoid arthritis. In patients who received a primary diagnosis of rheumatoid arthritis, use of DMARDs was found to be 53.7% (data not shown). This is lower than the 72% use rate reported by Grijalva and colleagues [8] in 2004. However, they identified their patients on the basis of both rheumatoid arthritis ICD-9-CM codes and at least 1 prescription of DMARDs. Their sensitivity analysis, which identified patients on the basis of only rheumatoid arthritis diagnostic codes, as was the approach in the present study, yielded similar estimates (52% in 2004).

Significantly higher use of NSAIDs and DMARDs was

TABLE 4.
Medication Trends for Patients with Arthritis and Other Rheumatic Conditions (AORCs), 2001-2005

Medication, year	All patients	Adults (19-64 years)	Elderly (≥65 years)
NSAIDs			
2001	31.0 (26.0-35.9)	32.5 (26.7-38.2)	28.4 (21.3-35.5)
2002	34.9 (30.3-39.6)	35.3 (30.2-40.4)	34.4 (27.9-40.8)
2003	36.7 (31.8-41.6)	39.4 (33.3-45.6)	31.3 (24.5-38.1)
2004	33.6 (28.9-38.3)	36.2 (31.2-41.2)	29.1 (22.2-36.0)
2005	30.9 (26.0-35.7)	32.6 (27.7-37.5)	27.6 (19.4-35.8)
Analgesics			
2001	18.3 (14.8-21.8)	16.5 (12.8-20.1)	21.5 (15.0-27.9)
2002	23.5 (19.6-27.5)	22.1 (17.4-26.8)	25.8 (20.0-31.5)
2003	25.4 ^a (21.6-29.2)	23.2 ^a (17.5-28.9)	29.6 (23.7-35.5)
2004	23.7 (18.8-28.6)	23.8 (19.0-28.5)	23.5 (16.7-30.3)
2005	26.7 ^a (21.9-31.5)	25.7 ^a (20.8-30.7)	28.4 (21.9-35.0)
Steroids			
2001	14.9 (11.6-18.1)	12.9 (9.4-16.5)	18.1 (13.6-22.6)
2002	13.6 (10.0-17.2)	12.3 (8.6-16.1)	15.6 (11.2-20.0)
2003	15.6 (11.8-19.3)	13.7 (10.5-17.0)	19.1 (12.1-26.1)
2004	15.8 (12.1-19.5)	14.4 (10.2-18.6)	18.3 (11.5-25.0)
2005	18.0 (13.5-22.4)	16.5 (12.7-20.2)	20.8 (14.0-27.6)
DMARDs			
2001	4.3 (0.3-8.4)	5.3 (0.10.7)	...
2002	3.4 (1.0-5.9)	4.4 (1.1-7.7)	...
2003	5.5 (1.1-9.8)	6.5 (0.8-12.3)	...
2004	0.6 ^a (0.1-1.1)
2005	6.8 (3.3-10.2)	6.9 (3.3-10.5)	...

Note. Data are % (95% confidence interval). Figures represent percentages of the visits for AORCs (in the respective category) that resulted in a prescription. Cells without data represent an unweighted frequency <30%. Calculation of weighted estimates and percentages would be inappropriate, as they do not meet the National Center for Health Statistics criteria required for reliable estimation. DMARDs, disease-modifying antirheumatoid drugs; NSAIDs, nonsteroidal anti-inflammatory drugs.

^aStatistically significant at $\alpha = .05$, compared with 2001.

reported in adult patients than in elderly patients. These differences could be explained by an evidence-based response of providers to specific drug classes, in terms of their safety and efficacy in different age groups. A study by Fraenkel and colleagues [11] found that older patients with rheumatoid arthritis were less likely to receive aggressive DMARD treatment than were younger patients with rheumatoid arthritis. Tuntucu and colleagues [12] concluded that patients with elderly-onset rheumatoid arthritis (at >60 years) received biological treatment in combination with DMARDs less frequently than did patients with early-onset rheumatoid arthritis. Scmajuk and colleagues [24] also reported that older patients with rheumatoid arthritis were less likely to receive DMARDs, compared with younger patients. Some concerns have been documented in numerous studies of NSAIDs, also. Turajane and colleagues [25] reported that, with increasing age, risk of gastrointestinal and cardiovascular adverse events increases in patients with osteoarthritis of the knee. It is a well-documented fact that older patients are at a greater risk for gastrointestinal adverse events from NSAIDs, compared with younger patients [26]. This may influence physicians' perception with regard to use of NSAIDs in elderly patients. These factors might have played a role in the higher rate of analgesic and steroid prescriptions in elderly patients. When analgesic use was broken down into narcotic and nonnarcotic use, elderly patients were found to be more likely to receive nonnarcotic analgesics but less likely to receive narcotic analgesics, compared with adult patients (data not shown). Also, the elderly patients were diagnosed with osteoarthritis more often than were the adult patients (Table 2), which may explain the higher prescription rates for analgesics (Table 3) in this population, since acetaminophen is the first choice in osteoarthritis treatment.

The present study has several limitations. It included only patients with a primary diagnosis of AORCs, which could possibly lead to underestimation of total visits. Variations in patient record forms from 2001 to 2005 could lead to some discrepancy. For example, the NAMCS and the NHAMCS collected information on up to 6 medications in 2001 and on up to 8 medications during 2002-2005 that were prescribed at the end of a visit, including both a new and a continuing prescription. In 2005, a separate field was introduced to capture the presence of conditions such as arthritis, obesity, and hypertension; this field was not present in the earlier years. However, to enable standard comparison parameters, this field was excluded from the study. Since our main focus was on studying the drug prescription or use trends for AORCs, we studied only cases in which an AORC was the primary diagnosis. Although this would underestimate the prevalence of AORCs, the drug prescription trends would be more directly linked to the primary diagnosis.

The overall annual visit estimates reported in the present study are reliable and stable, according to the NCHS, because of sample size and standard error considerations.

However, extrapolation of national visits from small subsamples could create potential problems with regard to the reliability and confidence levels, such as with the use trend for DMARDs. Estimates from this survey of civilian, noninstitutionalized persons underestimate the number of visits for AORCs in the United States, since the NAMCS and NHAMCS sampling frames exclude federally employed physicians, federal military and Veteran's Administration hospitals, community health centers, and tertiary care centers. There can be underreporting of over-the-counter medications, especially NSAIDs and nonopioid analgesics. Also, because of the cross-sectional nature of the data, we could not address medication refills and medication compliance or persistence issues. The data collected in the NAMCS and the NHAMCS did not allow for identification of patients in remission. *NCMJ*

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References

1. Arthritis basics. Centers for Disease Control and Prevention Web site. <http://www.cdc.gov/arthritis/basics.htm>. Accessed April 11, 2010.
2. Helmick CG, Felson DT, Lawrence RC, et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States Part 1. *Arthritis Rheum*. 2008;58(11):15-25.
3. Yelin E, Murphy L, Cisternas MG, et al. Medical care expenditures and earnings losses among persons with arthritis and other rheumatic conditions in 2003, and comparisons with 1997. *Arthritis Rheum*. 2007;56(5):1397-1407.
4. NC Division of Public Health. North Carolina Arthritis Report 2002. <http://www.epi.state.nc.us/SCHS/pdf/arthritis.pdf>. Accessed April 22, 2011.
5. Guidelines for the management of rheumatoid arthritis: 2002 update. *Arthritis Rheum*. 2002; 46(2):328-346.
6. Schnitzer TJ. Update of ACR guidelines for osteoarthritis: role of the coxibs. *J Pain Symptom Manage*. 2002;23(4 Suppl):S24-30.
7. Ausiello JC, Stafford RS. Trends in medication use for osteoarthritis treatment. *J Rheumatol*. 2002;29(5):999-1005.
8. Grijalva CG, Chung CP, Stein CM, Mitchel EF Jr, Griffin MR. Changing patterns of medication use in the patients of rheumatoid arthritis in a Medicaid population. *Rheumatology*. 2008;47(7):1061-1064.
9. Khanna R, Smith MJ. Utilization and costs of medical service and prescription medications for rheumatoid arthritis among recipients covered by a state Medicaid program: a retrospective, cross-sectional, descriptive, database analysis. *Clin Ther*. 2007;29(11):2456-2467.
10. Hootman JM, Helmick CG, Schappert SM. Magnitude and characteristics of arthritis and other rheumatic conditions on ambulatory medical care visits, United States, 1997. *Arthritis Rheum*. 2002;47(6):571-581.
11. Fraenkel L, Rabidou N, Dhar R. Are rheumatologists' treatment decisions influenced by patients' age? *Rheumatology*. 2006;45(12):1555-1557.
12. Tutuncu Z, Reed G, Kremer J, Kavanaugh A. Do patients with older-onset rheumatoid arthritis receive less aggressive treatment? *Ann Rheum Dis*. 2006;65(9):1226-1229.

13. Alibhai SM, Krahn MD, Cohen MM, Fleshner NE, Tomlinson GA, Naglie G. Is there age bias in the treatment of localized prostate carcinoma? *Cancer*. 2004;100(1):72-81.
14. Gurwitz JH, Osganian V, Goldberg RJ, Chen ZY, Gore JM, Alpert JS. Diagnostic testing in acute myocardial infarction: does patient age influence utilization patterns? *Am J Epidemiol*. 1991;134(9):948-957.
15. National Center for Health Statistics. National Ambulatory Medical Care Survey. Hyattsville, MD: United States Department of Health and Human Services, National Center for Health Statistics. ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NAMCS/. Accessed April 22.
16. National Center for Health Statistics. National Hospital Ambulatory Medical Care Survey. Hyattsville, MD: United States Department of Health and Human Services, National Center for Health Statistics. ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHAMCS/. Accessed April 22, 2011.
17. Hootman JM, Sniezek JE, Helmick CG. Women and arthritis: burden, impact and prevention programs. *J Women Health Gend Based Med*. 2002;11(5):407-416.
18. Schappert SM. Ambulatory care visits to physician offices, hospital outpatient departments, and emergency departments: United States, 1997. *Vital Health Stat* 13. 1999;143:i-iv, 1-39.
19. Hochberg M. Treatment of rheumatoid arthritis and osteoarthritis with COX-2 selective inhibitors: a managed care perspective. *Am J Manag Care*. 2002;8(17 Suppl):S502-S517.
20. Zhang W, Doherty M, Arden N, et al. EULAR evidence based recommendations for the management of hip osteoarthritis: report of a task force of the EULAR Standing Committee for International Clinical Studies Including Therapeutics (ESCSIT). *Ann Rheum Dis*. 2005;64(5):669-681.
21. Chan KA, Hernandez-Diaz S. Pharmacoepidemiology and rheumatic disorders. *Rheum Dis Clin N Am*. 2004;30(4):835-850.
22. Wolfe F, Cush JJ, O'Dell JR, et al. Consensus recommendations for the assessment and treatment of rheumatoid arthritis. *J Rheumatol*. 2001;28:1423-1430.
23. Verstappen SM, Jacobs JW, Bijlsma JW, et al. Utrecht Arthritis Cohort Study Group: Five year follow up of rheumatoid arthritis patients after early treatment with disease-modifying antirheumatic drugs versus treatment according to the pyramid approach in the first year. *Arthritis Rheum*. 2003;48(7):1797-1807.
24. Schmajuk G, Schneeweiss S, Katz JN, et al. Treatment of older adult patients diagnosed with rheumatoid arthritis: improved but not optimal. *Arthritis Rheum*. 2007;57(6):928-934.
25. Turajane T, Wongbunnak R, Patcharatrakul T, Ratansumawong K, Poigampetch Y, Songpatanasilp T. Gastrointestinal and cardiovascular risk of non-selective NSAIDs and COX-2 inhibitors in elderly patients with knee osteoarthritis. *J Med Assoc Thai*. 2009;92(Suppl 6):S19-S26.
26. Olivieri I, Palazzi C, Peruz G, Padula A. Management issues with elderly-onset rheumatoid arthritis: an update. *Drugs Aging*. 2005;22(10):809-822.



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The Increasing Impact of Human Immunodeficiency Virus Infections, Sexually Transmitted Diseases, and Viral Hepatitis in Durham County, North Carolina: A Call for Coordinated and Integrated Services

Marc Kolman, Mary DeCoster, Rae Jean Proeschold-Bell, Genevieve Ankeny Hunter, John Bartlett, Arlene C. Seña

BACKGROUND Durham County, North Carolina, faces high rates of human immunodeficiency virus (HIV) infection (with or without progression to AIDS) and sexually transmitted diseases (STDs). We explored the use of health care services and the prevalence of coinfections, among HIV-infected residents, and we recorded community perspectives on HIV-related issues.

METHODS We evaluated data on diagnostic codes, outpatient visits, and hospitalizations for individuals with HIV infection, STDs, and/or hepatitis B or C who visited Duke University Hospital System (DUHS). Viral loads for HIV-infected patients receiving care were estimated for 2009. We conducted geospatial mapping to determine disease trends and used focus groups and key informant interviews to identify barriers and solutions to improving testing and care.

RESULTS We identified substantial increases in HIV/STDs in the southern regions of the county. During the 5-year period, 1,291 adults with HIV infection, 4,245 with STDs, and 2,182 with hepatitis B or C were evaluated at DUHS. Among HIV-infected persons, 13.9% and 21.8% were coinfecting with an STD or hepatitis B or C, respectively. In 2009, 65.7% of HIV-infected persons receiving care had undetectable viral loads. Barriers to testing included stigma, fear, and denial of risk, while treatment barriers included costs, transportation, and low medical literacy.

LIMITATIONS Data for health care utilization and HIV load were available from different periods. Focus groups were conducted among a convenience sample, but they represented a diverse population.

CONCLUSIONS Durham County has experienced an increase in the number of HIV-infected persons in the county, and coinfections with STDs and hepatitis B or C are common. Multiple barriers to testing/treatment exist in the community. Coordinated care models are needed to improve access to HIV care and to reduce testing and treatment barriers.

The southern United States has been disproportionately affected by the epidemic of human immunodeficiency virus (HIV) infection and AIDS [1, 2]. Although the southern states compose only 37% of the US population [3], in 2007 46% of AIDS diagnoses and 50% of AIDS deaths in the United States occurred in the South [4, 5]. In North Carolina, 1,710 individuals were newly diagnosed with HIV infection in 2009, and approximately 35,000 people are living with HIV infection [6].

HIV/AIDS programs address 3 primary goals: (1) reducing the number of new HIV infections, (2) improving access to HIV care, and (3) reducing HIV-related health disparities [7]. Comprehensive, communitywide efforts to increase HIV testing, to provide links to care, and to improve adherence with antiretroviral therapy may be effective at reducing morbidity, suppressing population-level virologic load (community viral load), and preventing new infections [8].

HIV/AIDS, sexually transmitted diseases (STDs), and viral hepatitis share common risk factors and modes of transmission [9]. As a result, the Centers for Disease Control and Prevention (CDC) have promoted collaboration and service integration as a priority for programs addressing HIV, STDs,

and viral hepatitis [10]. Successful models of care are those that integrate funding with testing, prevention, treatment, and supportive service agencies [11, 12].

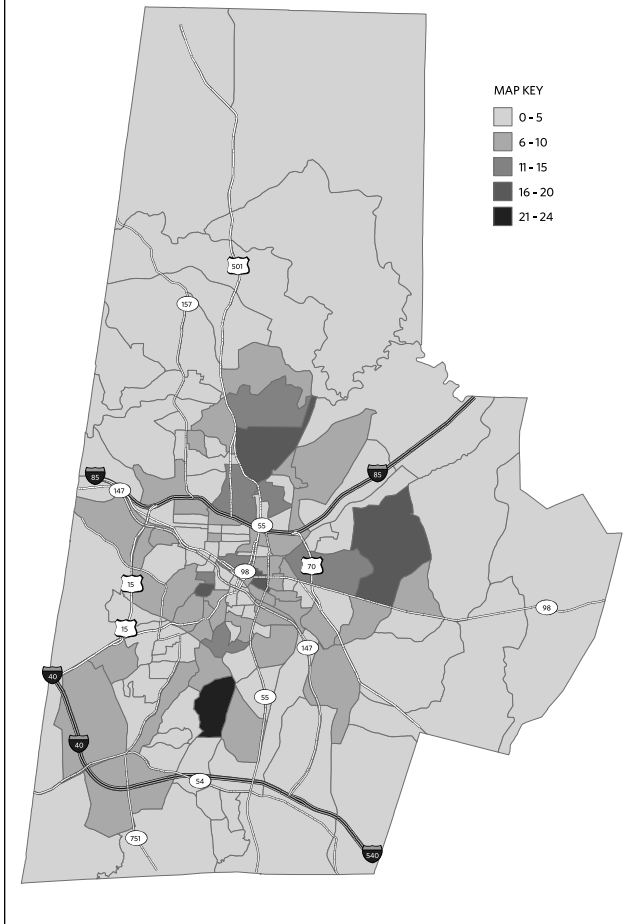
Durham County, North Carolina, has faced challenges from high rates of HIV/AIDS and STDs. Trends in hepatitis B or C are less clear, because of limited reporting and surveillance data. In 2009, Durham County ranked fourth in North Carolina for HIV disease rates (32.7 infections per 100,000 persons) and sixth for the number of early syphilis cases [13]. With approximately 270,000 residents, Durham County is home to Duke University Health Services (DUHS) and numerous health and social service providers. Despite that the county has a higher provider-to-population ratio than the state overall does [14], many county health indicators demonstrate poor health status, limited access to care, and health disparities [15].

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FIGURE 1A.
Human Immunodeficiency Virus Infections, 2004, Census
Block Groups, Durham County



In 2008, Durham Health Innovations (DHI) was developed as a partnership between DUHS and the community, to address the health of its residents. DHI planning grants were awarded to teams from academic centers, local nonprofit agencies, and public health, to assess key health measures and to propose alternative care models. We describe the work of DHI's HIV/STD/hepatitis planning team to explore the health care utilization of HIV-infected residents, the proportion of coinfections, and the community's perspectives on HIV-related issues in Durham County.

Methods

The DHI HIV/STD/hepatitis planning team was convened with representatives from health care, public health, patient advocacy, and community and faith-based organizations. The team's key objectives were to explore the health care utilization by HIV-infected residents, to determine the proportion of coinfections with STDs and hepatitis B or C, and to assess the community's perspectives on HIV-related issues. Quantitative information included health care utilization data from DUHS (includes Duke University Medical Center [DUMC] and Durham Regional Hospital), clinical

data from HIV-infected persons receiving care, and geospatial information. Qualitative information was obtained from focus groups and key informant interviews, with regard to barriers to HIV and STD testing and care. The study was approved by the Duke University institutional review board.

Quantitative analysis. The team analyzed aggregate clinical and business data from Duke's Decision Support Repository (DSR), for patients who received care through DUHS, which were available for 2004-2008. DSR data were obtained for patients with a diagnosis of HIV/AIDS, STDs, and/or hepatitis B or C. STDs included gonococcal or chlamydial infections, trichomoniasis, syphilis, genital herpes, human papilloma virus infections, chancroid, granuloma inguinale, and lymphogranuloma venereum. Each subgroup denominator included patients with associated *International Classification of Diseases, 9th Revision* codes, starting with the year of the first encounter. If a patient died, he or she was removed from the denominator in subsequent years. Service utilization was evaluated for HIV-infected persons by use of outpatient visits, inpatient hospitalizations ≥ 1 day, and emergency department (ED) visits without subsequent admission, and it was tabulated as the number of encoun-

FIGURE 1B.
Human Immunodeficiency Virus Infections, 2008, Census
Block Groups, Durham County

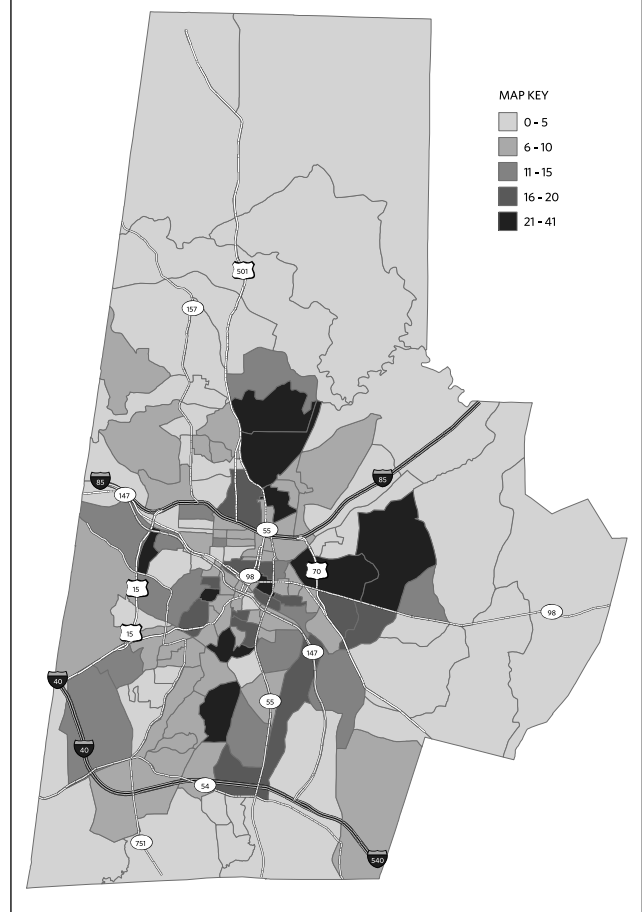
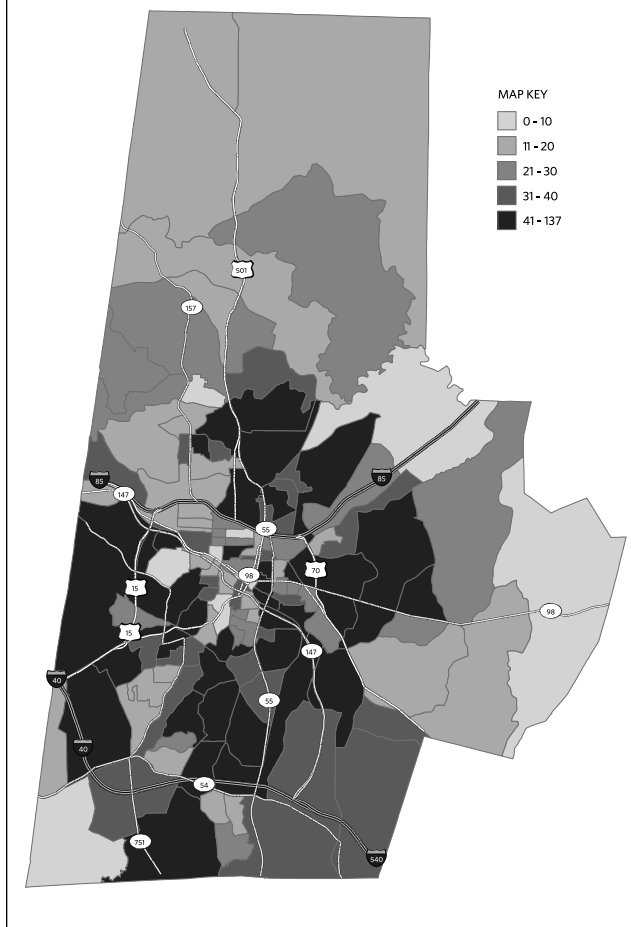


FIGURE 1C.
Sexually Transmitted Disease Infections, 2008, Census
Block Groups, Durham County



ters for each year. Descriptive statistics were generated using SAS version 9.2 (SAS Institute Inc., Cary, NC), and trends were analyzed using regression analysis with Excel 2007 (Microsoft, Redmond, WA).

To obtain a measure of community-level virologic suppression, we assessed the most recent viral load for each patient receiving HIV care and the proportion of patients with undetectable viral loads (<50 copies/ml). Since HIV loads were not available from the DSR, these data were obtained from patients treated at the DUMC Infectious Disease Clinic and the Lincoln Community Health Center Early Intervention Clinic in 2009, which is another major provider of HIV treatment in Durham.

High-resolution geospatial mapping of disease morbidity was conducted to assess annual trends during the 5-year study period. Geocoded addresses of patients diagnosed with HIV infection, STDs, or hepatitis B or C at DUHS were mapped using ArcGIS. Mapped addresses were aggregated by census block group, to protect patient confidentiality, using ArcMap. Higher densities of addresses were indicated by darker shading of the census block group. Interstate highways and roads were added for reference.

Qualitative analysis. The planning team met with key stakeholders and identified the need for focus groups comprising youth, African American students and churchgoers, Latinos, and HIV-infected persons receiving care. We also planned to interview HIV-infected persons with lapses in medical care, recognizing the difficulty of getting them together for a focus group. For recruitment, we contacted community organizations, which invited members by use of word of mouth and an institutional-review-board-approved script. Focus groups were cofacilitated by community organization members, to allow for optimal turnout and to increase comfort discussing the material. The other cofacilitator was a team member trained in conducting focus groups and interviews. We used an introductory script and a semistructured questionnaire for data collection about barriers to testing and treatment for HIV/STDs, viral hepatitis, and potential solutions.

Six focus groups were conducted among a convenience sample of residents from the community, composed of youth (peer educator ages, 15-20 years), students from a historically black university, church congregants, Latinos, and HIV-infected persons receiving care; each group consisted of 7-12 participants. We also interviewed 3 HIV-infected persons with lapses in medical care. Focus groups and interviews lasted 60-90 minutes. Participants were asked to complete a survey on demographic characteristics. Participants received lunch and a \$5 gift card.

Because religious beliefs and social norms emerged as strong themes, we added 4 focus groups comprising pastors of different ethnicities and religious denominations. Focus group questions asked about HIV-related church programming, youth programs involving information on HIV/STDs, the role of churches in HIV issues, and collaboration with health care agencies.

Qualitative data were reviewed by 2 team members, who identified themes separately and then discussed those themes to resolve any discrepancies. The team members prioritized themes that recurred frequently or were reported with emotion or in detail by participants.

Results

Quantitative findings. Geospatial mapping identified Durham County neighborhoods with the highest number of individuals treated at DUHS and diagnosed with HIV infection, STDs, or viral hepatitis. Temporal maps from 2004 to 2008 show a dramatic increase in the number of reported HIV infections in south-central and southwestern Durham County (Figure 1A and 1B). This observation may reflect the dynamic spread of HIV infection in this region, which is supported by the observed increase in STDs in the same areas (Figure 1B and 1C).

During the cumulative period from 2004 to 2008, 1,291 adults who received services at DUHS were diagnosed with HIV infection, 4,245 were diagnosed with STDs, and 2,182 were diagnosed with hepatitis B or C. Of those patients with

HIV infection who received treatment, 90% were Durham County residents. The number of patients with an HIV diagnosis treated at DUHS (which included patients who had been treated previously and those who had their first encounter) increased from 626 to 869 per year, while the number of patients with an STD doubled, from 705 to 1,652 per year. The number of hepatitis B or C diagnoses also increased, from 250 in 2004 to 994 in 2008. Of the 1,291 HIV-infected persons, 180 (13.9%) were coinfecting with an STD, and 281 (21.8%) were coinfecting with hepatitis B or C.

HIV-infected persons made 17,300 outpatient visits, with an average of 16.3 visits per person, as well as 1,431 ED visits (from 471 persons), with an average of 2.7 visits per person. The percentage of HIV-infected persons using the ED increased slightly during the study period, from 20.3%

in 2004 to 22.0% in 2008. However, the average number of ED visits per patient did not change noticeably over time (Figure 2). Almost half (47.8%) of the patients were hospitalized during the study period. For the 617 hospitalized HIV-infected persons, the average number of hospitalizations during the 5-year period was 3.1, with an average length of stay of 18.3 days. The percentage of patients hospitalized each year decreased, from 29.6% in 2004 to 26.8% in 2008, although the change was not statistically significant (Figure 2).

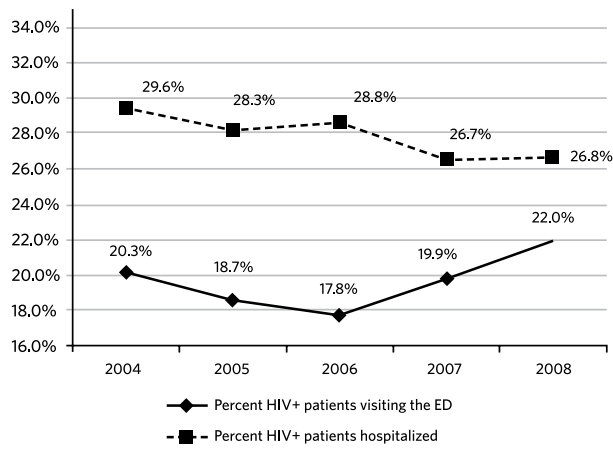
In 2009, there were 2,081 HIV-infected persons who received care at either the DUMC Infectious Disease Clinic or the Lincoln Early Intervention Clinic. Of these patients, 1,367 (65.7%) had undetectable viral loads, and an additional 257 (12.3%) had viral loads <500 copies/ml.

TABLE 1.
Testing and Treatment Barriers and Solutions

Barrier(s) to testing and/or treatment	Solution(s)
*Stigma and shame of having a disease that was transmitted through sex	Play up desire to know what is wrong with you Free STD hotline that offers anonymity
*Fear and denial: ignoring the possibility of having HIV, in hopes that one never gets sick and doesn't have to face the consequences of having HIV	*Letting people know that, if they are infected, there is treatment, and it is not a death sentence *PSAs/media campaigns *Celebrities talking more about treatment *Role models and doctors talking openly about having an STD *Real people in PSAs talking about continuing relationships, even when they have HIV or an STD
Fear that the health worker giving them their test results won't be sensitive or won't be able to help them cope with the diagnosis	*Training for health care workers *Increased counseling *Assistance from care bridge coordinators
Confidentiality fears	*Assurance of confidentiality from all persons at medical facilities Improved training in privacy and confidentiality for all levels of health care workers
*Belief that if you remain uncertain about your HIV status, you won't pass HIV on to anyone else	*More sex education *Celebrities normalizing having an STD and treatment *More PSAs
*Denial of positive status	Intensive counseling for those newly diagnosed Someone to check on them multiple times after their diagnosis and between appointments *More PSAs
*Mistrust of doctors and health care	Clinic-level interventions that emphasize treating the total person, knowing patients by name, giving reminder phone calls that are personalized, providing accurate information, having a welcoming demeanor, having compassion, and breaking down technical language
*Cost issues: people deprioritize treatment because they are preoccupied with paying bills	Reminder calls that mention the co-pay so patients can plan ahead Paying in installments Discounted medication Education that treatment for HIV is not always expensive *PSAs *Low-cost and free testing and treatment Sliding-scale fees More legal assistance to get disability Being billed later
*Transportation	*Better localized treatment in downtown, with a lab on site Transportation in the form of bus passes, a friend giving a ride, or being able to walk Clinic hours when buses run

Note. Asterisk indicates that the barrier or potential solution was named in >1 focus group or interview. HIV, human immunodeficiency virus; PSA, public service announcement; STD, sexually transmitted disease.

FIGURE 2.
**Resource Utilization of Adult Patients Diagnosed With
 Human Immunodeficiency Virus Infection (2004-2008)**



Qualitative findings. A total of 76 people participated in the focus groups and interviews, of which 53 (not including pastors) completed the survey on demographic characteristics. The races/ethnicities of these participants were as follows: 77% were African American, 15% were Latino, and 9% were white. Fifty-five percent of participants were male, and the average time that participants reported living in Durham County was 13.1 years.

Participants described avoiding testing because of fear they would be unable to cope with a positive diagnosis or that they would be stigmatized in ways that would affect their relationships and lives (Table 1). Only 2 Latino participants mentioned clinic hours being a barrier to testing.

Frequently mentioned barriers were cost and transportation. Other barriers stemmed from stigma and fear, such as fear of being ostracized or abandoned and fear of living with a chronic illness and facing possible death. Mistrust of doctors and of health care were also stated.

Youth in the focus groups indicated embarrassment about others finding out they may have an STD and indicated they would confide in a trusted friend or adult and that having this person accompany them for testing or treatment would be helpful. They indicated a preference for private health care locations, to avoid being seen. Youth suggested that having music and sports celebrities talk openly about STDs and testing could shift attitudes for young fans.

From the congregants group, participants emphasized their sense that people avoid testing because they prefer to live in denial, rather than face the consequences of testing positive for HIV, STDs, or viral hepatitis. They indicated a lack of understanding about symptoms and long-term effects and suggested a high-visibility campaign to move their community to take action. They expressed difficulty talking to their children about STDs but wanted to learn how to do so.

Pastors identified the need to discuss moral issues underlying risky behaviors and negative attitudes that

many congregants associate with HIV diagnosis (Table 2). One solution identified from the pastors focus groups was to combine HIV education in the church with other health topics not associated with stigma, such as influenza and diabetes.

The Latino experience in accessing health care appeared to be different from that of other Durham County residents. Participants reported a need for more Spanish-speaking providers and translators. Participants indicated fear of deportation if they were identified with HIV infection. To address this fear, participants suggested having Latino case managers and Spanish-language educational materials. Participants indicated that Latino men may not get tested because having health problems is equated with being weak. Finally, Latino participants related both positive and negative health care experiences in Durham, in terms of cultural sensitivity. They felt they were treated differently because of their ethnicity and desired more respectful treatment, such as the use of formal titles (eg, the formal “you” (“usted” in Spanish) and “señor” and “señora”).

Among HIV-infected persons receiving care, participants indicated that reliable transportation, low-cost arrangements, and appointment availability made it possible to get care. They stated that a lack of any of these resources resulted in lapses in medical care. Participants indicated they remained in HIV care because of personalized outreach (eg, reminder phone calls), a welcoming environment (eg, family atmosphere, treating the total person, compassion), support groups, social workers, and clear explanations from providers.

Participants with a previous lapse in HIV care highlighted transportation as a critical barrier to HIV treatment. For example, “Most of my friends don’t have cars. My relatives don’t have time and charge me for a ride.” Stigma and the cost of medications appeared to play a role in preventing people with HIV infection from seeking treatment. In addition, participants with a lapse in HIV care discussed their experience with comorbidities, including substance abuse, tuberculosis, and mental health issues, and how these limit one’s motivation and ability to seek HIV treatment (eg, too sick to ride the bus). They reported postponing treatment until they were faced with possible death: “I didn’t know if I was going to live.”

Discussion

Durham County has experienced high HIV/STD rates, with an increasing number of infected individuals from 2004 to 2008 located in neighborhoods in the south-central and southwestern parts of the county. Among HIV-infected persons treated at DUHS, 14% were coinfecting with an STD, and 22% were coinfecting with hepatitis B or C. Although an increasing proportion of HIV-infected persons visited the ED from 2004 to 2008, there was an average of 16 outpatient visits during the 5-year period, and hospitalizations remained stable. More than one-fourth of patients were

TABLE 2.
Themes From Pastor Focus Groups, Paired With Suggested Actions

Theme	Suggested action(s)
Congregants don't discuss HIV: "My father's youngest brother passed away from HIV/AIDS, but it was kept quiet in our family, and we still do not discuss it."	Pastors can use the pulpit to tell stories of how congregations have reached out to people with HIV.
Congregants assume that there will be great HIV/AIDS stigma, but there are churches that are very supportive.	One church could provide an HIV care team to congregants of other churches so that those congregants do not have to "out" themselves to the church they attend.
Immorality/condemnation: In the church, there is a sense of immorality for some if you have AIDS because of actions including not being faithful, so congregations do not talk about HIV.	Pastors can call attention to negative attitudes toward persons with HIV/AIDS in the context of their Christian faith; acceptance should be preached. The connection between HIV and leprosy is strong, and health and leprosy are taught about by Jesus. "HIV is today's leprosy."
It is a struggle to match HIV prevention messages, other than abstinence, with theology and morality.	Pastors can reassure congregants that every conversation they have with individuals discusses moral actions and complex choices.
The urgency to bring awareness to HIV is gone now that there are medications; congregants have moved on to issues such as cancer.	Public health people could pair together different health issues (eg, H1N1 and HIV) into a single talk to a church to increase acceptability. Churches could have a bulletin insert on HIV statistics, risk factors, and testing locations. Within churches, it may be helpful to have the HIV/AIDS ministry link with other ministries to rally support for their activities.
Parents and pastors in churches are interested in how to talk to youth about sex.	Churches and pastors need to talk about sex; develop ways to have faith-based conversations about sex.
Pastors are afraid of conflict. They don't want the congregants to leave.	Public health people could build interest in HIV with coalitions of churches, thus giving credibility to any individual church wishing to do something HIV related.
Pastors want and need more information on HIV testing and resources.	Public health people can regularly distribute and update a list of HIV resources to pastors.
The Durham community, including churches and pastors, expressed concerns about researchers' sporadic community involvement coinciding with specific grant funded projects.	Duke University must recognize the need for a durable commitment to the community and engage in sustained relationships.

Note. For a theme to be listed, it had to be named in at least 2 of the 4 pastor focus groups. HIV, human immunodeficiency virus.

hospitalized on a yearly basis, with an average stay of more than 2 weeks. This proportion may represent HIV-infected persons who have had lapses in medical care or who are not receiving care. In North Carolina, it is estimated that 38% of residents with HIV infection do not receive care [16]. In comparison, the CDC estimates that 25% of HIV-infected persons nationwide are undiagnosed and that 25% are diagnosed but are not receiving care [17].

We calculated the proportion of HIV-infected persons with undetectable viral loads treated at the Duke Infectious Disease Clinic or the Lincoln Early Intervention Clinic, to estimate the maximum level of communitywide virologic suppression, with the knowledge that the true community level would be lower once patients not receiving care were accounted for. While our findings suggest that HIV care is suboptimal, possibly because of factors such as medication nonadherence, substance abuse, and mental illness, the converse viewpoint is that two-thirds of patients have undetectable HIV RNA levels. Further investigations are needed to determine trends in community viral load over time, among both patients receiving care and those not receiving care.

The strongest barriers to testing identified from the focus groups were stigma, fear, and denial of risk. Latino participants expressed additional concerns, such as fear of deportation and lack of cultural sensitivity. The most common barriers to treatment were cost of care and transporta-

tion. Religious beliefs and social norms set by churches were strong themes surrounding HIV/STDs in the community, and pastors expressed interest in partnering with public health to educate congregants on health issues, including but not limited to HIV/STDs and viral hepatitis. Both congregants and pastors reported wanting to provide sex education, including STD prevention, to adolescent congregants, an interesting fact given the stigma barriers they articulated. This may signify a readiness to overcome the stigma barriers.

Several limitations were notable in our study. We conducted our assessments using DUHS data, and not county-wide surveillance data, for HIV, STDs, and hepatitis B or C. We did not have information from all health care providers in the community, and some residents may receive care outside of the county; however, our findings estimate utilization data from the major health care providers in Durham County. We presented health care utilization data for 2004-2008 for HIV-infected persons, but viral load data was for 2009 only. Despite these heterogeneous periods, we provided the most recent estimation of the viral load among HIV-infected persons receiving care who are either taking or not taking anti-retroviral therapy. Although we conducted the focus groups among a convenience sample, we obtained information from a diversity of residents. Another limitation of our qualitative analysis was the use of theme generation, as opposed to dual coding of transcripts. Last, our findings from Durham

County may not be generalizable to other communities in the state or nationwide.

Effective prevention and treatment of HIV infection and its coinfections are dependent on the reduction of high-risk behaviors, which are confounded by sensitive behavioral and moral issues. Continued activities are needed to shift public perception, including fear and stigma, that disappointingly still exist despite local, state, and national educational efforts. The results of our focus groups suggest that the integration of information regarding sexual behaviors and substance abuse may be more effective when combined with information regarding other chronic diseases (eg, hypertension, diabetes). Faith-based organizations can play a role in decreasing stigmas and can provide education through sermons and outreach ministries; the inclusion of these organizations into the HIV prevention strategy requires further exploration [18, 19].

Linking HIV-infected persons to HIV care and treatment is important, and it could improve the community viral load. Care bridge coordination (CBC) was initiated in Durham in 2008, through a grant supported by the University of North Carolina and the North Carolina HIV/STD Control Program, in which the coordinator ensures newly diagnosed HIV-infected persons enter care soon after diagnosis and that persons "lost to care" are linked back to care. The CBC program differs from standard HIV case management, which provides assistance to patients already receiving care. The CBC program can provide transportation and other social support to HIV-infected persons not receiving care, it can strengthen connections between HIV providers, and it can coordinate services for coinfecting individuals with STDs or hepatitis B or C.

A similar program to address HIV-infected persons who are lost to care has been implemented in several large cities; the program assists clients with navigating health and social service systems [20]. The program demonstrated significant improvements in provider engagement, health outcomes, and utilization of HIV care. Furthermore, the proportion of participants with an undetectable viral load was 50% greater at 12 months than at baseline. Maintaining HIV-infected persons in care may yield significant cost savings by improving the health of those retained in care and by potentially reducing infectiousness from HIV and coinfections, including STDs and hepatitis B or C, that facilitate secondary disease transmission.

Conclusions

During a 5-year period, the health care utilization of HIV-infected persons in Durham County has remained stable, despite dramatic increases in HIV infections in some areas. Coinfections with STDs or hepatitis B or C were notable among HIV-infected persons. Multiple barriers to testing and treatment for HIV/STDs and viral hepatitis still exist in the community. Coordinated and integrated services are needed to link and retain HIV-infected persons

receiving care, to screen for coinfections, and to reduce barriers to testing and treatment at the individual and community levels. **NCMJ**

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References

1. AIDS in the United States by geographic distribution. Centers for Disease Control and Prevention Web site. <http://www.cdc.gov/hiv/resources/factsheets/geographic.htm>. Accessed January 13, 2011.
2. Hightow LB, MacDonald PD, Pilcher CD, et al. The unexpected movement of the HIV epidemic in the southeastern United States. *J Acquir Immune Defic Syndr*. 2005;38:531-537.
3. State & county quickfacts. US Census Bureau Web site. <http://quickfacts.census.gov/qfd/index.html>. Accessed April 8, 2011.
4. Southern AIDS Coalition. Southern States Manifesto: Update 2008. http://www.southernaidscoalition.org/policy/southern_states_manifesto_2008.pdf. Accessed May 18, 2011.
5. Centers for Disease Control and Prevention (CDC). HIV/AIDS Surveillance Report, 2007. Vol 19. Atlanta, GA: US Department of Health and Human Services, CDC; 2009.
6. North Carolina Epidemiologic Profile for HIV/STD Prevention & Care Planning, December 2010. http://epi.publichealth.nc.gov/cd/stds/figures/Epi_Profile_2010.pdf. Accessed February 17, 2012.
7. The White House Office of National AIDS Policy. National HIV/AIDS Strategy for the United States. Washington, DC: White House; 2010.
8. Das M, Chu PL, Santos G-M, et al. Decreases in community viral load are accompanied by reductions in new HIV infections in San Francisco. *PLoS One*. 2010;5(6):e11068.
9. Fleming DT, Wasserheit JN. From epidemiological synergy to public health policy and practice: the contribution of other sexually trans-

- mitted diseases to sexual transmission of HIV infection. *Sex Transm Infect.* 1999;75(1):3-17.
10. US Department of Health and Human Services. Program Collaboration and Service Integration: Enhancing the Prevention and Control of HIV/AIDS, Viral Hepatitis, Sexually Transmitted Diseases, and Tuberculosis in the United States. http://www.cdc.gov/nchhstp/programintegration/docs/207181-C_NCHHSTP_PCSI%20WhitePaper-508c.pdf. Accessed February 12, 2012.
 11. Centers for Disease Control and Prevention. STD/STI Framing Conversation Report. http://www.cdc.gov/std/health-disparities/Framing_Report.pdf. March 2010. Accessed April 26, 2011.
 12. Mugavero M, Norton W, Saag M. Health care system and policy factors influencing engagement in HIV medical care: piecing together the fragments of a fractured health care delivery system. *Clin Infect Dis.* 2011;52(Suppl 2):S238-S246.
 13. North Carolina Division of Public Health. Epidemiological Profile for HIV/STD Prevention & Care Planning. <http://www.epi.state.nc.us/epi/hiv/stats.html>. December 2010. Accessed April 15, 2011.
 14. Cecil G. Sheps Center for Health Services Research. North Carolina Health Professions 2009 Data Book: A Report on Health Care Resources in North Carolina. http://www.shepscenter.unc.edu/hp/publications/2009-HPDS_DataBook.pdf. 2010. Accessed February 17, 2012.
 15. Durham County Health Department, Partnership for a Healthy Durham, Durham County Community Health Assessment, 2007. http://www.healthdurham.org/docs/file/durhams_health/2007DurhamHealthAssessmentWithYRBSdata-final.pdf. Accessed February 17, 2012.
 16. North Carolina Department of Health and Human Services. North Carolina Epidemiologic Profile for HIV/STD Prevention and Care Planning. October 2008. <http://www.epi.state.nc.us/epi/hiv/stats.html>. Accessed April 8, 2011.
 17. Centers for Disease Control and Prevention. CDC HIV Prevention Strategic Plan: Extended through 2010. <http://www.cdc.gov/hiv/resources/reports/psp/>. Accessed February 17, 2012.
 18. Agate LL, Cato-Watson D, Mullins JM, et al. Churches United to Stop HIV (CUSH): a faith-based HIV prevention initiative. *J Natl Med Assoc.* 2005;97(7 Suppl):60S-63S.
 19. Lindley LL, Coleman JD, Gaddist BW, White J. Informing faith-based HIV/AIDS interventions: HIV-related knowledge and stigmatizing attitudes at Project F.A.I.T.H. churches in South Carolina. *Public Health Rep.* 2010;125(Suppl 1):12-20.
 20. Bradford JB, Coleman S, Cunningham W. HIV system navigation: an emerging model to improve HIV care access. *AIDS Patient Care STDS.* 2007;21:S49-S58.

take control
of your
health
and your life
Get Tested for HIV

Be a
beacon of light
to others. Your
example can make
a difference.
Get tested for HIV.



Free and confidential or anonymous HIV tests are available. To find an HIV testing site near you, go to www.hivtest.org, call 800-232-4636, or send a text message with your zip code to "KNOWIT" (566948).



Seasonality of Poor Pregnancy Outcomes in North Carolina

Marie Lynn Miranda, Rebecca Anthopolos, Sharon E. Edwards

BACKGROUND Seasonal variation in poor pregnancy outcomes has not received the same level of research attention and rigor as has the well-established seasonal variation in births.

METHODS In this analysis of data from the 2001-2005 North Carolina Detailed Birth Record, we use season of conception as a proxy for environmental or other risk factors. We model the continuous pregnancy outcome of birth weight percentile for gestational age by use of linear regression. We use logistic regression to model the binary pregnancy outcomes of low birth weight (<2500 g), preterm birth (<37 weeks), and small for gestational age (<10th percentile of birth weight for gestational age).

RESULTS We found significant seasonal patterns in poor pregnancy outcomes. Our results suggest that, in North Carolina, seasonal patterns are most pronounced among non-Hispanic white women living in urban areas.

LIMITATIONS The present study is limited by the restricted set of maternal and pregnancy variables available in this data set. Richer data, potentially including psychosocial and activity measures of the women, would allow us to more ably discern what is driving the seasonal patterns we observed. The pronounced increased risk associated with a spring season of conception provides an important clue for determining the true causative factors.

CONCLUSIONS Poor pregnancy outcomes in North Carolina follow a clear seasonal pattern based on timing of conception, with patterns most pronounced among non-Hispanic white women living in urban areas. These seasonal patterns are suggestive of causative environmental factors and certainly warrant additional research.

Seasonal variation in births is well-established [1, 2]. For example, in the United States, the annual pattern of birth has been characterized by a peak during August and September, with a trough in early spring [1]. Correspondingly, conceptions increase from October to January [2]. Timing of conception is suggestive of periconceptional maternal environmental risk factors that may impact pregnancy health, and it may also predispose a pregnancy to a particular set of seasonally varying exposures during specific gestational windows of vulnerability, which may be harmful to maternal and fetal health. The season or month of conception has been associated with early pregnancy loss [3], small for gestational age [4], preterm birth [4], pregnancy-induced hypertension and preeclampsia [5, 6], and birth defects [7-9]. Studies have also demonstrated a relationship between birth month or season and various pregnancy outcomes [4-6, 10].

The factors underlying the association between conception or delivery timing and pregnancy outcomes are unclear [1, 3]. It has been hypothesized that seasonal variation in pregnancy outcomes is related to seasonally varying environmental exposures possibly connected to agricultural activity [3, 7, 9], air pollution [10], biologic processes induced by climatic changes [6], alterations in circadian rhythm (affecting vitamin D intake) [6], and changes in outdoor ambient temperature (influencing total energy intake, infection, and physical activity) [11]. In addition, in developing countries, differences in the availability of food items during the year

[8] and seasonal patterns in endemic diseases (eg, malaria) [12] have also been emphasized.

Understanding why the timing of conception or delivery matters to maternal and fetal health is especially important in the context of identifying causes of racial disparities in pregnancy outcomes between black women and white women in the United States. Season of conception and delivery have been shown to vary by geography [13, 14], culture [14], and maternal sociodemographic characteristics [1, 15, 16]. For example, in an Atlanta, Georgia-based study, while the birth rate peaked during spring months (summer conceptions) for college-educated women, less-educated groups experienced a trough in births during the same months—the largest of which was observed among non-Hispanic black women and Hispanic women who were unmarried and had less than a high school education [1]. Thus, the timing of conception or delivery, as well as pregnancy outcomes, may depend on sociocultural or geographic characteristics, which would, in turn, affect the exposures to seasonally varying environmental risk factors experienced by different subpopulations.

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In the present study, we use season of conception as a proxy for environmental exposures that are harmful to maternal and fetal health and that may differ on the basis of maternal race and place of residence. We select season of conception over season of birth because season of conception represents an anchor from which to assess the potential impact of seasonality (ie, 2 women who conceive in mid-February will have the same season of conception, but their season of birth may differ, depending on the gestational age at which their babies are born). We place an additional focus on race because of the pronounced disparities in pregnancy outcomes between non-Hispanic black women and non-Hispanic white women in the United States, especially in the American South [17-19]. Using North Carolina statewide data on pregnancy outcomes, we examine (1) whether season of conception is associated with birth weight and gestational age, (2) whether this association differs between black and white women, and (3) whether this association differs between women residing in an urban area and women residing in a rural area.

Methods

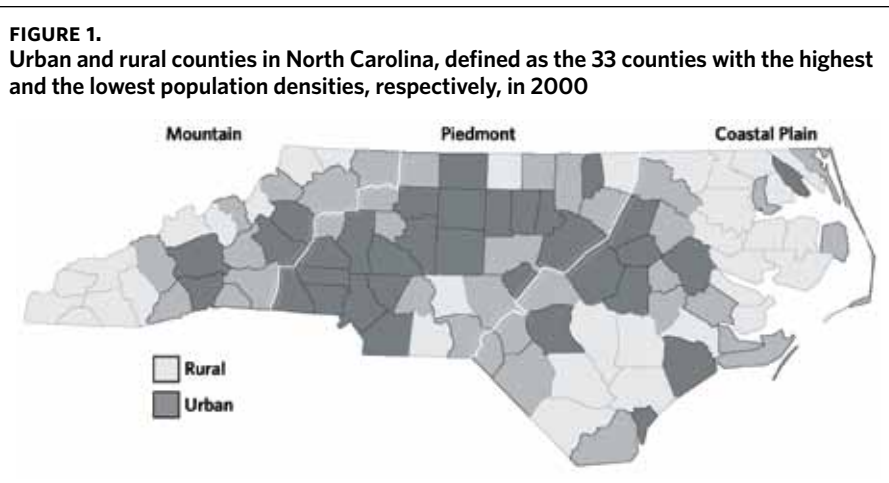
Data. The North Carolina Detailed Birth Record (NCDBR) provides data on all documented live births that occur in the state of North Carolina [20], including information on maternal demographic characteristics, maternal and infant health, and maternal obstetrics history. In validation studies across the United States, including in North Carolina, administrative birth certificate data have been shown to be accurate, particularly for demographic and birth outcome variables [21-24]. For this analysis, we restricted the data set to singleton first births to non-Hispanic white women and non-Hispanic black women, with an estimated date of conception during 2001-2005 ($n = 197,535$). We excluded births with missing covariate data ($n = 358$), congenital anomalies ($n = 1660$), birth weight <400 g ($n = 258$), and extremely high or extremely low gestational age (<24 weeks or >42 weeks; $n = 5985$) or maternal age (<15 years or >44

years; $n = 998$). With these restrictions, 188,276 births qualified for inclusion. All work was performed in compliance with a research protocol approved by Duke University's institutional review board.

Gestational age was calculated as the difference in completed weeks between the date of birth and the date of last normal menses. We used an algorithm provided by the North Carolina State Center for Health Statistics (M. Avery, personal communication); if the calculated gestational age was not reasonable on the basis of the birth weight, the clinical estimate of gestation was used, instead of the calculated gestational age. By use of the algorithm provided by the North Carolina State Center for Health Statistics, 1.3% of births were assigned the clinical estimate of gestation, instead of the calculated estimate of gestation. The date of conception was calculated as 2 weeks less than the difference between the date of birth and the gestational age [5, 25]. Season of conception was then assigned on the basis of the month of conception, with winter defined as December-February, spring as March-May, summer as June-August, and fall as September-November.

Since the type and level of environmental exposures are likely to vary by geography and urbanization, we assigned a region of North Carolina and a level of urbanization to all births, on the basis of the county of residence. Three geographic regions of North Carolina—the coastal plain, in the east; the piedmont, in the center; and the mountains, in the west—are well-established. We used county-level population density, on the basis of 2000 US Census data, to classify the 100 counties in North Carolina into 3 levels of urbanization. The 33 counties with the highest population density were classified as “urban,” the 33 counties with the lowest population density were classified as “rural,” and the remaining 34 counties were classified as “suburban” (Figure 1).

Statistical analysis. We modeled the continuous pregnancy outcome of birth weight percentile for gestational age by use of linear regression. Logistic regression was used to



model the binary pregnancy outcomes of low birth weight (<2500 g), preterm birth (<37 weeks), and small for gestational age (<10th percentile of birth weight for gestational age). Although a race-specific definition of low birth weight might be more appropriate, we applied the widely used definition of low birth weight as <2500 g for both non-Hispanic white and non-Hispanic black births, to maintain comparability with previous literature. In addition to controlling for season of conception, all models controlled for maternal age, maternal education, maternal marital status, maternal tobacco use during pregnancy, infant sex, and region of North Carolina (ie, coastal plain, piedmont, or mountains). Since both very young maternal age and very old maternal age are associated with adverse pregnancy outcomes, we categorized maternal age into 5-year age groups: 15-19, 20-24, 25-29, 30-34, 35-39, and 40-44 years [18]. For those models using data on all North Carolina births, the 3-level measure of county urbanization was included as a covariate. All statistical analyses were performed using SAS version 9.2 (SAS Institute, Cary, NC).

Since the work in the present study is designed as an exploratory tool for generating hypotheses about environmental exposures that may be appropriate for further

research, we fit race-specific models that use statewide birth data, as well as fitting race-specific models that focus separately on births to residents of urban and rural counties. We recognize that this approach, which requires 6 models per outcome, is somewhat cumbersome. However, it does not constrain the coefficients on the suite of explanatory variables to be constant across race or degree of urbanization. In results not shown here, we found that, for non-Hispanic black women and non-Hispanic white women, the coefficients were quite different for variables such as maternal age, maternal education, smoking status, and geographic area; thus, dealing with race-based differences by use of an interaction term would have required us to interact race with multiple covariates other than season. The multiple interactions greatly hamper ease of interpretation. In addition, if there are seasonally varying environmental exposures for which season of conception acts as a proxy for the exposures' impact on birth outcomes, we would anticipate that these exposures would be quite different between urban and rural settings (eg, pesticides may be a key exposure in rural, agricultural areas, whereas summer ozone levels may be a key exposure in high-traffic, urban areas). Given the exploratory nature of this work, we believe the benefits and flex-

TABLE 1.
Maternal Characteristics of Births, by Race and Season of Conception

Characteristic	Non-Hispanic white				Non-Hispanic black			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Age, years								
15-19	5695 (16.0)	5700 (16.9)	5419 (15.6)	5560 (15.7)	4452 (35.4)	4646 (36.7)	4310 (36.8)	4202 (35.2)
20-24	9898 (27.8)	9199 (27.3)	9118 (26.2)	9657 (27.3)	4538 (36.1)	4472 (35.3)	4023 (34.3)	4286 (35.9)
25-29	10,014 (28.2)	9271 (27.5)	9948 (28.6)	10,030 (28.4)	1894 (15.1)	1922 (15.2)	1843 (15.7)	1828 (15.3)
30-34	7171 (20.2)	6894 (20.4)	7394 (21.3)	7201 (20.4)	1142 (9.1)	1052 (8.3)	1030 (8.8)	1050 (8.8)
35-39	2408 (6.8)	2264 (6.7)	2470 (7.1)	2470 (7.0)	438 (3.5)	470 (3.7)	410 (3.5)	465 (3.9)
40-44	381 (1.1)	424 (1.3)	405 (1.2)	407 (1.2)	101 (0.8)	103 (0.8)	96 (0.8)	105 (0.9)
Educational attainment								
<9th grade	526 (1.5)	465 (1.4)	477 (1.4)	466 (1.3)	236 (1.9)	263 (2.1)	280 (2.4)	249 (2.1)
Some high school	3910 (11.0)	3871 (11.5)	3724 (10.7)	3844 (10.9)	2843 (22.6)	3140 (24.8)	2871 (24.5)	2612 (21.9)
Completed high school	9488 (26.7)	8962 (26.6)	8751 (25.2)	9122 (25.8)	4502 (35.8)	4296 (33.9)	4029 (34.4)	4208 (35.3)
Some college	8483 (23.9)	7900 (23.4)	7931 (22.8)	8358 (23.7)	2897 (23.1)	2947 (23.3)	2532 (21.6)	2804 (23.5)
Completed college	13,160 (37.0)	12,554 (37.2)	13,871 (39.9)	13,535 (38.3)	2087 (16.6)	2019 (15.9)	2000 (17.1)	2063 (17.3)
Not married	9984 (28.1)	9625 (28.5)	9370 (27.0)	9837 (27.8)	9674 (77.0)	9943 (78.5)	8957 (76.5)	9171 (76.8)
Smoked during pregnancy	5107 (14.4)	4719 (14.0)	4546 (13.1)	4695 (13.3)	865 (6.9)	823 (6.5)	728 (6.2)	735 (6.2)
Region of NC								
Coastal Plain	10,021 (28.2)	9266 (27.5)	9467 (27.2)	9979 (28.2)	4839 (38.5)	4912 (38.8)	4353 (37.2)	4563 (38.2)
Piedmont	20,743 (58.3)	19,741 (58.5)	20,463 (58.9)	20,513 (58.1)	7398 (58.9)	7451 (58.8)	7056 (60.2)	7078 (59.3)
Mountains	4803 (13.5)	4745 (14.1)	4824 (13.9)	4833 (13.7)	328 (2.6)	302 (2.4)	303 (2.6)	295 (2.5)
County urbanization								
Rural	2379 (6.7)	2347 (7.0)	2394 (6.9)	2419 (6.8)	1069 (8.5)	1064 (8.4)	957 (8.2)	981 (8.2)
Suburban	6834 (19.2)	6492 (19.2)	6334 (18.2)	6727 (19.0)	1990 (15.8)	2039 (16.1)	1787 (15.3)	1811 (15.2)
Urban	26,354 (74.1)	24,913 (73.8)	26,026 (74.9)	26,179 (74.1)	9506 (75.7)	9562 (75.5)	8968 (76.6)	9144 (76.6)
Total	35,567	33,752	34,754	35,325	12,565	12,665	11,712	11,936

Note. Data are no. (%). Winter, December-February; spring, March-May; summer, June-August; fall, September-November. NC, North Carolina.

TABLE 2.
Pregnancy Outcomes, by Season of Conception and Race

Outcome	Non-Hispanic white				Non-Hispanic black			
	Winter (n = 35,567)	Spring (n = 33,752)	Summer (n = 34,754)	Fall (n = 35,325)	Winter (n = 12,565)	Spring (n = 12,665)	Summer (n = 11,712)	Fall (n = 11,936)
Birth weight percentile for gestational age, mean (SD)	48.6 (28.4)	48.3 (28.5)	49.1 (28.3)	48.8 (28.4)	36.6 (27.1)	36.9 (27.1)	37.5 (27.2)	36.8 (27.3)
LBW	6.8%	7.3%	6.7%	6.6%	13.1%	13.2%	13.1%	13.0%
PTB	9.7%	10.6%	10.2%	9.6%	14.0%	14.8%	15.6%	14.8%
SGA	10.0%	10.3%	9.5%	9.8%	18.9%	18.7%	18.3%	19.3%

Note. Winter, December-February; spring, March-May; summer, June-August; fall, September-November. LBW, low birth weight (<2500 g); PTB, preterm birth (<37 weeks); SD, standard deviation; SGA, small for gestational age (<10th percentile of birth weight for gestational age).

ibility of fitting both regionally and racially stratified models outweigh the risk of type I error associated with the additional models.

Results

Table 1 presents the maternal characteristics of births by race and by season of conception. Clear differences in maternal characteristics exist between non-Hispanic white births and non-Hispanic black births; however, for both race groups, although there was some variation by season of conception, there were no dramatic differences in the distribution of maternal characteristics across seasons. This finding differs from the findings of some analyses of national data [1, 16]. The composition of births, in terms of geographic region and level of urbanization, was also fairly constant across seasons. The breakdown of births by geographic region and level of urbanization is consistent with the proportion of the overall population residing in each region and in counties classified by level of urbanization. There appeared to be

more seasonal variability in maternal characteristics among births to residents of rural counties, compared with trends found in the statewide sample. However, this may be caused by fewer observations in rural areas.

Table 2 presents pregnancy outcomes by season of conception and by race, for births in all North Carolina counties. There are clear racial disparities in birth outcomes, with non-Hispanic black births having higher rates of all adverse outcomes, compared with non-Hispanic white births. Although outcomes by urban and rural status are not included in the table, it is worth noting that the rates of adverse pregnancy outcomes in rural counties were consistently higher than those in urban counties (eg, 13.4% of births in rural counties were preterm, compared with 10.9% of births in urban counties). Spring and winter conceptions had a lower mean birth weight percentile for gestational age among statewide births for both race groups ($P < .05$), as well as among rural county births for the non-Hispanic white group ($P < .05$). Rates of small for gestational age were lowest among non-Hispanic

TABLE 3.
Covariate-Adjusted Odds Ratios (aORs) and 95% Confidence Intervals (CIs) for Binary Pregnancy Outcomes among Non-Hispanic White Births, for All Pairs of Seasons of Conception

Outcome, area	Fall vs spring	Fall vs summer	Fall vs winter	Spring vs summer	Spring vs winter	Summer vs winter
LBW						
NC	0.90 ^a (0.85-0.96)	0.97 (0.91-1.03)	0.97 (0.91-1.03)	1.08 ^a (1.01-1.14)	1.07 ^a (1.01-1.14)	1.00 (0.94-1.06)
Rural	0.97 (0.79-1.20)	1.27 (1.02-1.59)	1.04 (0.84-1.28)	1.31 (1.05-1.63)	1.06 (0.86-1.31)	0.81 (0.65-1.02)
Urban	0.88 ^a (0.82-0.95)	0.93 ^a (0.87-1.00)	0.97 (0.90-1.04)	1.05 (0.98-1.13)	1.10 ^a (1.02-1.18)	1.04 (0.97-1.12)
PTB						
NC	0.91 ^a (0.86-0.96)	0.94 ^a (0.90-0.99)	1.00 (0.95-1.05)	1.04 (0.99-1.09)	1.10 ^a (1.05-1.16)	1.06 ^a (1.01-1.12)
Rural	0.97 (0.81-1.15)	1.03 (0.87-1.23)	1.11 (0.93-1.33)	1.07 (0.90-1.27)	1.15 (0.97-1.37)	1.08 (0.90-1.29)
Urban	0.90 ^a (0.85-0.96)	0.93 ^a (0.87-0.98)	0.99 (0.93-1.05)	1.03 (0.97-1.09)	1.10 ^a (1.04-1.16)	1.07 ^a (1.01-1.13)
SGA						
NC	0.96 (0.91-1.01)	1.03 (0.98-1.08)	1.00 (0.95-1.05)	1.07 (1.02-1.13)	1.04 (0.99-1.10)	0.97 (0.92-1.02)
Rural	1.10 (0.92-1.32)	1.30 (1.08-1.57)	1.11 (0.93-1.33)	1.18 (0.98-1.43)	1.01 (0.84-1.21)	0.85 (0.71-1.03)
Urban	0.93 (0.88-0.99)	1.00 (0.94-1.06)	0.99 (0.93-1.05)	1.08 (1.01-1.14)	1.06 (1.00-1.12)	0.99 (0.93-1.05)

Note. Data are aOR (95% CI). Winter, December-February; spring, March-May; summer, June-August; fall, September-November. Models for each outcome were controlled for age, education, marital status, smoking during pregnancy, infant sex, and region of North Carolina (NC). Models for all NC counties also controlled for urban and rural county classification. LBW, low birth weight (<2500 g); PTB, preterm birth (<37 weeks); SGA, small for gestational age (<10th percentile of birth weight for gestational age).

^aIndicates aOR is significant at .05 and season of conception is a significant covariate in the model, on the basis of the type III P value.

TABLE 4.
Covariate-Adjusted Odds Ratios (aORs) and 95% Confidence Intervals (CIs) for Binary Pregnancy Outcomes among Non-Hispanic Black Births, for All Pairs of Seasons of Conception

Outcome, area	Fall vs spring	Fall vs summer	Fall vs winter	Spring vs summer	Spring vs winter	Summer vs winter
LBW						
NC	1.00 (0.93-1.07)	0.99 (0.92-1.07)	1.00 (0.93-1.08)	1.00 (0.93-1.08)	1.00 (0.93-1.08)	1.01 (0.93-1.08)
Rural	1.05 (0.82-1.35)	0.96 (0.75-1.24)	1.14 (0.89-1.47)	0.91 (0.71-1.17)	1.08 (0.84-1.39)	1.19 (0.92-1.53)
Urban	0.99 (0.91-1.08)	0.98 (0.90-1.07)	0.96 (0.88-1.05)	0.99 (0.91-1.08)	0.97 (0.89-1.05)	0.98 (0.90-1.06)
PTB						
NC	1.01 (0.94-1.08)	0.94 (0.88-1.01)	1.07 (0.99-1.15)	0.94 (0.87-1.01)	1.06 (0.99-1.14)	1.13* (1.05-1.21)
Rural	0.91 (0.72-1.14)	0.85 (0.67-1.07)	1.13 (0.89-1.45)	0.94 (0.75-1.18)	1.25 (0.99-1.58)	1.34 (1.06-1.70)
Urban	1.02 (0.94-1.10)	0.96 (0.89-1.04)	1.05 (0.96-1.14)	0.95 (0.87-1.03)	1.03 (0.95-1.12)	1.09 (1.00-1.18)
SGA						
NC	1.05 (0.98-1.11)	1.07 (1.00-1.14)	1.03 (0.97-1.10)	1.02 (0.96-1.09)	0.99 (0.93-1.05)	0.97 (0.91-1.03)
Rural	1.04 (0.84-1.29)	0.94 (0.76-1.18)	0.93 (0.75-1.15)	0.91 (0.73-1.13)	0.89 (0.72-1.10)	0.98 (0.79-1.22)
Urban	1.03 (0.96-1.11)	1.10 (1.02-1.18)	1.05 (0.98-1.13)	1.06 (0.99-1.14)	1.02 (0.95-1.10)	0.96 (0.89-1.03)

Note. Data are aOR (95% CI). Winter, December-February; spring, March-May; summer, June-August; fall, September-November. Models for each outcome were controlled for age, education, marital status, smoking during pregnancy, infant sex, and region of North Carolina (NC). Models for all NC counties also controlled for urban and rural county classification. LBW, low birth weight (<2500 g); PTB, preterm birth (<37 weeks); SGA, small for gestational age (<10th percentile of birth weight for gestational age).

*Indicates aOR is significant at .05 and season of conception is a significant covariate in the model, on the basis of the type III *P* value.

white spring conceptions across all North Carolina counties, in urban counties, and in rural counties ($P < .05$). Spring conceptions also had the highest rates of preterm birth and low birth weight among non-Hispanic white births across North Carolina ($P < .05$), in rural counties ($P < .05$, for low birth weight only), and in urban counties ($P < .05$). Among non-Hispanic black births, however, summer conceptions had the highest rate of preterm birth across all North Carolina counties ($P < .05$), as well as in rural and urban counties.

To better understand the association between pregnancy outcomes and season of conception, we fit models that controlled for relevant maternal and infant covariates, as well as for geography and urbanization. Generally, covariates behaved as we expected, with poor birth outcomes being associated with advanced maternal age, lower maternal educational attainment, unmarried status, and smoking status. Among non-Hispanic black rural births, maternal educational attainment, marital status, and smoking status were not significantly associated with pregnancy outcomes.

In models of binary outcomes among non-Hispanic white births, preterm birth and low birth weight were associated with season of conception in both statewide and urban county models ($P < .05$). Table 3 presents the covariate-adjusted odds ratios (aORs) and 95% confidence intervals (CIs) for the pairwise comparisons between seasons of conception, for all logistic models of pregnancy outcomes among non-Hispanic white births. Statewide, the odds of preterm birth were approximately 10% higher among spring conceptions and 6% higher among summer conceptions, compared with those for winter and fall conceptions ($P < .05$). Preterm birth followed a similar pattern among births in urban counties. In the statewide model, spring conceptions were more likely to

be low birth weight than were conceptions in all other seasons ($P < .05$). Among births in urban counties, fall conceptions were less likely to be low birth weight than were spring and summer conceptions ($P < .05$), and winter conceptions were less likely to be low birth weight than were spring conceptions ($P < .05$). Small for gestational age was marginally associated with season of conception among non-Hispanic white births statewide, in urban counties, and in rural counties ($P = .05$, for all). Other than this marginal association with small for gestational age, no other binary pregnancy outcome was associated with season of conception among non-Hispanic white births in rural counties. Note that the smaller sample size in rural areas may account, in part, for nonsignificant statistical results.

Among non-Hispanic black births, only preterm birth was significantly associated with season of conception in statewide models ($P < .05$) (Table 4). The odds of preterm birth were higher among summer conceptions than among winter conceptions (aOR, 1.13; 95% CI, 1.05-1.21). No association between any of the binary pregnancy outcomes and season of conception was found in non-Hispanic-black-specific models when the analysis was restricted to births in rural or urban counties; thus, differences in the statewide model may be driven by differences in suburban counties.

Models that associated birth weight percentile for gestational age and season of conception are summarized in Table 5. Among non-Hispanic white births in rural counties, summer conceptions had a higher mean birth weight percentile for gestational age than did conceptions in all other seasons ($P < .05$). Among non-Hispanic black births across North Carolina, birth weight percentile for gestational age was also higher for summer conceptions than for fall or winter conceptions ($P < .05$).

TABLE 5.
Modeled Mean Birth Weight Percentile for Gestational Age, by Season of Conception, on the Basis of Race-Specific Statewide, Urban, and Rural Models

Race, area	Season of conception			
	Fall	Spring	Summer	Winter
Non-Hispanic white				
NC	46.60	46.32	46.90	46.57
Rural	44.62 ^a	44.99 ^a	47.06	45.07 ^a
Urban	46.99	46.79	46.92	46.93
Non-Hispanic black				
NC	36.93 ^a	37.16 ^{a,b}	37.78 ^b	36.84 ^a
Rural	37.06	38.28	38.75	37.44
Urban	36.86	36.92	37.68	36.84

Note. Winter, December-February; spring, March-May; summer, June-August; fall, September-November. Models for each outcome were controlled for age, education, marital status, smoking during pregnancy, infant sex, and region of North Carolina (NC). Models for all NC counties also controlled for urban and rural county classification.

^{a,b}In each row, if season of conception was a significant covariate in the model, on the basis of the type III P value, then sets of seasons with means that are not significantly different ($P \geq .05$) are noted with the same letter.

Discussion

Consistent with the findings of previous research, we found significant seasonal patterns in poor pregnancy outcomes. We conceive that seasonal patterns are a potential proxy for differing environmental exposures across seasons. Because of our access to the NCDBR, we were able to explore these seasonal patterns in greater depth. Our results suggest that, in North Carolina, seasonal patterns are most pronounced among non-Hispanic white women living in urban areas. This is somewhat surprising given the significantly higher rates of poor pregnancy outcomes among non-Hispanic black women in North Carolina and nationally. This seemingly anomalous result may arise from other, non-seasonal social and environmental factors overwhelming seasonal environmental exposures for non-Hispanic black women. These results are also surprising given the higher rates of poor pregnancy outcomes among women residing in rural areas in North Carolina and nationally. Again, this seemingly anomalous result may arise from other, nonspatial social and environmental factors overwhelming seasonal environmental exposures for women living in rural areas. In future work, we hope to disentangle some of these questions by implementing spatial models that go well beyond simply controlling for region of the state and degree of urbanization.

That we did not observe seasonal variation in maternal characteristics (except for rural births) differs from other analyses of seasonality and suggests that seasonal variation in birth outcomes is more likely caused by unmeasured environmental or other factors than by individual-level risk factors. This is confirmed in the adjusted models, where we controlled for individual-level risk factors and still observed significant seasonal patterns in poor pregnancy outcomes. We note that seasonality in the total number of pregnan-

cies means that there is seasonal variation in the number of fetuses exposed to a given potential risk factor. This in itself could lead to seasonal variation in the attributable number of cases, even if the relative proportion does not change.

A limitation of the work in the present study is the reliance on data from the NCDBR, which includes only information on live births. We were thus not able to consider seasonal variability in early pregnancy loss; therefore, we may be understating the seasonal variation in pregnancy outcomes overall. The present study is further limited by the restricted set of maternal and pregnancy variables available from the NCDBR. A richer set of variables, potentially including psychosocial and activity measures, would allow us to more ably discern what is driving the observed seasonal patterns (although, note that such analyses would almost certainly be performed using substantially smaller sample sizes).

In the end, we do not consider season of conception, in and of itself, to be a causative factor for poor pregnancy outcomes. Rather, we believe it serves as a proxy for some other, time-varying factor. Thus, while we were able to discern seasonality, the present study is limited in its ability to identify the specific environmental or other factors that may be driving the seasonal patterns. The results do, however, suggest important directions for future research. In addition, the pronounced increased risk associated with a spring season of conception provides an important clue for ferreting out the true causative factors.

Conclusions

Poor pregnancy outcomes in North Carolina follow a clear seasonal pattern based on timing of conception. These seasonal patterns are most pronounced among non-Hispanic white women living in urban areas. These seasonal patterns are suggestive of causative environmental factors and certainly warrant additional research. In future research, we plan to explore potential environmental exposures as the drivers of the seasonal patterns demonstrated in the present study. **NCMJ**

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References

1. Darrow LA, Strickland MJ, Klein M, et al. Seasonality of birth and implications for temporal studies of preterm birth. *Epidemiology*. 2009;20:699-706.
2. Warren CW, Gwinn ML, Rubin GL. Seasonal variation in conception and various pregnancy outcomes. *Soc Biol*. 1986;33:116-126.


3. Weinberg CR, Moledor E, Baird DD, Wilcox AJ. Is there a seasonal pattern in risk of early pregnancy loss? *Epidemiology*. 1994;5:484-489.
4. Fulford AJ, Rayco-Solon P, Prentice AM. Statistical modelling of the seasonality of preterm delivery and intrauterine growth restriction in rural Gambia. *Paediatr Perinat Epidemiol*. 2006;20:251-259.
5. Algert CS, Roberts CL, Shand AW, Morris JM, Ford JB. Seasonal variation in pregnancy hypertension is correlated with sunlight intensity. *Am J Obstet Gynecol*. 2010;203:215. PM:20537304
6. Phillips JK, Bernstein IM, Mongeon JA, Badger GJ. Seasonal variation in preeclampsia based on timing of conception. *Obstet Gynecol*. 2004;104:1015-1020.
7. Garry VF, Harkins ME, Erickson LL, Long-Simpson LK, Holland SE, Burroughs BL. Birth defects, season of conception, and sex of children born to pesticide applicators living in the Red River Valley of Minnesota, USA. *Environ Health Perspect*. 2002;110(Suppl 3):441-449.
8. Obeidat AZ, Amarin Z. Neural tube defects in the north of Jordan: is there a seasonal variation? *J Child Neurol*. 2010;25:864-866.
9. Schreinemachers DM. Birth malformations and other adverse perinatal outcomes in four U.S. wheat-producing states. *Environ Health Perspect*. 2003;111:1259-1264.
10. Ritz B, Yu F, Chapa G, Fruin S. Effect of air pollution on preterm birth among children born in Southern California between 1989 and 1993. *Epidemiology*. 2000;11:502-511.
11. Murray LJ, O'Reilly DP, Betts N, Patterson CC, Davey Smith G, Evans AE. Season and outdoor ambient temperature: effects on birth weight. *Obstet Gynecol*. 2000;96:689-695.
12. Rayco-Solon P, Fulford AJ, Prentice AM. Differential effects of seasonality on preterm birth and intrauterine growth restriction in rural Africans. *Am J Clin Nutr*. 2005;81:134-139.
13. Lam DA, Miron JA, Riley A. Modeling seasonality in fecundability, conceptions, and births. *Demography*. 1994;31:321-346.
14. Cesario SK. The "Christmas Effect" and other biometeorologic influences on childbearing and the health of women. *J Obstet Gynecol Neonatal Nurs*. 2002;31:526-535.
15. Tita AT, Hollier LM, Waller DK. Seasonality in conception of births and influence on late initiation of prenatal care. *Obstet Gynecol*. 2001;97:976-981.
16. Buckles K, Hungerman DM. Season of Birth and Later Outcomes: Old Questions, New Answers. Working Paper 14573. Cambridge, MA: National Bureau of Economic Research; 2008. <http://www.nber.org/papers/w14573>.
17. Miranda ML, Maxson P, Edwards S. Environmental contributions to disparities in pregnancy outcomes. *Epidemiol Rev*. 2009;31:67-83.
18. Swamy GK, Edwards S, Gelfand A, James SA, Miranda ML. 2012. Maternal age, birth order, and race: differential effects on birth-weight. *J Epidemiol Community Health*. 2012;66(2):136-142.
19. Miranda ML, Maxson P, Edwards S, Swamy G, Gelfand AE, James SA. Disparities in maternal hypertension and pregnancy outcomes: evidence from North Carolina, 1994-2003. *Public Health Rep*. 2010;125:579-587.
20. Confidential patient database: North Carolina Detailed Birth Record 2001-2006. North Carolina Center for Health Statistics, Raleigh, NC; 2007.
21. Reichman NE, Hade EM. Validation of birth certificate data: a study of women in New Jersey's HealthStart program. *Ann Epidemiol*. 2001;11:186-193.
22. Reichman NE, Schwartz-Soicher O. Accuracy of birth certificate data by risk factors and outcomes: analysis of data from New Jersey. *Am J Obstet Gynecol*. 2007;197:32-38.
23. Buescher PA, Taylor KP, Davis MH, Bowling JM. The quality of the new birth certificate data: a validation study in North Carolina. *Am J Public Health*. 1993;83:1163-1165.
24. Zollinger TW, Przybylski MJ, Gamache RE. Reliability of Indiana birth certificate data compared to medical records. *Ann Epidemiol*. 2006;16:1-10.
25. Engle WA. Age terminology during the perinatal period. *Pediatrics*. 2004;114:1362-1364.
26. Xiong X, Mayes D, Demianczuk N, et al. Impact of pregnancy-induced hypertension on fetal growth. *Am J Obstet Gynecol*. 1999;180:207-213.
27. Xiong X, Buekens P, Pridjian G, Fraser WD. Pregnancy-induced hypertension and perinatal mortality. *J Reprod Med*. 2007;52:402-406.
28. Buchbinder A, Sibai BM, Caritis S, et al. Adverse perinatal outcomes are significantly higher in severe gestational hypertension than in mild preeclampsia. *Am J Obstet Gynecol*. 2002;186:66-71.
29. Habli M, Levine RJ, Qian C, Sibai B. Neonatal outcomes in pregnancies with preeclampsia or gestational hypertension and in normotensive pregnancies that delivered at 35, 36, or 37 weeks of gestation. *Am J Obstet Gynecol*. 2007;197:406-407.
30. Chang J, Elam-Evans LD, Berg CJ, et al. Pregnancy-related mortality surveillance—United States, 1991-1999. *MMWR Surveill Summ*. 2003;52:1-8.
31. Savitz DA, Zhang J. Pregnancy-induced hypertension in North Carolina, 1988 and 1989. *Am J Public Health*. 1992;82:675-679.
32. England L, Zhang J. Smoking and risk of preeclampsia: a systematic review. *Front Biosci*. 2007;12:2471-2483.

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Introduction

Who can resist the attraction of the state fair? Once a year, North Carolinians gather at the fairgrounds in Raleigh to celebrate the end of the cycle of growth and harvest. The state fair is meant to give tribute to the farmers and farm families who produce the food, fiber, and forestry products that sustain us. But even a happy event like the fair has its risks, evidenced by the *E. coli* outbreaks that occurred in 2004, and again in 2011. This is a metaphor of sorts for agriculture: it is a basic and necessary pursuit of humans, a core part of our economy, an avocation as much as an occupation, but because of its nature, it is inherently dangerous.

Agriculture remains a dominant economic engine of the state, but the rural character of North Carolina has changed markedly. Before 1980, most of the population was counted as rural, but since then the rural population has grown by only a few percentage points, while there are now twice as many city folk—another 3 million. Farmland makes up 27% of the total area of the state, divided into cropland, woodland, pasture, and homes and ponds. We have more than 45,000 farms, most less than 100 acres in size, run by 52,000 principal operators (45,000 men and 7,000 women), and that employ 648,000 people, accounting for 17% of the total workforce. While we may have become more citified, we still have a large and vibrant agricultural sector. We are beginning to learn that agriculture is now closer to our city lives, as we understand more and more about how it affects population health.

The planting, tending, and harvesting of agricultural products is a physical activity that involves putting heavy equipment and large animals in motion; cutting, shredding, and shifting large quantities of material; and using chemicals and natural agents that can be dangerous. This means that a significant portion of the population is at an elevated risk of injury and illness because of their occupation. The link between agriculture and health risk has long been understood, and the response has been one that balanced production with the risks but that emphasized efficiency and production. After all, people depend on food to support their health. That equation has shifted in the recent past, as we have begun to recognize that we have to take into consideration effects beyond the risk of direct injury to farm workers and as we begin to consider the longer-term effects of agricultural production and processing. We have begun to unravel the complex interrelationships that tie agriculture to the entire population's health.

This recognition of the broader implications of agricultural processes and consequences has, interestingly, not led us away from the primary elements of the sector—the farm workers—but has helped us to recognize how to better protect those who are directly involved. The programs and projects described in this issue of the NCMJ reflect our broader understanding of the longer-term effects of agriculture on all our people.

This brings us back to the unfortunate *E. coli* infections: people, many of them children, were merely looking in on agriculture when they became ill. This, indirectly, illustrates the interconnectedness of our lives, where the farm is actually closer to our lives now than it was years ago. The primary effect of the connection has long been considered economic, but we are recognizing that a healthy state requires healthy farms, as well as healthy cities. NCMJ

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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.

Agriculture 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 understatement. 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. 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. 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. 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#rearwardricultural>. 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. 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. 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. Accessed October 23, 2011.
26. North Carolina Department of Labor. Recordkeeping and Reporting: 29 CFR 1904. 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. 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. Accessed October 23, 2011.

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

Sheila Higgins, Tanya Barros, Herbert G. Garrison

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.

Agriculture 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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Reference

1. Hughes R, Rodgman E. Crashes Involving Farm Tractors and Other Farm Vehicles/ Equipment in North Carolina 1995-1999. University of North Carolina Highway Safety Research Center, University of North Carolina at Chapel Hill, 2000. <http://www.hsrb.unc.edu/pdf/2000/Farm.pdf>. Accessed July 25, 2003.

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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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References

1. Centers for Disease Control and Prevention. Workplace safety & health topics: agriculture. <http://www.cdc.gov/niosh/topics/agriculture>. Accessed August 26, 2011.
2. Bureau of Labor Statistics. Fatal occupational injuries in North Carolina. <http://www.bls.gov/iif/oshwc/cfoi/tgs/2009/iiffi37.htm>. Accessed August 26, 2011.
3. Bureau of Labor Statistics. Table 1: Fatal occupational injuries, comparison of 2009 preliminary and updated, selected characteristics. http://www.bls.gov/iif/oshwc/cfoi/cfoi_revised09.pdf. Accessed August 26, 2011.
4. Bureau of Labor Statistics. Survey of Occupational Injury and Illness. Table 6: Incidence rates of nonfatal occupational injuries and illnesses by industry and case types. <http://www.bls.gov/iif/oshstate.htm#NC>. Accessed August 26, 2011.
5. Bureau of Labor Statistics. Table 1: Incidence rates of nonfatal occupational injuries and illnesses by case type and ownership, selected industries, 2009. http://www.bls.gov/news.release/archives/osh_10212010.pdf. Accessed September 26, 2011.
6. US Department of Agriculture. 2007 Census of Agriculture. <http://www.nacagr.gov/stats/>. Accessed August 26, 2011.
7. NC DETECT. The University of North Carolina (UNC) Department of Emergency Medicine, Carolina Center for Health Informatics Report: Overview and Analysis of NC DETECT Emergency Department Visit Data: 2009. Chapel Hill, NC: UNC-Chapel Hill; 2011. <http://ncdetect.org/pubs.html>.
8. Schappert MA, Rechtsteiner EA. Ambulatory medical care utilization estimates for 2006. National Health Statistics Reports, no.8. Hyattsville, MD: National Center for Health Statistics, CDC; 2008. <http://www.cdc.gov/nchs/data/nhsr/nhsr008.pdf>. Accessed August 26, 2011.
9. Rautianinen RH, Reynolds SJ. Mortality and morbidity in agriculture in the United States. *J Agric Saf Health*. 2002;(3):259-276.
10. Richardson D, Loomis D, Bailer AJ, Bena J. The effect of rate denominator source on fatal occupational injury rate estimates. *Am J Ind Med*. 2004;46:261-270.
11. Earle-Richardson GG, Jenkins PL, Scott EE, May JJ. Improving agricultural injury surveillance: a comparison of incidence and type of injury event among three data sources. *Am J Ind Med*. 2011;54:586-596.
12. New York Center for Medicine and Agricultural Health. Injury surveillance. <http://www.nycamh.com/research/current/injury-surveillance.php?id=485>. Accessed August 2, 2011.
13. Pickett W, Hartling L, Dimich-Ward R, et al. Surveillance of hospitalized farm injuries in Canada. *Inj Prev*. 2001;7:123-128.
14. Murphy DJ. Safety and Health for Production Agriculture. St. Joseph, MN: American Society of Agricultural Engineers; 1992.

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Living and Working Safely: Challenges for Migrant and Seasonal Farmworkers

Thomas A. Arcury, Sara A. Quandt

Migrant and seasonal farmworkers are essential to North Carolina agriculture, yet they experience major health risks. This commentary describes the characteristics of North Carolina farmworkers, important hazards they face, and the status of regulatory protections. Finally, it presents a summary of policy needed to protect the health of farmworkers.

Migrant and seasonal farmworkers are essential to the success of agriculture in North Carolina. These farmworkers provide the hand labor needed to plant, cultivate, and harvest many of the state's economically important crops, including tobacco, cucumbers, sweet potatoes, berries, peaches, apples, and Christmas trees. Immigrant farmworkers are also increasingly full-time employees, supporting the production of livestock and poultry, as well as crops. Although essential for agriculture's financial success, farmworkers seldom share in its financial rewards. Rather, they experience significant occupational and environmental exposures, deplorable living conditions, limited safety training, and few supporting regulations [1].

This commentary reviews the characteristics of the farmworkers who work in North Carolina, important farmworker occupational and environmental health risks and outcomes, living conditions that affect farmworker health, and the status of safety training and regulatory protections. Finally, this commentary presents a summary of policy and regulations needed to protect the health of farmworkers.

Farmworkers in North Carolina

Few data document the number of farmworkers employed in North Carolina or describe the characteristics of these farmworkers. The 2007 Census of Agriculture (available at: <http://www.agcensus.usda.gov>) provides some information. In 2007, 12,284 North Carolina farms employed 77,400 workers, with 2413 of these farms employing migrant labor and 9521 farms employing 48,305 employees who worked fewer than 150 days per year. The North Carolina Employment Security Commission estimated that, in 2010, farms in the state employed 35,520 migrant farmworkers, 24,725 seasonal farmworkers, and 8905 farmworkers with H-2A guest worker visas. These numbers are acknowledged to be conservative estimates. In 2009, the Employment

Security Commission reported that 35,000 of the 36,000 migrant farmworkers spoke Spanish.

Information describing the personal characteristics of farmworkers employed in North Carolina is limited to small surveys. These show that the overwhelming majority of farmworkers are Latino, and most were born in Mexico. However, farmworkers have diverse backgrounds, and some African American and Afro-Caribbean farmworkers continue to be employed in the state. Recently, some farms have employed workers from Southeast Asia. Migrant farmworkers are largely unaccompanied men, but some farmworker families migrate, and many seasonal workers live with their families. Although most farmworkers are in their 20s and 30s, a sizable number of farmworkers are under 18, and some are as young as 12 and 13. Farmworkers in their 40s, 50s, and 60s are common. Farmworkers are poor, and many have little formal education. Most farmworkers speak Spanish, with approximately one-quarter speaking an indigenous (American Indian) language.

Occupational Exposures and Health Outcomes

Agriculture is a dangerous industry. Occupational and environmental hazards that confront farmworkers in North Carolina include the physical environment (sun, heat, rain, organic and inorganic dust), wild plants (eg, poison ivy) and animals (eg, snakes), sharp tools, equipment, chemicals, and noise.

Official rates for occupational injuries and illnesses are not available for farmworkers in North Carolina. Few farmworkers have access to workers' compensation. No surveillance system exists for occupational injuries in agriculture. Therefore, farmworker injury and illness data must be gleaned from surveys and clinic reports. Occupational injuries common to farmworkers include cuts and lacerations, eye injuries, musculoskeletal problems, and skin conditions [2]. Hearing loss and respiratory conditions are common to

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The North Carolina Gold Star Grower Program

Regina Cullen

Agriculture provides employment and income to more than 20 million people nationwide and to more than 800,000 here in North Carolina. It's an industry that can exact a powerful cost: farm machinery, agricultural chemicals, grain bins, and farm animals all can place those working in agriculture in a danger zone, both in the working environment as well as in living conditions. During 2007, hired farm labor was reported on 482,186 (22%) of the nation's farms and ranches. North Carolina, 1 of 9 states that account for just over half of all workers hired directly by farm operators, has made efforts to highlight agricultural danger zones.

The North Carolina legislature enacted the Migrant Housing Act (MHA) of North Carolina, which took effect in 1990. The MHA consolidated the inspection of migrant housing in the North Carolina Department of Labor (NCDOL) and updated housing inspection standards. In addition to enforcing the Occupational Safety and Health Administration migrant housing regulations—the Temporary Labor Camp Standard (29 CFR 1910.142)—the MHA added fire protection, heating, kitchen sanitation, and hot water requirements. Field sanitation provisions were expanded to apply to all individuals providing migrant housing. Housing owners or operators who provide housing to 1 or more migrant worker must register the housing with NCDOL 45 days before the workers take occupancy. Water and septic systems are required to be inspected by the local county health departments.

For many North Carolina growers, this legislation was not an easy pill to swallow. Before the MHA, growers had been subject to other rules, enforced by other agencies, and did not come under inspection unless they housed more than 10 farmworkers. But for advocates, the MHA did not go far enough.

The North Carolina Gold Star Grower program began in the early 1990s as a response to the inspection process. Some growers complained, "Why are you inspecting me? I meet all the requirements! There are folks down the road that NEED your inspection. I don't! I work hard to keep this house right!" Office staff and inspectors noticed this, as well, commenting, "Some housing is always in great shape. What can we do to acknowledge the growers' efforts?" Inspectors observed that some growers provided housing that exceeded the MHA requirements: installing telephones or providing appliances such as microwave ovens and freezers.

Such discussions led one staffer to remark, "Remember back in school, when we'd get a gold star on our papers?" The Gold Star Grower program began with simple thank you notes, blue cards with a gold star in the corner, sent to those whose housing met all the requirements of the MHA. In 1992, there were 136 Gold Star Growers (13% of those inspected).

NCDOL held the first recognition luncheon in 1994 and

has held them annually ever since. In the beginning, these events took place in various locations throughout the state, including Kernersville, Wilson, Lexington, Farmville, Mount Olive, and Greenville. Hosts included North Carolina State University Cooperative Extension agents: Mark Tucker, in Forsyth County, and Tom Campbell, in Pasquotank County. Commodity groups—cucumber, tobacco, blueberry, Christmas trees—are supporters. Growers who receive 2 consecutive stars are then eligible to conduct their own housing inspections the following year. They must attend the luncheon, continue to register their housing, and have their water and septic systems inspected.

Two-way communication proved beneficial: problems discussed at Gold Star luncheon meetings included farm safety issues. The danger zone expanded from housing issues to the farm field and beyond. In 1998, driving farm equipment on rural roadways was the topic Gold Star Growers considered their "most serious workplace safety problem." Solutions included grant money from the Governor's Highway Safety Program to fund educational programs and to provide all registered growers with slow moving vehicle signs for their farm vehicles. Billboards with tractors and the slogan "Slow Moving" were posted in a number of rural counties, drawing attention to the problem. North Carolina State Cooperative Extension worked with NCDOL to promote Light & Reflect, the safety program developed as a result of this initiative. Other agricultural safety initiatives include workplace safety DVDs, in English and Spanish, filmed on Gold Star farms. Safety topics include pesticide information, heat stress/stroke recognition and prevention, and machine guarding. At present, a housing DVD is in production. Topics include fire prevention, bathroom sanitation, electrical issues, and maintenance. The DVDs, distributed to all growers who register their housing, are used to conduct on-site farm training.

Our belief is that all agriculture-related illnesses, injuries, and fatalities are preventable. The Gold Star Grower program addresses the health and safety of the agricultural workforce by viewing it from multiple perspectives: grower, farmworker, and safety professional. The Gold Star list keeps growing; the program has proven to be an effective initiative for the growers and the state. Permitting growers who have earned the right to self-inspect allows the Agricultural Safety and Health Bureau to focus resources on unregistered camps and on growers who need intervention. **NCMJ**

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farmworkers employed in other regions of the country, but little research has been conducted on these effects in North Carolina.

Three hazards are particularly critical for North Carolina

farmworkers. Heat stress is common among farmworkers, because of the state's high temperatures in July and August [3]. These high temperatures are magnified by the physical exertion of farm labor, which often occurs within the enclo-

sure of tight tobacco rows. Few years pass without a death from heat stress in North Carolina.

Nicotine exposure from working with tobacco plants is another important hazard for North Carolina farmworkers. Farmworkers absorb nicotine while working with tobacco, to the point of acute nicotine poisoning; this is referred to as green tobacco sickness, or GTS [4]. One-quarter of farmworkers experience GTS each year. Symptoms of GTS include headache, dizziness, nausea, vomiting, insomnia, and anorexia. GTS is a self-limiting occupational illness, because the body will metabolize nicotine within 24 hours. However, GTS can lead to severe dehydration when combined with the heat in which farmworkers labor. Further, farmworkers must work every day or not receive any income, and those who are particularly susceptible to GTS continue to experience symptoms daily.

Biomarker data document that all North Carolina farmworkers show evidence of recent agricultural pesticide exposure [5]. Luckily, acute pesticide exposure remains rare. However, long-term exposure to small amounts of pesticides has negative health consequences. Data documenting the sequelae of long-term exposure among North Carolina farmworkers are not available, but current research is being conducted to address this issue.

Living Conditions

Farmworkers experience significant exposure to hazards because of their living conditions. Although these hazards are more severe among migrant farmworkers, they also apply to many seasonal farmworkers who live in North Carolina year-round. Travel and transportation is the first of these hazards. The act of crossing the border from Mexico to the United States results in many deaths each year. Many farmworkers do not control the transportation that they use. They must travel in crowded vehicles from region to region, looking for work. They must also travel, on a daily basis, from their residences to work in these vehicles.

Housing is another hazard that farmworkers experience. The housing available to farmworkers, whether in migrant farmworker camps controlled by farmers or contractors or in rural communities, is overwhelmingly substandard. Housing regulations exist for migrant farmworkers but not for seasonal farmworkers. However, enforcement of migrant housing regulations is limited. For example, more than 25% of migrant camps violate regulations for sufficient laundry facility and bedroom space, and 1 in 5 camps has signs of rodent infestation [6]. Farmworker housing exposes workers and their families to toxicants, including lead and pesticides; to allergens, including mold, mildew, and insect and rodent dander; to electrical and structural hazards; and to crowded conditions.

Although farmworkers toil to produce food, they are often food insecure; almost half of farmworker households studied by Quandt and colleagues [7] were found to be food insecure. Food insecurity results from low wages and not having

access to safety net programs, such as food stamps. Food insecurity is more pronounced among farmworkers who have children living with them.

Many farmworkers, seasonal as well as migrant, are separated from their families. Recent US policy on immigration has exacerbated this problem, as many farmworkers are now staying in the United States year-round, rather than risk trying to cross the border each year. Farmworkers are often isolated, living in rural areas with no transportation. They experience discrimination and harassment. They must often work long hours, with little diversion or entertainment. As a result, farmworkers have high rates of anxiety, depression, and other mental health problems [8].

Also related to separation from family and isolation, farmworkers are at increased risk for sexually transmitted diseases, including HIV, because of their use of commercial sex workers and because of men having sex with men [9]. Farmworkers are at increased risk for infectious diseases, such as tuberculosis and hepatitis, because of crowded living conditions.

Finally, when farmworkers get injured or ill, they have limited access to health care [10]. The migrant clinic network is limited to approximately 24 clinics across the state. Many of these have limited hours of operations. Farmworkers seldom have health insurance.

Training and Regulatory Requirements

Although farmworkers experience extensive occupational and environmental hazards and although they endure extremely poor living conditions, policies to protect the occupational health of farmworkers are limited. Agriculture is exempt from many of the occupational health standards of other industries; these exemptions, referred to as "agricultural exceptionalism," were meant to protect family farms but continue to shield industrial agriculture [11].

Current regulations protecting North Carolina farmworkers include those concerning pesticide safety, field sanitation, housing for migrant farmworkers, and minimum wage. The US Environmental Protection Agency's Worker Protection Standard (WPS) requires that those who might be exposed to pesticides receive specific training, that they be provided with information about the pesticides to which they might be exposed, and that they be provided with medical care if they experience an acute pesticide exposure. The Occupational Safety and Health Administration (OSHA) supports regulations prescribing field sanitation requirements for farmworkers. These regulations indicate where and when drinking water and cups, hand washing facilities, and restrooms are to be provided to farmworkers. The North Carolina Migrant Housing Act (MHA), which is more stringent than the OSHA regulations on which it is based, includes regulations for minimum housing requirements for migrant farmworkers (no such regulations are available for seasonal farmworkers). These housing regulations provide minimum standards for bedding, storage space for personal belongings, showers,

toilets, refrigerator space, and laundry facilities. The North Carolina Department of Labor's Wage and Hour Bureau is responsible for ensuring that farmworkers receive at least the minimum hourly rate of pay; farmworkers employed on small farms are exempt from the minimum wage law. Farmworkers with H-2A visas should receive an hourly rate greater than the minimum. However, research in North Carolina and elsewhere shows that farmworkers often are not afforded the protections of the WPS, the OSHA field sanitation requirements, the North Carolina MHA, or the minimum wage rates [6, 12, 13].

Discussion

North Carolina and the nation must become more realistic about the labor needed to support agriculture, and they must become more humane in treating those who work to plant and harvest our fruits, vegetables, and other agricultural products. Because of the history of agricultural exceptionalism, few health and safety regulations are available to protect agricultural workers.

Immigration policy reform is needed. Although immigrant workers are essential to the financial success of agriculture, it is extremely difficult for agricultural employers and workers to conform to current immigration regulations. The H-2A visa program is one avenue for the legal and safe movement of agricultural workers. In North Carolina, migrant farmworkers with H-2A visas who have been recruited by the North Carolina Growers Association are represented by the Farm Labor Organizing Committee. Although research shows that the occupational safety and living conditions of migrant farmworkers with H-2A visas are better than those of migrant farmworkers without H-2A visas [12, 13], investigators also raise serious human rights concerns about the current H-2A visa program [14].

Regulations are needed that require occupational safety training that is linguistically and educationally appropriate for farmworkers [15]. However, safety training is no panacea for the technological and organizational changes needed to make agriculture a safer industry. Appropriate safety regulations that address all areas of agriculture work, including child labor, heat stress, pesticide and other chemical exposures, minimum wage and payment for overtime work, workers' compensation, field sanitation, and housing, are needed. Farmworkers need assurance that they will be protected should they decide to report violations of existing regulations or should they decide to organize. In North Carolina, the Farmworker Advocacy Network (<http://www.ncfan.org/>) has advocated for new legislation that addresses many of these safety regulations. Funding is needed to support the enforcement of current safety regulations. Neither the North Carolina Department of Agriculture and Consumer Services nor the North Carolina Department of Labor has sufficient staff to enforce the current WPS pesticide safety regulations or the current migrant housing and field sanitation regulations.

Adequate health care for all farmworkers is also needed. Few farmworkers in North Carolina have employer-provided health insurance. Workers' compensation is available only to farmworkers with H-2A visas or to those working for someone with 10 or more full-time employees. The North Carolina Farmworker Health Program, Office of Rural Health and Community Care (<http://www.ncfhp.org/>), supports migrant farmworker clinics across the state, as well as other programs. However, the 24 clinic sites supported through this program are insufficient to serve the needs of migrant farmworkers, who labor in most of the state's 100 counties. Further, seasonal farmworkers often are not eligible for these services.

In 1960, the Edward R. Murrow documentary *Harvest of Shame* showed the plight of farmworkers in the United States. This documentary increased awareness in America about the human cost of its food. It also led to policy changes that improved some aspects of farmworker lives. Although improvement in farmworker occupational health and safety continues, public policy is needed to address the conditions that farmworkers, farmers, and all agricultural workers must endure. **NCMJ**

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References

1. Arcury TA, Quandt SA, eds. *Latino Farmworkers in the Eastern United States: Health, Safety, and Justice*. New York: Springer; 2009.
2. May JJ. Occupational injuries and illness in farmworkers in the eastern United States. In: Arcury TA, Quandt SA, eds. *Latino Farmworkers in the Eastern United States: Health, Safety, and Justice*. New York: Springer; 2009:71-101.
3. Mirabelli MC, Quandt SA, Crain R, et al. Symptoms of heat illness among Latino farmworkers in North Carolina. *Am J Prev Med*. 2010;39(5):468-471.
4. 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.
5. Arcury TA, Grzywacz JG, Talton JW, et al. Repeated pesticide exposure among North Carolina migrant and seasonal farmworkers. *Am J Ind Med*. 2010;53(8):802-813.
6. Vallejos QM, Quandt SA, Grzywacz JG, et al. Migrant farmworkers' housing conditions across an agricultural season in North Carolina. *Am J Ind Med*. 2011;54(7):533-544.
7. Quandt SA, Arcury TA, Early J, Tapia J, Davis JD. Household food security among Latino farmworkers in North Carolina. *Public Health Rep*. 2004;119(6):568-576.
8. Grzywacz JG, Quandt SA, Chen H, et al. Depressive symptoms among Latino farmworkers across the agricultural season: individual and contextual influences. *Cultur Divers Ethnic Minor Psychol*.

2010;16(3):335-343.

9. Rhodes SD, Bischoff WE, Burnell JM, et al. HIV and sexually transmitted disease risk among male Hispanic/Latino migrant farmworkers in the southeast: findings from a pilot CBPR study. *Am J Ind Med.* 2010;53(10):976-983.
10. Arcury TA, Quandt SA. Delivery of health services to migrant and seasonal farmworkers. *Annu Rev Public Health.* 2007;28:345-363.
11. Wiggins M. Farm labor and the struggle for justice in the eastern United States fields. In: Arcury TA, Quandt SA, eds. *Latino Farmworkers in the Eastern United States: Health, Safety, and Justice.* New York: Springer; 2009: 201-220.
12. Robinson EN, Nguyen HT, Isom S, et al. Wages, wage violations, and pesticide safety experienced by migrant farmworkers in North Carolina. *New Solut.* 2011;21(2):251-258.
13. Whalley LE, Grzywacz JG, Quandt SA, et al. Migrant farmworker field and camp safety and sanitation in eastern North Carolina. *J Agromedicine.* 2009;14(4):421-436.
14. Bauer M. *Close to Slavery: Guestworker Programs in the United States.* Montgomery, AL: Southern Poverty Law Center; 2007.
15. Arcury TA, Estrada JM, Quandt SA. Overcoming language and literacy barriers in safety and health training of agricultural workers. *J Agromedicine.* 2010;15(3):236-248.



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Mountain Pesticide Education and Safety Outreach Program: A Model for Community Collaboration to Enhance On-Farm Safety and Health

Jim Hamilton, Jill Sidebottom

This article showcases the outcomes of the Mountain Pesticide Education and Safety Outreach program, a collaborative effort between Christmas tree growers, cooperative extension, farmworkers, farmworker health outreach staff, and others to reduce pesticide exposure and on-farm injuries. Lessons learned during the project that can be adopted by other communities will also be shared.

Many Latino workers find employment in the Christmas tree industry in rural western North Carolina. A majority of the estimated 5,000 workers hired each year to work on Christmas tree farms are Latino. The language barrier between employers and workers in this industry makes this workforce vulnerable to pesticide exposure and other occupational safety risks. The goal of the Mountain Pesticide Education and Safety Outreach program, or Mountain PESO program, was to develop industry-specific educational materials for Christmas tree farms and to deliver on-site training programs for Latino workers that could be modeled and replicated in other Christmas tree production areas. Since 2004, it has evolved from a tailgate training activity into large-scale farmworker field days and in-depth integrated pest management (IPM) training for Latino workers.

Frustration with communication and language barriers are a problem among growers and workers in the Christmas tree industry and can have health and environmental implications [1]. A vast majority of growers, even those with the best intentions, are not equipped with the language skills to effectively communicate many important safety messages to their workforce. Worker and grower unfamiliarity with some pesticide safety regulations can also influence the extent to which industry participants receive proper pesticide safety training. Some safety/informational materials provided to workers are not applicable to the crop with which they are working. These problems can translate into environmental risks when Latino workers apply pesticides without being properly trained. Grower and worker awareness, of pesticide and occupational safety, has immediate and long-term effects on the welfare of the workforce, as well as on the image of agriculture.

Initial Program

The Mountain PESO project was initially developed, in 2004, because Christmas tree farm managers had expressed interest to Watauga County's agriculture extension agent. They wanted to provide their workers with more-appropriate pesticide safety training and to help certain members of their Spanish-speaking staffs to develop and coordinate regular pest scouting schedules on their farms. The first activity of the PESO program included a tailgate training program developed in Spanish by the extension agent (fluent in Spanish), with input from 2 leader Christmas tree growers and a former Christmas tree worker (Latino). Input from growers indicated that training emphasis should be placed on communicating the importance of proper safety equipment use for specific chemicals and on application procedures commonly used in the production of Christmas trees.

Insecticides for Christmas trees are applied with either high-pressure hose sprayers or tractor-driven air-blast mist blowers [2]. Growers mentioned that few workers participate in this type of application and that workers who do more-specialized spraying get more training on site. More workers perform herbicide treatments with Roundup, a non-restricted herbicide, by backpack sprayers during the summer months, to eliminate weed competition. Emphasis was therefore placed on training farmworkers on proper safety equipment use and on application practices with high-pressure and backpack pesticide applications, with the most common Christmas tree chemicals.

Training events were coordinated with each grower, to maintain rapport and to avoid work schedule conflicts. Each training event took place in the early morning, before field-work began, and lasted for approximately 1 hour. The first trainings were delivered at 5 Christmas tree farms, to 55 workers, in Watauga County. Each training event covered the following items and was followed with a Q&A session,

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where workers voiced their questions and concerns about pesticide application: (1) exposure routes of pesticides and health effects of improper safety/application practices; (2) chemicals used in Christmas trees and Personal Protective Equipment required for each type of application; (3) handling, mixing, and reentry intervals; (4) hand washing in the field and proper clothing protocol for postapplication.

At the end of each training event, each worker was provided their own pair of gloves, safety goggles, respirators, rubber boots, and 2 Tyvek suits, to encourage their proper use in the field. Providing free equipment to workers was seen as a positive incentive for grower participation in the program. While employers are required to provide this type of equipment anyway, free equipment offset any perceived loss of productivity by having their workers in training for part of a workday. Handouts in Spanish that outlined proper hand washing and handling of contaminated clothing were also distributed as supplemental materials.

Feedback from the initial round of PESO training was overwhelmingly positive. Growers who participated in the project indicated that they noticed their workers wearing safety equipment more frequently during pesticide applications. Use of safety goggles and respirators was noticeably improved from past years. Seven workers interviewed a month after the safety program indicated that they felt more knowledgeable about proper application practices after the training sessions and were more conscientious about proper use of safety equipment. Workers and growers appreciated the informal atmosphere of the training, which allowed for interaction and questions.

Follow-up Programs

After the first PESO training, and because of increasing grower interest in improving the pest scouting abilities of their Latino employees, Hamilton, Sidebottom, and county extension agents developed a pilot IPM training program in Spanish that was delivered in 3 western North Carolina counties in spring 2005. Latino employees typically visit each tree multiple times during the growing season. If taught how to recognize pests, the signs of infestation, and thresholds, they can provide growers with the most-current information on pest levels. The ability to control pests in a timely manner encourages growers to adopt nontraditional methods of pest control and to reduce pesticide use. This project was funded by the North Carolina Department of Agriculture Pesticide Environmental Trust Fund.

Approximately 100 Latino farmworkers attended the trainings, which included a formal classroom component that allowed workers the opportunity to learn about important pests in the industry. This was followed by an outdoor scouting and hands-on pest identification component, to build worker confidence in scouting. The IPM program also had a pesticide safety component, conducted by Hamilton, the bilingual pesticide specialist with the North Carolina Department of Agriculture (NCDA), and a nurse with the

Farmworker Health Program. A preworkshop survey developed by Hamilton revealed that more than 90% of the workers were involved in the application of agricultural chemicals and spent an average of 15 days (per year) applying insecticides and an average of 40 days applying herbicides (primarily Roundup). Again, grower and worker feedback from these trainings was overwhelmingly positive.

In 2006, a farm safety field day was conducted in Ashe County with 160 Christmas tree workers and personnel from 5 other state and county agencies, including the North Carolina Department of Labor, the Ashe County Sheriff's Department, and NCDA. Participating workers were surveyed immediately after the workshop on what they felt were the most important topics covered during the event. Workers indicated that each of the topics covered (including chainsaw safety, shearing safety, baler safety, and heavy equipment safety) was important. Many participants also highlighted pesticide safety and reentry intervals as especially important. Follow-up interviews were performed with 25 workers who had participated in the field day. They suggested that more time should be devoted to more-industry-specific pesticide safety education—especially among new employees. While growers often distributed a safety brochure for the industry, many complained that it was neither up-to-date nor adequate for current chemicals and production practices.

Lessons Learned

Cooperative Extension in the Christmas tree counties is uniquely positioned to reach growers, as well as the underserved farmworker demographic, by capitalizing on the rapport and respect established by county agents who work with these industry participants. An important element of the PESO program was multiagency collaboration. The study by Hamilton and colleagues [3] showed that grower distrust of individuals perceived as "activists" and visitation practices of certain labor advocacy and health groups have created a rapport barrier and have daunted the success of a number of farmworker education programs—despite their good intentions. To raise the comfort level and to improve collaboration between all participant groups, personnel from other farmworker outreach programs and agencies were invited to participate in training activities. Christmas tree growers, extension agents and specialists within the North Carolina Cooperative Extension Service, inspectors with the North Carolina Department of Labor, the North Carolina Farmworker Health Program, and NCDA inspectors worked together on these projects.

While bilingual publications are becoming more prolific for use by Latino workers, more programming and training delivery in Spanish may ameliorate pesticide exposure risks among this population. Expectations that a majority of the industry's Latino workers and growers will become bililingually proficient should be modest. More-formalized, more-standardized, and more-frequent pesticide safety training

should be implemented, to improve grower and worker understanding of safety issues. While growers and workers often develop their own strategies for managing difficulties with the language barrier, improved training in Spanish with an entity with which rapport has been established offers a greater chance for improving education and reducing risk.

Development of appropriate, industry-specific pesticide and farm safety training strategies, and delivery to this underserved labor force, is one way to reduce exposure risk. Additionally, if more Latino field personnel are trained in basic IPM scouting techniques and strategies and are active participants in on-farm IPM activities, pest identification and control can be more quickly and efficiently executed. A reasonable expected outcome would not only be a reduction in the quantity of chemicals applied, but also a reduction in exposure risks to on-farm personnel. During the last couple of years, North Carolina State University's Department of Environmental and Molecular Toxicology has developed Pesticides and Farmworker Health Toolkits, which are industry-specific bilingual resources to be used in formal and/or informal training sessions. The materials are highly visual and interactive and take into consideration many of the recommendations provided by employers and workers. Much of the information in the health tool kit for Christmas trees came from recommendations gleaned from surveys and

observations from the Mountain PESO project. Because of positive feedback from growers, farmworkers, and agency personnel alike, the project coleaders have been seeking funding for its expansion and have been modeling the training approach for other commodities. **NCM**

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References

1. Hamilton JV Jr. The dynamics of labor in North Carolina's Christmas tree industry [dissertation]. Raleigh: Department of Forestry, North Carolina State University; 2004. <http://repository.lib.ncsu.edu/ir/handle/1840.16/5920>. Accessed February 16, 2012.
2. Sidebottom JR 2003. Crop profile for Christmas trees in North Carolina (mountains). North Carolina Cooperative Extension Service AG Publication. 598-604. <http://www.ipmcenters.org/cropprofiles/docs/NCchristmastrees.pdf>. Accessed February 15, 2012.
3. Hamilton J, Cabbage F, Steelman T. Challenges and potential for Hispanic labor training: insight from North Carolina's Christmas tree industry. In: Ashton SF, Hubbard WG, Rauscher HM, eds. A Southern Region Conference on Technology Transfer and Extension. Asheville, NC: US Department of Agriculture, Forest Service, Southern Research Station; 2009:57-62. http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs116.pdf. Accessed February 16, 2012.

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North Carolina's Preparedness to Respond to On-Farm Emergencies

Annette G. Greer, William Meggs

North Carolina farm families, emergency services, and fire departments do not always have sufficient training to respond to on-farm emergencies. The main barrier to preparedness is lack of awareness of these needs. We recommend improved emergency response through collaborative education using AgriSafe of North Carolina and Certified Safe Farm North Carolina, two programs geared toward safety training.

North Carolina farms are typically dual home and work environments where machinery, chemicals, animals, and farm structures coexist with workers and family members, suggesting a need for holistic, collaborative emergency response capabilities. Farm rescues may involve emergencies ranging from tractor rollovers to power takeoff entanglements, pesticide exposures, and silo fires. The federal directory of Farm Rescue and EMS reports that farm families and farmworkers are at greater risk when there is inadequate training. "First responders, EMTs, and other rescue workers have been injured or killed because they lack knowledge of farm equipment, its dangers, and how to respond" [1]. The national Office of Rural Health Policy, Health Resources and Services Administration, has noted an urgent need for emergency response training related to farming, stating that "responders lack knowledge and understanding of the nature of the agricultural production work sites." North Carolina is also identified as one of the rural states lacking any comprehensive farm rescue training program [1].

North Carolina Farm Emergency Needs

In studies examining farm fatalities, tractor injuries were determined to be the most common and the most fatal of farming injuries. Tellingly, the wife tended to discover the victim and responded either medically, by stopping the machinery involved with the accident, or by calling for help [2, 3]. According to McLaughlin and Mayhorn, farm emergency response training appears to be lacking for farm spouses, because there is little to no standardization of controls on equipment, new or old (eg, International Organization for Standardization Technical Committee), and there exists such great variability in the manufacture dates of farm equipment, which can span decades [3]. The same issue of nonstandardized farm equipment besets emergency responders, too.

For Greer, one of the authors of this commentary, agricultural work has resulted in family members who have experienced (1) lightning strike, (2) leg chainsaw accident, (3) gloved hand caught in tobacco harvester chain, (4) corn harvester fire, (5) tractor rollover with loaded sprayer, and (6) eye puncture resulting in eye removal, to name just a few. All required some level of medical attention, others required emergency room visits, and more-serious accidents required emergency medical services (EMS) response and hospitalization. No, the farm did not have an emergency plan. No, the fire marshal had never been by to assess any of the facilities involved with these events. No, the cooperative extension agent had never conducted a safety inspection. It was not required by the Occupational Safety and Health Administration, and, after all, the culture of farming resists such intrusions "on the farm." Some farm neighbors were not as lucky. A grain bin accident rendered one person disabled, and a tractor accident with a "side boy" resulted in the death of another person, who was cutting brush on a ditch bank. So nonparticipation in farm emergency planning or in training for farm emergency response teams can be costly in terms of lives. Mortality experienced in the Mid-Atlantic region is represented, by state, in Table 1 [4]. A correlation between the number of farms, farm acreage, and topography in the Mid-Atlantic states plays a role in the variability of risk. Each type of farm brings its own risks, its own kinds of equipment and chemicals, and its own seasonal patterns. In most years, North Carolina is second only to Tennessee (Table 1) in farm deaths. Yet neither North Carolina nor Tennessee offers any established farm emergency response training program that is coordinated across emergency response providers. These statistics bear out the urgency for farm families, workers, and rural emergency responders to develop a coordinated system of farm emergency response. However, the National Institute for Occupational Safety and Health requires a safety plan only for farms that employ 10 or more nonfamily workers [5].

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TABLE 1.
Mid-Atlantic Regional Farm Injury-Related Deaths, by State

Year	State					
	VA	NC	MD	GA	SC	TN
2003	13	22	9	13	4	31
2004	10	17	0	12	7	16
2005	23	21	7	12	9	30
2006	20	22	0	12	3	25
2007	17	8	0	14	9	28
2008	21	22	4	12	7	24

Note. GA, Georgia; MD, Maryland; NC, North Carolina; SC, South Carolina; TN, Tennessee; VA, Virginia.

Several recent studies conducted by researchers affiliated with the North Carolina Agromedicine Institute help us to understand the level of preparedness in the farm community and among emergency personnel. Three separate surveys were administered, in collaboration with the North Carolina Cooperative Extension, Office of State Fire Marshal, and Office of EMS (A.G.G., W.M., unpublished data). For the farm survey, 32 of the 100 counties in North Carolina were represented by 58 respondents, who gave little indication of emergency preplanning. Rather, the great majority indicated that neither fire services (82.7%) nor EMS (89.6%) had ever toured their farms to prepare a fire or emergency preplan. However, 21% indicated that an incident requiring a response from the fire department had occurred on the farm within the last 10 years, and 26% reported having had an incident requiring EMS, indicating a need for farm emergency planning. Sixty-six percent of respondents indicated that at least 1 injury requiring professional medical care had occurred, for a total of 101 injuries (or an average of 2.6 injuries per farming operation). Disabling injuries were reported by 41% ($n = 24$) of the 44 respondents. Despite these injury reports, only 5% reported having taken the First on the Scene program, and only 22% reported having received any similar training.

For the farm emergency response survey sent in collaboration with the Office of State Fire Marshal, 59 of the 100 counties in North Carolina were represented. Of the 166 individuals who completed responses, 83% reported that they were not aware of any requests for or completions of any preplan for farm emergency response in their county. Ten percent indicated they had completed the development of a plan for emergency response, but those amounted to fewer than 5 farms in the county responding. When queried about training for agriculture safety and farm emergency response of at least 25 hours, 87.3% of the respondents indicated that they were unaware of any specialized training for this among their fire personnel. Eighty-nine percent of respondents did indicate that their fire personnel would be interested in receiving additional training specifically on preplanning, response, and care for agricultural emergencies.

For the farm emergency response survey sent in collaboration with the Office of EMS, 43 of the 100 counties in North Carolina were represented. Ninety-two percent of respondents indicated that EMS personnel would be interested in receiving additional training specifically on farm emergency preplanning, response, and care for agricultural emergencies. EMS reported greater numbers of responses to farm accidents and also reported more-specialized training for farm accident emergencies, indicating that their reporting systems and accountability for training may be better documented. This finding also shows that they might be best positioned to provide leadership in the design of collaborative efforts.

Foundations for a Farm Emergency Response System

Unlike public schools or large industries, farms are not required to establish any emergency plans. However, models do exist for a systematic, coordinated response to disasters and for planning for farm emergencies. In 2004, the Centers for Disease Control and Prevention (CDC) published guidelines for safety management in disaster and terrorism response, which includes information for farms. The CDC document (publication 2004-144) focuses on preparedness (especially planning and training) and management as means of reducing the hazards that emergency responders face [6]. But emergency responders in rural areas are often rural citizens or farmworkers, who serve in a strictly volunteer capacity, and such training likely does not reach many of them.

National Occupational Research Agenda agricultural center program objectives include (1) the improvement of health and safety for farmworkers susceptible to injury or illness because of circumstances limiting options for safeguarding their own safety and health, (2) the use of proven health and safety strategies through partnerships and collaborative efforts, (3) the ability to reduce injuries and deaths in the farm environment, and (4) the improvement of the health and the well-being of agriculture workers and families by reduction of occupational contributing factors [5]. These goals include studying farm family members and their literacy with regard to prevention, preparedness, and response to hazards. As a result, many federal and state agencies have responded. Still, emergency planning for agriculture, at the federal and state levels, has focused largely on homeland security with regard to pesticides and animal or food-source contamination [7, 8]. Some efforts have produced educational materials or recommendations. The Cooperative State Research, Education, and Extension Service, along with the US Department of Agriculture, published *Agriculture Equipment of Public Roads*, through a committee on agricultural safety and health research and extension, in an effort to reduce tractor deaths for both farmers and the public, on highways that convey farm equipment [9]. The report contains many recommendations, but its use in planning has

not been tested. In addition, the North Carolina Department of Labor publishes an educational *Guide to Farm Safety and Health*, which provides some safety information for farmers and farmworkers [10]. Thus, through a variety of sources, information is available to the farming community. Still, there has been no effort to put this into a training program that coordinates the demands of preparedness, prevention, and response—this despite recommendations from the CDC that farm disaster response should include plans for multi-agency, coordinated training; the use of a systems approach to events; and joint exercises [11].

There also exist independent farm rescue training instructors in North Carolina who are certified through the National Farmmedic Training Program (NFTP). Developed at Cornell University and adopted by private industry, NFTP was intended (1) to reduce farm machinery extrication incidents, which are time-intensive and often end in the death of the victim; and (2) to reduce responder injuries and fatalities during rescues and fire ground operations on farms [11]. During the last few years, the community college system of North Carolina has offered training using these certified instructors. However, in rural areas of North Carolina and the Mid-Atlantic region, use of NFTP is cost-prohibitive (L. Hughes, personal communication). Many states, led by North Carolina, adapted the NFTP curriculum to include specific tasks in existing fire and rescue training and promoted it as “agricultural rescue.” Expense is still key, given that many North Carolina rural services have a volunteer base. Yet the Office of EMS now has regional specialists assigned to determine rural response needs and is encouraging collaboration for farm emergency response (R. Godette, personal communication). The North Carolina Department of Agriculture is putting together an instrument to help farmers assess their preparedness.

Most importantly, 2 programs offered through the North Carolina Agromedicine Institute hold promise for coordinating interagency collaboration toward the creation of a coherent farm emergency response system [12]. The first, begun in 1987, is AgriSafe Network of North Carolina, which is affiliated with an established program through the University of Iowa. AgriSafe is an effort to create a network of North Carolina health care providers who are committed to assisting farmers, farmworkers, and their families, by offering services at reduced cost. In 2010-2011, more than 1,600 individuals were screened for occupational health issues. Toward accomplishing its mission, AgriSafe provides interprofessional and lay agricultural medicine training. This network of agricultural partners—with the health industry, state agencies, and farm operators—can serve as a collaborative force for a farm emergency response solution. Further, the Certified Safe Farm (CSF) program helps to build a foundation for plan preparation in farm emergency

response. The CSF program consists of 4 main components: occupational health screening, personalized and group education, incentives (such as discounts in purchasing safety equipment), and on-farm safety reviews with performance standards. The reviews use a proven farm safety checklist, and extension agents are trained on how to administer the CSF checklist, to ensure standardization. All components are designed to reduce injuries and illnesses among the agricultural population.

North Carolina offers a wealth of resources from which to develop a farm emergency response system. It is imperative that the system be coordinated, interagency in nature, and inclusive of the farm community as a partner in development and training. **NCMJ**

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References

1. Department of Health and Human Services. Farm Rescue and EMS: A State by State Directory. Washington, DC: HRSA, Office of Rural Policy; 2010.
2. McLaughlin AC, Fletcher LA, Sprufera J. The aging farmer: human factors research needs in agricultural work. Proceedings of the Human Factors and Ergonomics Society 53rd Annual Meeting. Santa Monica, CA: Human Factors and Ergonomics Society; 2009.
3. McLaughlin AC, Mayhorn CM. Avoiding harm on the farm: human factors. *Gerontechnology*. 2011;10(1):26-37.
4. State Occupational Injuries, Illnesses, and Fatalities. Bureau of Labor Statistics Web site. <http://www.bls.gov/iif/oshstate.htm>. Accessed June 7, 2011.
5. NIOSH program review, 2006: Agriculture, forestry, and fishing. Centers for Disease Control and Prevention Web site. <http://www.cdc.gov/niosh/nas/agforfish/pdfs/AFFevidenceforNAS12-06.pdf>. Accessed June 7, 2011.
6. Centers for Disease Control and Prevention. Protecting Emergency Responders, Volume 3. Pittsburgh, PA: Rand Corporation; 2004. <http://www.cdc.gov/niosh/docs/2004-144/pdfs/2004-144.pdf>. Accessed September 1, 2011.
7. Homeland security measures for agriculture. US Environmental Protection Agency Web site. <http://www.epa.gov/agriculture/thom.html>. Accessed August 12, 2011.
8. Purdue B. North Carolina Disaster Recovery Guide. Raleigh, NC: North Carolina Office of State Budget and Management; 2009.
9. The Committee on Agricultural Safety and Health Research and Extension. Agricultural Equipment on Public Roads. Washington, DC: USDA-CSREES; 2009. http://www.csrees.usda.gov/about/white_papers/pdfs/ag_equipment.pdf. Accessed September 1, 2011.
10. The North Carolina Department of Labor. A Guide to Farm Safety and Health. Raleigh, NC: Occupational Safety and Health Division; 2008.
11. National Farm Medic Training Program. <http://www.farmedic.com>. Accessed August 15, 2011.
12. AgriSafe-NC. East Carolina University Web site. <http://www.ecu.edu/cs-dhs/agromedicine/AgriSafe.cfm>. Accessed August 20, 2011.

Consequences of Respiratory Exposures in the Farm Environment

Ricky L. Langley

Depending on the type of farming practice, respiratory symptoms are common among agricultural workers. Farmers are at risk for pulmonary illnesses, including chronic bronchitis, organic dust toxic syndrome, farmer's lung diseases, allergic and nonallergic asthma, nasal irritation and polyps, and chemical pneumonitis.

The agricultural environment presents numerous opportunities for exposures that may affect the respiratory system. Exposures vary by the type of agricultural occupation, but may include various dust particles, including inorganic particles such as silica, and various organic particles such as molds, bacteria, endotoxins, mycotoxins, pollens, grains, and animal feed. Other substances that may be inhaled include various gasses, from working in confined animal feeding operations (CAFOs). Numerous chemicals used or generated on farms may be inhaled, such as pesticides, exhaust fumes, fertilizers, and nitrogen oxides [1, 2]. Additionally, some zoonotic pathogens may be spread by the inhalation route.

Exposures can cause disease of either the upper or the lower respiratory tract, or both. Farmers often report more problems with smell impairment and often have more nasal polyps and hyperemia of the nasal mucosa, possibly indicating effects of allergens and irritants in their workplaces [3]. In contrast, other studies found that growing up on a farm appears to have a protective effect, with a lower prevalence of allergic rhinitis and asthma [4-6]. Surprisingly, farmers have lower rates of lung cancer, probably because of a lower prevalence of smoking.

Animal Exposures

Most farms have various species of animals present. Animals may be raised as a source of income (eg, beef cattle, swine, poultry, goats, and sheep) or may be used to guard other animals (dogs, donkeys, llamas), or they may be present simply as domestic pets.

Animals may be the source of allergens (saliva, urine, and dander) or zoonotic pathogens. Zoonotic infections that may be spread by the respiratory route include anthrax, brucellosis, Q fever, tularemia, plague, leptospirosis, hanta virus, influenza, psittacosis, and Newcastle disease virus. Disturbing the soil on farms may also increase exposure to

fungi, which could result in mycotic infections such as histoplasmosis, blastomycosis, coccidioidomycosis, and cryptococcosis. Additionally, agriculture workers, especially migrants, have high proportional mortality rates from tuberculosis [7]. *Mycobacterium bovis* may occur in ruminants and can be spread to workers, but most cases are caused by *Mycobacterium tuberculosis*. Migrant workers often live in camps, in close quarters, which aids in the spread of tuberculosis to fellow workers.

Workers in CAFOs are likely to be exposed to organic dust from animal waste, feed particles, endotoxins, glucans, and various gasses, such as ammonia, methane, carbon dioxide, hydrogen sulfide, and volatile organic compounds. Exposures to these dusts and chemicals may cause mucous membrane irritation, organic dust toxic syndrome (ODTS), bronchitis, allergic asthma, and nonallergic asthmalike symptoms [1, 2, 8]. It has been estimated that 60% of CAFO workers will have 1 or more respiratory symptom if they work longer than 6 years in this environment [9]. It is estimated that 25% of all workers in swine CAFOs will experience chronic bronchitis [2]. Likewise, farmers in egg, poultry, and dairy production are more likely to wheeze, compared with farmers not raising animals [10].

Agricultural Chemicals

Pesticides are commonly used on farms to control weeds, nematodes, and insects that damage crops. Disinfectants (also classified as pesticides) are used inside CAFOs to clean floors and utensils. Overexposure can cause acute upper and occasionally lower respiratory symptoms. Fumigants such as methyl bromide, phosphine, chloropicrin, sulfur fluoride, and vikane are highly irritating, and overexposure may result in pulmonary edema and death. Exposure to organophosphate and carbamate pesticides may result in individuals presenting with respiratory symptoms of wheezing, bronchorrhea, and respiratory depression, along with other classic parasympathetic manifestations. Ingestion

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of the pesticide paraquat may lead to death or permanent respiratory impairment. Paraquat ingestion leads to a proliferation of connective tissue in the lungs, resulting in pulmonary fibrosis. Recent research on the effect, on farmers, of pesticide use has found an increased risk of wheezing, chronic bronchitis, asthma, and hypersensitivity pneumonitis (Table 1) [11-13].

Anhydrous ammonia is used as a fertilizer on farms. It is often a cause of skin and eye burns in farmers. Massive exposure, such as from a ruptured hose, may cause severe inflammation at all levels of the respiratory tract, resulting in acute pulmonary edema. Chronic sequelae may include chronic bronchitis, bronchial hyperreactivity, and bronchiolitis obliterans.

Recently filled grain silos may generate high levels of nitrogen oxides. Upon entering the silo, a reddish brown gas may be visible over the grain. Inhalation of this gas may lead to a condition known as silo filler's disease. Sudden death, acute or delayed pulmonary edema, or latent bronchiolitis obliterans may occur [1, 2].

Farmers often perform equipment repairs indoors, especially during the winter season, in preparation for the spring planting. Operating gasoline or diesel fuel engines indoors can result in carbon monoxide poisoning. Welding on galvanized steel may produce zinc oxide fumes that, when inhaled, may result in metal fume fever. Exposure to diesel exhaust and solvents used in painting, cleaning, and other activities also increases the risk of wheezing in farmers. Proper ventilation in the facility is important to prevent these from occurring.

Dust Exposure

Dusts on farms can be broadly classified as organic or inorganic in nature. Exposure to organic dust, such as pollen, bacteria, fungi, animal secretions/excretions, mycotoxins, and endotoxins, may cause respiratory symptoms and diseases such as allergic asthma, ODTs, chronic bronchitis, and hypersensitivity pneumonitis. In fact, agricultural production has been recorded as the leading industry for deaths due to hypersensitivity pneumonitis [14].

Exposure to inorganic dust often occurs when farmers are plowing their fields or transplanting their crops. Sandy soils in North Carolina have high levels of respirable silica. While the rate of silicosis in farmers in North Carolina is not known, 2.4% of silicosis cases were associated with the agriculture, forestry, and fishing industry in a recent Centers for Disease Control and Prevention survey [14].

Farmer's lung (FL) disease, also called extrinsic allergic alveolitis or hypersensitivity pneumonitis (HP), is caused by the inhalation of various microbial organisms, such as thermophilic actinomycetes and *Micropolyspora faeni* that often grow in hay bales or grain. Once a farmer becomes sensitized and develops circulating antibodies to these allergens, subsequent exposures may result in antigen-antibody complexes that may occur in the lungs. Illness severity

TABLE 1.
Pesticides Associated with Respiratory Symptoms or Diseases

Symptom/Disease	Pesticides
Wheezing	Chlorpyrifos, malathion, parathion, dichlorvos, phorate, alachlor, atrazine, EPTC, petroleum oil, trifluralin, permethrin
Allergic asthma	Coumaphos, heptachlor, parathion, carbon tetrachloride/carbon disulfide (80/20 mix), ethylene dibromide
Nonallergic asthma	DDT, Malathion, Phorate
Chronic bronchitis	Dichlorvos; DDT; cyanazine; paraquat; methyl bromide; heptachlor; carbaryl; carbofuran; chlordane; lindane; toxaphene; coumaphos; diazinon; malathion; parathion; 2,4,5 T; 2,4,5 TP; petroleum oil
Hypersensitivity pneumonitis	Lindane, aldicarb, DDT
Lung cancer	Arsenicals, metolachlor, pendimethalin, diazinon, chlorpyrifos

ranges from acutely reversible to a chronic debilitating disease resulting from a progressive pulmonary fibrosis [1, 2]. Noncaseating granulomas and multinucleated Langerhan's giant cells may be seen on lung biopsies. The prevalence in the United States is believed to be less than 5% [2]. FL is reported to be most typical among those who manage barn-enclosed cattle. There is a lower prevalence of FL in smokers.

ODTS, also called toxic alveolitis, mycotoxicosis, or silo unloader's disease, is a nonallergic toxic-mediated inflammatory reaction of the airways, with systemic flulike symptoms that occur within a few hours of dust inhalation. It often occurs after the removal of moldy silage from grain bin silos. The illness is usually self-limiting and nonprogressive. It is caused by exposure to high levels of organic dust and endotoxins. It is much more common than FL, with a prevalence, in one study, of 36% among farmers who attended an agricultural trade show [8].

Medical Evaluation

When an agricultural worker presents with respiratory symptoms, the health care provider must elicit a thorough occupational history during the evaluation. It is useful to determine whether the symptoms are acute or chronic in nature. If the worker has a fever, then a zoonotic infection should be considered. Most inhalation exposures to chemicals in high concentration will cause acute respiratory symptoms. Rarely will long-term respiratory damage develop after a single exposure to a low concentration of a chemical. However, chronic low-level exposure to dust and gasses in CAFOs may lead to the development of chronic pulmonary illnesses, such as chronic bronchitis, asthma, and HP [1, 2]. The health care worker should be able to recognize the difference between ODTs and HP, as HP can progress to interstitial fibrosis (Table 2). There is also concern that long-term exposure to pesticides may increase the risk of chronic lung

disease [11-13].

In the workup of respiratory complaints, standard clinical evaluation is performed, including pulmonary function testing, chest X-rays, and, possibly, allergy skin testing and serum radioallergosorbent testing for suspected HP. Peak-flow meters may be helpful to determine whether the symptoms are work related. If a zoonotic infection is suspected, then sputum and blood cultures should be obtained. If the cause cannot be determined, a lung biopsy may be necessary.

Medical monitoring of individuals with FL should include periodic pulmonary function testing and chest X-rays [2]. Measurement of blood gases and exercise tolerance may be useful to assess the degree of impairment. If symptoms have progressed, then modification of work behaviors, environmental control measures, and use of an appropriate respirator should be advised. Rarely, the farmer may need to change jobs. Medical monitoring should be considered for individuals who are to begin work in CAFOs in which exposure to agricultural dusts and gasses are expected. Periodic examinations, including pulmonary function testing, may allow for the detection of developing airflow obstruction while it is still reversible.

Prevention of Respiratory Diseases

Preventing dust and gas buildup in the farm environment is the best way to avoid most respiratory illnesses. Adequate ventilation, especially in silos and CAFOs, protects human health, and it may also improve the health of the animals in these facilities. A tractor cab with air filtration reduces inhalation of field dust. Silos must be entered with extreme caution, to prevent asphyxiation hazards. Use of personal protective equipment, such as properly fitted respirators, may be useful, in addition to engineering methods to control dust and gas buildup.

Agricultural workers using chemicals should follow label directions on the use of personal protective equipment, and farm operators should obtain material safety data sheets on all chemicals used on farms, in case a person is exposed. Chemicals should be stored properly, and farmers should have a fire hazard plan.

Agricultural workers involved in raising poultry and swine should be encouraged to receive annual influenza vaccinations [15]. Farmers should be on the lookout for any increase in illnesses, abortions, stillbirths, or deaths in their animals. If these occur, they should seek veterinary assistance. NCMJ

TABLE 2.
Features of Farmer's Lung, Compared to Those of Organic Dust Toxic Syndrome (ODTS)

Feature	Farmer's Lung	ODTS
Epidemiology		
Incidence	2-30/10,000	1-33/100
Clustering	Uncommon	May occur
Season	Most common winter, early spring	Most common in summer, fall
Exposure	Repeated exposure to causative agent	Heavy exposure to organic dust, may occur after first exposure
Causative agents	Antigens from thermophilic actinomycetes, fungi, proteins, others	Endotoxins, others
Symptoms	Chills, dyspnea, myalgias, fever, headache, malaise, arthralgias, cough, chest tightness, fever (symptoms develop 2-6 hours after exposure); symptoms more severe than with ODTS	Chills, dyspnea, myalgias, arthralgias, cough, chest tightness, headache, malaise (symptoms develop 2-6 hours after exposure)
Clinical exam	Fever, end-inspiratory bibasilar rales	Normal or scattered rales
Chest x-ray	Usually finely nodular infiltrate more evident in lower lobes and mediastinum, interstitial strands	Normal or minimal interstitial infiltration
White blood count	Neutrophilia, also may see mild to moderate eosinophilia or relative increase in mononuclear cells	Neutrophilia with left shift
Pulmonary function test	Moderate to severe restriction, decreased DLCO	Normal or obstruction
Blood gas	Hypoxemia	Usually normal
Serum precipitins	Usually positive	Usually negative
Bronchoalveolar fluid	Elevated neutrophils and lymphocytes	Elevated neutrophils
Lung biopsy	More chronic inflammation of alveoli with mononuclear cells, possibly granulomas and foreign body giant cells, neutrophils, eosinophils	Acute inflammation of terminal bronchioles, alveolar and interstitial areas. Exudate consist of neutrophils and macrophages, may see fungal spores present
Course	Acute syndrome may resolve if no further exposures. Chronic syndrome may be progressive, leading to pulmonary fibrosis.	Usually resolves spontaneously without long-term sequelae

Note. Table adapted from Von Essen and Donham [1] and Donham and Thelin [2]. DLCO (Carbon monoxide diffusion capacity of the lung)

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References

1. Von Essen SG, Donham KJ. Respiratory disease related to work in agriculture. In: Langley RL, McLymore RL, Meggs WJ, Roberson GT, eds. Safety and Health in Agriculture, Forestry, and Fisheries. Rockville, MD: Government Institutes Inc.; 1997:353-384.
2. Donham KJ, Thelin A. Agricultural respiratory diseases. In: Agricultural Medicine Occupational and Environmental Health for the Health Professions. Victoria, Australia: Blackwell Publishing; 2006:65-144.
3. Holmstrom M, Thelin A, Kolmodin-Hedman B, Van Hage M. Nasal complaints and signs of disease in farmers—a methodological study. *Acta Otolaryngol.* 2008;128(2):193-200.
4. Adler A, Tager I, Quintero DR. Decreased prevalence of asthma among farm-reared children compared with those who are rural but not farm-reared. *J Allergy Clin Immunol.* 2005;115(1):67-73.
5. Douwes J, Travier N, Huang K, et al. Lifelong farm exposure may strongly reduce the risk of asthma in adults. *Allergy.* 2007;62(10):1158-1165.
6. Ege MJ, Mayer M, Normand AC, et al. Exposure to environmental microorganisms and childhood asthma. *N Engl J Med.* 2011;364(8):701-709.
7. Mills PK, Beaumont JJ, Nasser K. Proportionate mortality among current and former members of the United Farm Workers of America, AFL-CIO, in California 1973-2000. *J Agromedicine.* 2006;11(1):39-48.
8. Von Essen S, Frysek J, Nowakowski B, Wampler M. Respiratory symptoms and farming practices in farmers associated with an acute febrile illness after organic dust exposure. *Chest.* 1999;116(5):1452-1458.
9. Donham K, Haglund P, Peterson Y, Rylander R, Belin L. Environmental and health studies of workers in Swedish swine buildings. *Br J Ind Med.* 1989;46:31-37.
10. Hoppin JA, Umbach DM, London SJ, Alavanja MC, Sandler DP. Animal production and wheeze in the Agricultural Health Study: interactions with atopy, asthma, and smoking. *Occup Environ Med.* 2003;60(8):e3.
11. Hoppin JA, Umbach DM, London SJ, Lynch CF, Alavanja MC, Sandler DP. Pesticides and adult respiratory outcomes in the agricultural health study. *Ann NY Acad Sci.* 2006;1076:343-354.
12. Hoppin JA, Umbach DM, London SJ, et al. Pesticide use and adult-onset asthma among male farmers in the Agricultural Health Study. *Eur Respir J.* 2009;34(6):1296-1303.
13. Hoppin JA, Umbach DM, Kullman GJ, et al. Pesticides and other agricultural factors associated with self-reported farmer's lung among residents in the Agricultural Health Study. *Occup Environ Med.* 2007;64(5):334-341.
14. National Institute for Occupational Safety and Health, Division of Respiratory Disease Studies. Work-related lung disease surveillance report 2007. NIOSH publication 2008-143a. Morgantown, WV: US Department of Health and Human Services; 2008.
15. Gray GC, Baker WS. The importance of including swine and poultry workers in influenza vaccination programs. *Clin Pharmacol Ther.* 2007;82(6):638-641.

A hand-drawn medical prescription form on a white background. At the top, there are four lines for patient information: NAME, AGE, ADDRESS, and DATE. Below these is a large 'R' symbol. The main body of the form contains the handwritten text: "When it comes to medical treatment, you shouldn't have: a) Only one option." At the bottom of the form, there is a line for the text "Learn more at AHRQ.GOV". Below the form, there are three logos: the AHRQ logo (Agency for Healthcare Research and Quality), the Ad Council logo, and a small logo of a bird.

Aging Farmers Are at High Risk for Injuries and Fatalities: How Human-Factors Research and Application Can Help

Anne Collins McLaughlin, John F. Sprufera

Agriculture is a dangerous profession with an aging population, combining age-related changes in physical and cognitive abilities with complex tasks performed under hazardous conditions. There are three general approaches to reducing injuries: designing for safety, providing positive reinforcement in prevention programs, and making safety a family affair.

Older Farmers Are at Risk

Farmers are an aging population nationwide, and North Carolina is no exception. The US Department of Agriculture reports an average age of more than 57 years for US farmers, and more than a quarter are older than 65. In addition to the lack of new, younger farmers, farmers tend to retire later than do individuals in most other occupations, adding to the disproportionate amount of older individuals. Unfortunately, the dangers of working on a farm are only aggravated when the effects of aging are considered. Older farmers have been found to be at high risk because they tend to suffer injuries more frequently than do younger farmers and the injuries they suffer are more likely to be fatal [1]. Thus, any focus on agricultural safety should include older farmers as a population of interest, with emphasis on the changes in the abilities and attitudes that can come with age. In the following commentary, we review the connection between human behavior, aging, and agricultural accidents.

General Hazards in Agricultural Work

Although there are numerous specific hazards associated with agricultural work, we focused on 4 risk constructs that could contribute to agricultural accidents. These include hidden hazards, risk attitudes, workload, and equipment age.

A hazard is considered hidden when it runs contrary to the expected dangers of a product or process. An example from agriculture is the pressure associated with hydraulic lines. Although normal leaks can be temporarily stopped by covering with a fingertip, the pressure of the hydraulic leak will cut through skin and flesh. As another example, grain bins, one of the most common locations for a fatal accident, have 2 hidden hazards associated with asphyxiation. The first occurs when humidity causes grain to be perceived to

be solid when it is not. The second occurs when undetectable fumes build up inside the bin, causing unconsciousness and eventually suffocation to an individual [2]. Such hidden hazards can occur in all professions, but the tendency of farmers to use equipment for multiple purposes (often purposes not envisioned by the designers) makes hidden hazards likely to affect farming operators.

Other important risk contributors are the attitudes of farmers and operators. One attitude found on farms that is not typical of most workplaces is that accidents are inevitable. Although farmers wish to avoid accidents, most farmers report a general sense that accidents are part of their occupation [2]. This outlook could have many consequences, from encouraging risky behaviors to the underreporting of accidents. Older farmers likely experienced situations similar to those that eventually resulted in an accident but escaped previously without negative consequences. Thus, they have been rewarded over a lifetime with nonaccident experiences that contribute to an attitude of "just this one time," to get the job done.

"Getting the job done" is the third farming-specific risk contributor. There is high pressure in agricultural work to complete a task despite adverse conditions, such as weather, darkness, time pressure, broken equipment, or an inadequate workforce. This differs from many work environments, where emotional distance exists between the worker and the outcome of the task. For example, in a factory, there may be pressure to meet a goal or quota, but the outcome each day likely does not drive the overall finances of that worker. Farmers are highly invested in harvest outcomes because of both the effect on their long-term finances and their personal investment as owner-operators or family members. Such contingencies often explain why farmers do not always employ safe behaviors when completing a task. Unfortunately, getting the job done often requires

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performing strenuous and complex tasks under suboptimal conditions.

Changes Related to Older Age

Physical, cognitive, and motor abilities all show age-related declines. Visual acuity and auditory capabilities are among the physical abilities that tend to decline with age. Such declines can have a direct impact on agricultural safety, demonstrated by the correlation between older-adult hearing loss and agricultural accidents [3]. Other abilities that tend to decline with age include performing multiple tasks concurrently, remembering to take future action (prospective memory), and the inhibition of task-irrelevant information [4]. Last, reaction time tends to increase with age, particularly when a decision is required. Such changes may partially explain why older farmers have been found to be more likely to be injured by machinery (often complex and fast-moving) than are younger farmers [5]. These age-related declines in cognitive abilities increase the importance of safe equipment design—agricultural work frequently requires coordination of multiple streams of information and action. In the example of ditch mowing, the operator must monitor inputs from the environment, such as slope, obstacles, and ground condition, while operating the machinery.

In tasks of daily living, older adults tend to cope well with the reduction in available mental resources, typically by selecting tasks they can do well, optimizing their work to fit their abilities, and compensating for lost abilities with strategies, such as planning more thoroughly [6]. However, the aforementioned pressures of farmwork do not always permit older farmers to employ these strategies and likely contribute to the high accident rates for older farmers.

A last age-related risk contributor is that farmers tend to use old equipment, and older farmers typically use even older equipment [2]. Whereas a car may be considered old after 10 years, tractors tend to be several decades old before being replaced. Indeed, the largest number of fatal accidents involved tractors of more than 20 years of age [7]. Aged equipment comes with its own problems, including the need for repair and not having the latest safety devices or measures (including rollover protection systems and guards on moving parts, such as power takeoff shafts, which are used to couple tractors, to power other equipment).

Potential Solutions and Areas for Future Research

We have enumerated the safety issues related to aging farmers in terms of their workloads, abilities, equipment, and attitudes. We next provide potential solutions and our assessment of remaining research questions.

Designing safety for aging as well as non-aging farmers. While newer products are often safer, the economy of agriculture does not permit replacement of all older equipment. The culture of agriculture is also such that new equipment often does not replace older equipment—it only adds to the total available [2]. Retrofitting equipment—such as install-

ing a rollover protection system and seat belts on older tractor models—promises to be more beneficial for farmers. However, more research is needed to choose and design these retrofits. A last comment on equipment safety is that newness does not guarantee safety. For example, having an ostensibly safe cutoff switch triggered by lack of weight on a seat can encourage hurried behaviors, as the farmer tries to perform a task outside the cab and return before the motor turns off.

Interfaces for farm equipment could also be improved for an older workforce. Modifying equipment to include multimodal warnings and feedback may reduce the attentional load placed on the operator. For example, giving the tractor driver an auditory cue may be more effective than a visual cue, as the operator's visual attention is already taxed by driving. However, such designs should be tested, since the salience of an auditory cue in a potentially noisy environment must be considered. Though there are numerous resources to inform design for older users [8], a search of the literature found few resources specific to agricultural equipment and tasks.

Positive reinforcement, not punishment. Attitudes toward risks are internal to the operators and are part of farming culture; thus, the motivations for the behavior must be addressed. Rewards are an effective way to promote desired behaviors. For instance, government agencies or insurance companies might offer incentives for keeping an updated farm safety plan. These attempts at changing behavior could be most useful for the large number of family farms that are not required to follow safety regulations [9]. Although regulation can be an effective tactic to increase safety (as has occurred in European farming), using a positive reward system might be more popular with US family farms than would increased regulation.

Care must be taken to prevent safer designs from punishing older farmers. Rules for safety are often broken, but preventing that behavior in the future requires understanding why the rules were broken. Adding an extra step, confirmation, procedure, or guard to enforce a rule may increase the time it takes for a farmer to complete a task, which may frustrate the operator into bypassing the safety measure. Testing new and retrofitted designs with farmers, including older farmers, is the most important step in creating acceptable designs.

In many fields, such as health care and aviation, behavioral models have been useful in understanding and changing unsafe behaviors. Examples of these models include Ajzen's Theory of Planned Behavior and the Theory of Reasoned Action [10]. These models have been applied only infrequently in the agricultural context [11], and it is our opinion that including such theoretical background will move the field of agricultural safety forward in ways that additional training and regulation have not.

Making safety a family affair. The operator of the machines on the farm is not the only person who can encourage safety: the farmer's spouse can also play a role in helping the farm

adhere to safety regulations and plan for emergencies. Such involvement may increase the engagement of all family members and increase feelings of accountability in maintaining and adhering to a current plan. This could be particularly helpful for farmers working alone. Older farmers have been found to be more likely to have been working alone when they were fatally injured [2]. Part of a safety plan can include communication between family members and workers, with technology specific to this purpose.

Research has shown that farms with a current safety plan report fewer accidents than do those without one, but more research is needed to understand whether safety plans cause a safer environment or whether farms that choose to have plans already promote a culture of safety. More research is also needed on the roles other family members can play in forming and adhering to these plans.

Conclusions

Farming is an occupation in which danger and consequences can increase with the age of the farmer. By utilizing the information concerning design for aging and behavioral change, researchers can determine both technological and social solutions to help prevent accidents. Such physical, cognitive, and social ergonomic applications on the farm can improve the livelihood of the industry and can serve as an example of how human factors can reduce the risks of a dangerous work environment. **NCMJ**

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References

1. Gelberg KH, Struttman TW, London MA. A comparison of agricultural injuries between the young and elderly: New York and Kentucky. *J Agric Saf Health*. 1999;5(1):83-81.
2. McLaughlin AC, Mayhorn CM. Avoiding harm on the farm: human factors. *Gerontechnology*. 2011;10(1):26-37.
3. Choi S, Peek-Asa C, Sprince NL, et al. Hearing loss as a risk factor for agricultural injuries. *American Journal of Industrial Medicine*. 2005;48(4):293-301.
4. Park DC, Schwartz N, eds. *Cognitive Aging: A Primer*. Philadelphia, PA: Psychology Press; 2000.
5. Gelberg KH, Struttman TW, London MA. A comparison of agricultural injuries between the young and elderly: New York and Kentucky. *J Agric Saf Health*. 1999;5(1):83-81.
6. Baltes PB. On the incomplete architecture of human ontogeny: selection, optimization, and compensation as foundation of developmental theory. *Am Psychol*. 1997;52:366-380.
7. McLaughlin AC, Fletcher LA, Sprufera J. The aging farmer: human factors research needs in agricultural work. In: *Proceedings of the Human Factors and Ergonomics Society 53rd Annual Meeting*. Santa Monica, CA: Human Factors and Ergonomic Society; 2009: 1230-1234.
8. Pak R, McLaughlin AC. *Display Design for Older Adults*. Boca Raton, FL: CRC Press; 2010.
9. Cole HP. Cognitive-behavioral approaches to farm community safety education: a conceptual analysis. *J Agric Saf Health*. 2002;8(2):145-159.
10. Fishbein M, Ajzen I. *Predicting and changing behavior: the reasoned action approach*. New York: Psychology Press (Taylor & Francis); 2010.
11. Colémont AA, Van den Broucke SS. Measuring determinants of occupational health related behavior in Flemish farmers: an application of the theory of planned behavior. *J Safety Res*. 2008;39(1):55-64.

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Health and Safety on North Carolina Farms

Larry Wooten

Many rural areas in North Carolina do not receive the professional health care they deserve. North Carolina Farm Bureau recognized this unfilled need and implemented its Healthy Living for a Lifetime program in 2010. This initiative is one way to help improve the health of the state's 52,000 family farmers.

Because the state's greatest asset is its people, good health is a basic requirement for economic viability and success. Many people in rural areas in North Carolina are not receiving the professional health care they need and deserve. In fact, in most rural areas of the state, there are not enough doctors, clinics, and hospitals to meet the needs that are there.

As a responsible corporate partner, North Carolina Farm Bureau—the state's largest general farm organization—recognized this unfilled need and implemented its Healthy Living for a Lifetime mobile health program in 2010, as a way to help not only farm families, but rural residents and their families as well.

Farm Bureau policy positions are set by the vast majority of North Carolina's 52,000 family farmers [1]. Through participation in the annual grassroots resolutions process, our thousands of active volunteer leaders debate and ultimately vote on the contents of the organization's official policy book [2]. These member-grown policy positions guide the work of Farm Bureau when it comes to advocating for farmers in the regulatory and political bodies of local, state, and federal governments.

Health care is a major budgetary factor for the small and medium family farms that dominate North Carolina's agricultural landscape. The state's farms average 418 acres, just slightly above the national average [1]. Today, 97% of all US farms are owned by individuals, family partnerships, or family corporations [3].

Compared with other industries, agriculture presents a broad array of occupational hazards in terms of both health and safety. This is particularly true for the family-operated farm or small farm where workers must perform all jobs and, therefore, encounter a wide array of hazards [4].

In addition to being the brain and the backbone of our food supply, farmers and the workers who make up the agriculture and agribusiness industry account for almost one-fifth of the state's income and employees. Nearly \$70 billion

of North Carolina's \$398 billion gross state product is contributed by the combined food, fiber, and forestry industries [5].

A common problem in rural areas is the lack of doctors and other medical professionals. However, other related problems also hinder access to health care for many rural residents. Those problems can include lack of transportation, lack of knowledge about coverage resources, and less access to resources for prevention. More than 18% of North Carolinians are uninsured, and the number is rising. Compared with their urban counterparts, the state's rural residents have less access to quality health care, higher poverty rates, fewer new jobs, and a lack of critical knowledge of health prevention and wellness.

That's why the Healthy Living for a Lifetime initiative is vital to the farmers and rural residents of the state. Through early detection, follow-up health support, and the establishment of healthy lifestyle habits, this initiative will increase long-term employability among participants. It will also help rural residents find local medical homes or ongoing health services.

It's been just over 1 year since we launched the Healthy Living for a Lifetime initiative, and the results have been revealing. To date, free health screenings have been provided to more than 2,800 farmers and to rural residents across 25 counties. The results have confirmed that the health problems of rural North Carolina are both pervasive and severe.

Just as in national statistics, we've found obesity to be a problem. Left untreated, obesity leads to a number of health problems. Healthy Living for a Lifetime's participating client screenings, from 2010, resulted in the following statistics: 73% of the 1400 clients tested were either overweight or obese, 45% had high cholesterol, 19% had high blood glucose, and 62% had high blood pressure. Moreover, a significantly higher percentage of this population was at high risk for obesity, high cholesterol, diabetes, and high blood pressure, compared with the national averages.

Beyond the basic health and wellness concerns facing farmers and rural residents, the hazards of the profes-

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sion add another layer of issues. Farming and forestry are among the most hazardous occupations, exposing workers to a variety of health and safety risks, ranging from chemical and toxic gas exposure to accidents associated with heavy machinery and livestock [6].

There are several state and federal government agencies responsible for helping to educate rural folks about the hazards associated with farm work. The departments of labor and agriculture, as well as land grant universities and others, have developed educational programs designed to prevent farm accidents.

The North Carolina Cooperative Extension, for example, provides safety information to farmworkers, pesticide applicators, and their families, through training programs and publications designed to improve health and safety [6].

North Carolina workers in the agriculture, forestry, fishing, and hunting industry suffered 13 fatal occupational injuries in 2009, 10 of which were transportation incidents. Preliminary data for 2010 reveals there were 7 incidences of fatal occupational injuries in the industry [7].

In addition to the deep personal tragedy of disabling work injuries and fatalities, the medical expenses, lost wages, insurance administration, and uninsured costs have long-term detrimental effects on the industry and the general economy [4].

In North Carolina, Department of Labor inspectors enforce the federal Occupational Safety and Health Act through a state plan approved by the US Department of Labor. The Occupational Safety and Health Division of the North Carolina Department of Labor also offers many educational programs to the public and produces publications to help inform people about their rights and responsibilities with regard to occupational safety and health [4].

Farm Bureau's volunteer leaders have also worked with these agencies and other entities, such as the North Carolina Agromedicine Institute, to help prevent the accidents, illnesses, and other health issues that can result from working the land.

For decades, county farm bureaus have hosted a variety of health and safety events. They even created North Carolina Farm Bureau's Willie the Safety Squirrel, to emphasize the importance of good health and safety to children and teens.

Skin cancer is a real concern for farmers, particularly for young farmers. We encourage the medical community to emphasize the dangers to their patients. Several county farm bureaus have assisted in this educational effort. We have sponsored booths at events that included information on proper sun protection and free hats that help farmers and others avoid the risk of skin cancer. Many county farm bureaus have hosted skin cancer events, as well as blood drives.

While some county farm bureaus have chosen to make cash donations to support their local medical communities, others have used that money to help agricultural-related organizations in their prohealth efforts. County farm

bureaus, for example, have donated funds to the 4-H Health and Fitness Boot Camp. Other county farm bureaus have even sponsored events focusing on proper dental hygiene.

Yet still more Farm Bureau members and organizational publications have helped raise awareness of the dangers of heat exhaustion and heat stroke, which can produce permanent injury. Heat related illness is a very serious problem and kills approximately half of those who experience heat stroke [4].

Most farmworkers who are regularly exposed to excessive levels of sound suffer undue hearing loss. Noise also produces other effects detrimental to job performance and well-being [4]. Recognizing this need, North Carolina Farm Bureau has been working with researchers at the University of Michigan on a farmers' hearing loss study. The goal of this project is to develop effective programs to protect farmers' hearing.

Research has resulted in technological improvements that continue to make farming safer and healthier. Air-conditioned and air-filtered cabs on tractors protect farmers from excessive heat and sun, as well as from dust and fumes from pesticides. GPS-controlled equipment eliminates eye strain and potential rollovers. All-terrain vehicles, while still a significant hazard, are safer now than in the past.

While technology is helpful, it cannot prevent all the hazards and dangers of farm work. The top causes of farm accidents and deaths are tractor-related rollovers and collisions. Tractor overturns account for more farm work deaths than any other accident type. Using a rollover protective structure and a seat belt provides the tractor operator with the best available protection in the event of an overturn [4].

North Carolina Farm Bureau's rollover protective structure program provides cost-share assistance to farmers who choose to install the protective structures on their older tractors. In addition to rollovers on unlevel farmland, highway incidents remain the most frequent fatal event in the workplace in North Carolina, as well as in the nation. There were 51 such incidents in North Carolina in 2009 [7].

North Carolina's population is projected to increase by more than 50% between 2000 and 2030. One obvious side effect of this rapid growth is more cars traveling on the state's 78,000 miles of maintained urban and rural roadways.

For the average driver, the biggest problem accompanying more traffic is congestion and a longer commute to work. For farmers, the top concern is worker safety—specifically accidents that occur while driving tractors, combines, and other equipment along roads, between fields.

Along with the population increase, North Carolina's agricultural industry has experienced dramatic changes. Crop diversity, a reduction in the number of farms, and vast improvements in biotechnology have created an environment where agricultural practices are considered a year-round activity in many counties across the state. So farm equipment is now on the highways more than ever before.

Some of the most recent-statistics on farm vehicle

crashes in North Carolina show 3000 crashes between 1991 and 1999 [8]. More of the most-recent statistics also show that farm vehicle and nonfarm vehicle accidents account for less than 1% of crashes statewide. A crash involving a farm vehicle and a nonfarm vehicle, however, results in death or serious injury 51% of the time [9].

Sixty-six percent of citations resulting from farm and nonfarm vehicle crashes that were issued to nonfarm drivers were for failure to reduce speed, so the biggest measure anyone can take to help prevent an accident and save the life of a farmer is to slow down and drive with caution.

Aside from helping to encourage drivers to travel carefully along the state's back roads, county farm bureaus have hosted a farm medic class for fire departments, rescue squads, and county emergency medical services personnel, to demonstrate different farm equipment and ways to deal with agricultural-specific accidents, such as becoming entangled in power takeoff shafts. Fire and electrical awareness have also been topics of events from several counties that have worked with volunteer fire departments and power company officials.

"Fatal-vision goggles", which simulate driving under the influence of alcohol, as well as information that deals with the dangers of text-messaging while driving, have been distributed at many rural high schools, with assistance from Farm Bureau members and troopers with the North Carolina Highway Patrol.

Farm Bureau continues to monitor not only the overall health of the bottom line of agriculture but also the well-being and safety of the state's farmers. We are committed to improving the quality of life of our membership. Working together with the state's agencies and medical communities

that are responsible for public health in North Carolina is definitely part of that mission. **NCMJ**

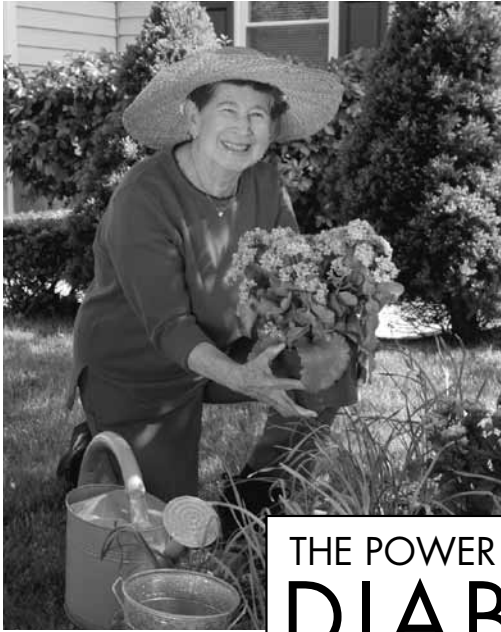
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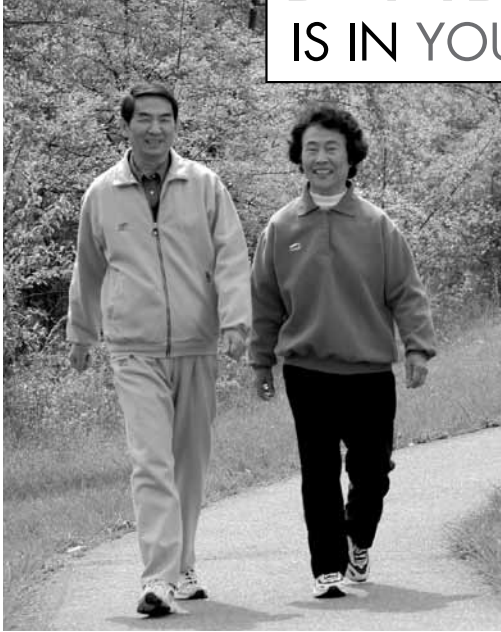
Potential conflicts of interest. L.W. has no relevant conflicts of interest.

References

1. Agricultural Statistics Division. NC Dept of Agriculture and Consumer Services. Agricultural Statistics-2010 Annual Statistics Book. NC Dept of Agriculture and Consumer Services Web site. <http://www.ncagr.gov/stats/2010AgStat/index.htm>. Accessed February 21, 2012.
2. The Voice of Agriculture. American Farm Bureau Federation Web site. <http://www.fb.org/>. Accessed February 21, 2012.
3. American Farm Bureau Federation. Food and Farm Facts Book and Map Poster. Washington, DC: American Farm Bureau Federation; 2011:11.
4. North Carolina Department of Labor. A Guide to Farm Safety and Health. Raleigh, NC: North Carolina Department of Labor, Occupational Health and Safety Division; 2008:v-vi,1-4.
5. Walden M. Agriculture and agribusiness: North Carolina's number one industry. Agricultural and Resource Economics Web site. http://www.cals.ncsu.edu/agcomm/news-center/wp-content/uploads/2011/02/agribusiness_10_1.pdf. Accessed February 21, 2012.
6. Agriculture & food: farm health & safety. North Carolina Cooperative Extension Web site. <http://www.ces.ncsu.edu/index.php?page=farmhealthsafety>. Accessed February 21, 2012.
7. US Bureau of Labor Statistics. Fatal occupational injuries in North Carolina. US Bureau of Labor Statistics Web site. <http://www.bls.gov/iif/oshwc/foi/tgs/2009/iiffi37.htm>. Accessed February 21, 2012.
8. Lacy JK, Hunter W, Huang H. A study of farm vehicle crashes in North Carolina. UNC Highway Safety Research Center Web site. <http://www.hsrb.unc.edu/pdf/2001/farmcrash.pdf>. Accessed February 21, 2012.
9. Luginbuhl RC, Jones VC, Langley RL. Farmers' perceptions and concerns: the risks of driving farm vehicles on rural roadways in North Carolina. *J Agric Saf Health*. 2003;9(4):327-348.



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Running the Numbers

*A Periodic Feature to Inform North Carolina Health Care Professionals
About Current Topics in Health Statistics*

Inpatient Hospitalizations Related to Agricultural Machine Injuries in North Carolina, 2006-2010

Incidents involving agricultural machinery are a frequent cause of injuries related to farming activities, although the availability of data with which to track such injuries on a population-based level is limited. Multisource surveillance methods—employing data collected through sources such as death certificates, emergency department records, migrant and community health providers, and hospital discharge data—provide a more complete tracking system than does single-source reporting; however, such systems can be costly to set up and maintain [1, 2]. In the absence of a comprehensive agricultural injury surveillance system, individual data sources can still provide a useful snapshot of the epidemiology of farm injuries in a population. The following is a description of inpatient hospitalizations related to agricultural machine injuries, obtained from the North Carolina Hospital Discharge Database.

The North Carolina Hospital Discharge Database captures information on all inpatient hospitalizations in nonfederal hospitals in North Carolina. North Carolina residents who are admitted to hospitals outside the state are not included in the database. This may bias data for certain border counties, particularly those in the northeastern part of the state, so county-level data should be interpreted with caution. The database contains 1 field for reporting an E code diagnosis, which was added to the database in 1997. The E code is used to denote an external cause of injury code and is used as a supplemental code, with the International Classification of Diseases, 9th Revision, Clinical Modification diagnosis code. We searched the database for the code E919.0 (“accidents caused by agricultural machines”) for the 5-year period 2006-2010. For this analysis, the data for calendar year 2010 were provisional.

There were a total of 294 inpatient hospital discharges for injuries related to agricultural machines in North Carolina during 2006-2010. Patients were cared for at 61 different facilities throughout the state, with the largest numbers of patients being admitted to Pitt County Memorial Hospital, in Greenville ($n = 37$), and North Carolina Baptist Hospital, in Winston-Salem ($n = 34$). Fractures, including skull, neck/

FIGURE 1.
Number of Hospitalizations Due to Injuries from Agriculture Machines, by County of Residence, North Carolina, 2006-2010

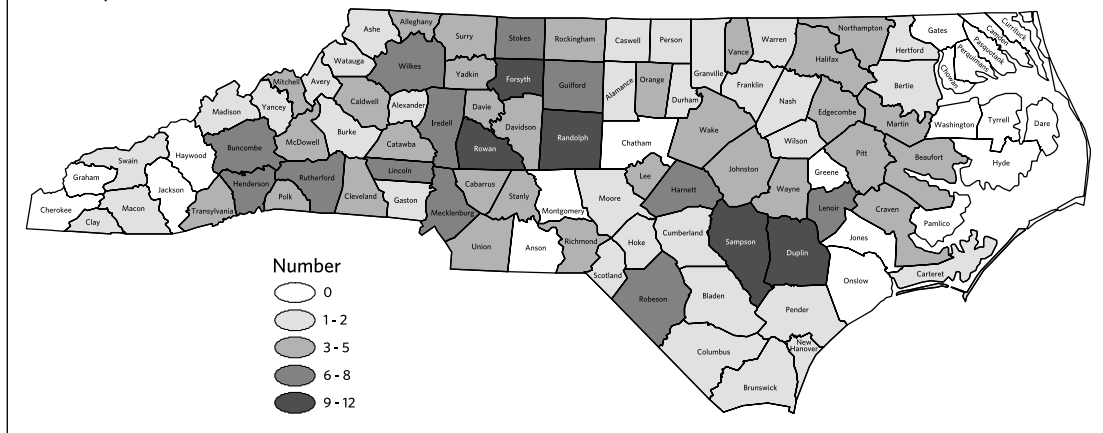


TABLE 1.
Characteristics of Patients (N = 294) Admitted to the Hospital for
Agricultural Machine Injuries, North Carolina, 2006-2010

Patient characteristic	No. (%)
Discharge status	
Discharged to home	191 (65.0)
Discharged to home under care of home health services	44 (15.0)
Discharge to skilled nursing facility	19 (6.5)
Discharged to another rehab facility	18 (6.1)
Died	15 (5.1)
Discharged to another, short-term general hospital	2 (0.7)
Discharged to a federal hospital	1 (0.3)
Left against medical advice/discontinued care	1 (0.3)
Discharged to intermediate care facility	1 (0.3)
Discharged to this institution to Medicare approved swing bed	1 (0.3)
Discharged to long-term care	1 (0.3)
Admission type	
Emergency	201 (68.4)
Urgent	46 (15.6)
Elective	26 (8.8)
Trauma center	21 (7.1)
Admission source	
Emergency department	198 (67.3)
Referral from physician/clinic	68 (23.1)
Transfer from hospital or other facility	27 (9.2)
Not stated	1 (0.3)

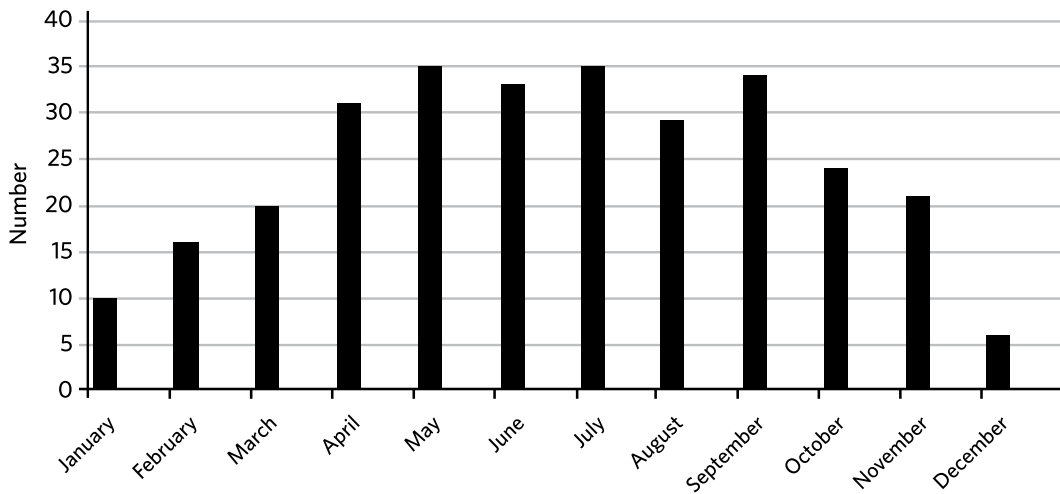
trunk, and limb, accounted for 46.6% of the hospitalizations, on the basis of principal diagnosis, followed by open wounds (13.3%). All but 21 counties had at least 1 such discharge, although, as noted above, the data are probably incomplete for the counties in the northeastern part of the state (Figure 1). Total inpatient hospital charges related to agricultural machine injuries were \$10,823,698, the average charge per admission was just under \$37,000, and the average length of hospital stay was 6.4 days. (Hospital charges reflect the amount the hospital charged for each admission, not the amount paid. Physician charges are not included.)

The admission type and discharge status of individuals admitted to the hospital for agricultural machine injuries are presented in Table 1. Eighty percent (191) of the patients were discharged to home, either under their own care or with assistance from home health services. Fifteen individuals (5.1%) died as inpatients, and 43 (14.6%) were discharged to other short-term or long-term care facilities. The most common type of admission was as an emergency (68.4%). Urgent admissions accounted for 15.6%, and trauma center admissions accounted for 7.1%. Just under 9% of admissions were elective. The main source of admission was via the emergency department (67.3%), followed by physician/clinic referral (23.1%) and transfers from other facilities (9.2%).

As seen in Figure 2, the majority (more than two-thirds) of admissions occurred during April-September—the main growing season in North Carolina. December and January had the fewest admissions. Individuals admitted for agricultural machine injuries covered all age groups (Figure 3). Seventy-six percent of the individuals were aged 40 years and older. Males accounted for 264 (89.8%) of the discharges.

These data provide some insight into one aspect of agricultural injuries in North Carolina. Injuries involving farm machines account for approximately 60 inpatient hospitalizations each year in the state,

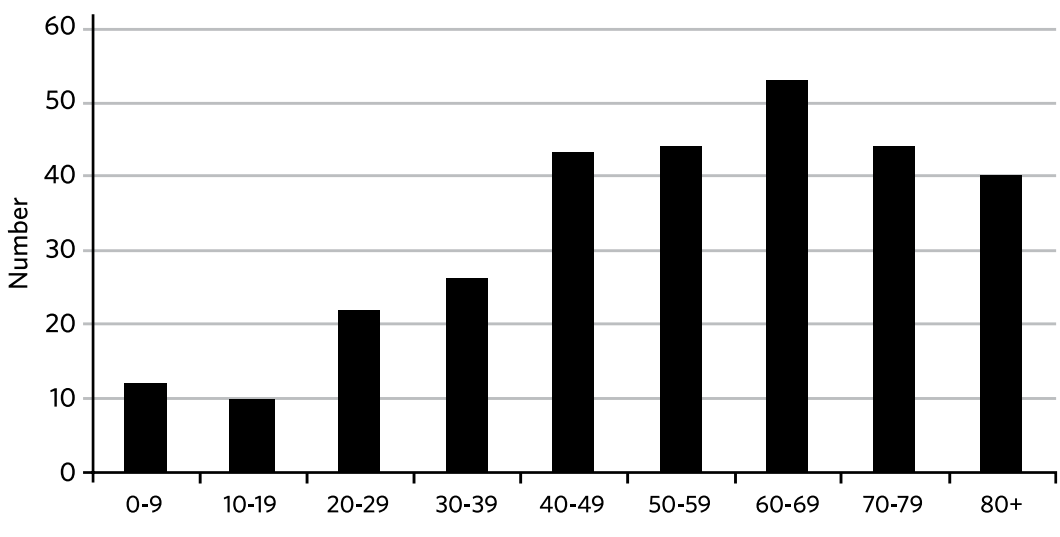
FIGURE 2.
In-Patient Discharges Due to Agricultural Machine Injuries by Month, North Carolina, 2006-2010



they occur in both rural and urban areas, and they affect all age groups. A large percentage of the injuries occurred among older individuals. While this may suggest that age is associated with an increased likelihood of such injuries, we did not examine this issue in further detail, because of the lack of a clearly definable population at risk for this analysis. A study of agricultural machine injuries from the Canadian province of Saskatchewan found a significant linear trend in the risk of injury with advancing age, so it is possible that a similar pattern exists in other regions, including in North Carolina [3].

There are some limitations to the data that must be acknowledged. First, the North Carolina Hospital Discharge Database captures only inpatient admissions, so individuals who were seen on an outpatient basis or who were treated in and released from the emergency department are not included. Second, the database captures only 1 E code diagnosis, so it is not possible to determine the specific location where

FIGURE 3.
In-Patient Discharges Due to Agricultural Machine Injuries by Age of Patient, North Carolina, 2006-2010



the injury occurred, such as a farm or a highway. As previously indicated, North Carolina residents who are admitted to hospitals out of state are not captured in the database, which may produce a somewhat skewed picture of the geographic distribution of such injuries in the state.

As discussed in the article by Higgins and colleagues [2] in this issue of the Journal, public health surveillance of agricultural injuries presents many challenges, and even obtaining a complete and accurate count of the number of injuries and fatalities is problematic. When used in conjunction with other databases and reporting systems—including emergency department records, trauma registries, death certificates, and physician reporting—hospital discharge data can be an informative source of information in a population-based farm injury surveillance system. **NCMJ**

References

1. Earle-Richardson GB, Jenkins PL, Scott EE, May JJ. Improving agricultural injury surveillance: a comparison of incidence and type of injury even among three data sources. *Am J Ind Med.* 2011;54(8):586-596.
2. Higgins S, Barros T, Garrison HG. Fatal flaws: issues associated with farm injury surveillance in North Carolina. *N C Med J.* 2011;72(6):461-465 (in this issue).
3. Hagel LM, Dosman JA, Rennie DC, Ingram MW, Senthilselvan A. Effect of age on hospitalized machine-related farm injuries among the Saskatchewan farm population. *J Agricul Safety Health.* 2004;10(3):155-162.

Contributed by Robert E. Meyer, PhD, MPH, and Allison M. Hayes, State Center for Health Statistics, North Carolina Division of Public Health, North Carolina Department of Health and Human Services, Raleigh, North Carolina.

Spotlight on the Safety Net

*A Community Collaboration
Kimberly Alexander-Bratcher*

North Carolina Farmworker Health Program

As Arcury and Quandt described earlier in this issue of the NCMJ, farmworkers are critical to the agricultural industry, but they have a high level of risk and exposure and experience significant barriers to health care. The North Carolina Farmworker Health Program (NCFHP) works with a statewide network of service providers to improve the health of migrant and seasonal farmworkers and their families in North Carolina.

Housed within the Office of Rural Health and Community Care of the North Carolina Department of Health and Human Services, the NCFHP is a statewide migrant health voucher program. Through contracts with community partners, the program has grown from serving 1,384 migrant and seasonal workers and their family members in 1993 to serving 15,411 in 2011. With funding from the Bureau of Primary Health Care, Health Resources Services Administration; State of North Carolina; the Blue Cross and Blue Shield of North Carolina Foundation; the Pesticide Environmental Trust Fund; and the American Recovery and Reinvestment Act, these services are provided to farmworkers and their families in 42 counties in the state. The NCFHP responds to gaps in health care that would otherwise prevent farmworkers from accessing needed care.

From the state office, the NCFHP provides funding to local agencies, to increase access to primary and preventive health care and dental services, to help build capacity through trainings and technical assistance, and to increase the provision of appropriate, quality services for farmworkers. It coordinates a statewide 340B program for low-cost pharmaceuticals, and it fosters interest in rural health leadership by placing interns in farmworker health settings. The contracted service sites conduct outreach to identify farmworkers and their health needs and to provide enabling services, including health education, interpretation, transportation, case management, and patient advocacy. These delivery sites provide primary care and dental health services (or provide patients with links to those care and services); provide patient referrals to specialty and mental health care, as well as appropriate follow-up; build provider partnerships in the communities; and launch special initiatives in response to farmworkers' needs.

The NCFHP provides funding to existing organizations that have a commitment to farmworkers and a need for resources. It funds outreach, evening clinics, mobile clinics, and other services to increase access to primary and preventive care for farmworkers. In the case of the Albemarle Hospital Foundation, the NCFHP funded a planning grant, to better tailor services to farmworkers. NCFHP provided funds to provide services to farmworkers in the region, including medical services offered in the field. The planning team modified policies as needed in order to facilitate the provision of services through outreach. Within a short time, the Albemarle Hospital Foundation was awarded federal migrant health center funding. With the help of an \$80,000 investment and other support from the NCFHP, the foundation was able to leverage long-term federal funding.

"The NCFHP is unique in that it partners with local agencies throughout the state to provide health services to a population that otherwise would be very isolated and completely underserved," noted Program Director Elizabeth Freeman Lambar. She described her work as an "opportunity to work with local outreach staff throughout the state, who have such a passion for the underserved population and who are a critical link to health services and farmworkers." She particularly appreciates their "caring and respect for patients" and their "sensitivity to individuals and the bigger picture of what may be compounding their health." NCMJ

*Kimberly Alexander-Bratcher, MPH, project director,
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North Carolina's Nursing Workforce: Economic and Sociological Concerns

Allen J. Smart

To the Editor—I read with great interest the July/August 2011 issue, titled “Future of Nursing in North Carolina.” The efforts of hundreds of North Carolina health care leaders are well-presented. During the past couple decades, the Kate B. Reynolds Charitable Trust has been involved in many of the efforts described, and we remain mindfully aware of the critical importance of nursing to addressing any (and all) challenges to improving the health of the state.

I wanted to offer a couple observations concerning the representation of ideas in the issue. Neither of my concerns is specific to North Carolina, but I believe that North Carolina's opportunities to move toward a problem-solving framework are being unnecessarily limited—as is the case in other states.

First, of the 13 articles listed under Invited Commentaries, only 1—“Evidence-Based Transition to Practice”—even touches on the perspectives of nursing employers. The nursing market is almost wholly shaped by the needs of employers (not patients), and the purchasing sector is routinely ignored in these discussions. For example, what are the various nursing employment sectors interested in purchasing, and what level of skills and education are they willing to pay for? North Carolina, like many states, has adopted a general belief that all nurses should be educated to at least the bachelor of science in nursing level. Are employers willing to compensate nurses to reflect the implied gain for the additional 2 years of liberal arts education, for example? If attainment of a bachelor of science in nursing degree removes a nurse from bedside nursing, who is going to be there to replace him or her? As long as the people holding the purse strings are not more actively involved in true leadership roles in these

discussions, there will continue to be only the small glimmers of hope that we experience from time to time—but nothing systemic.

Second, the articles never attempt to take a look at issues of class and race in nursing education, recruitment, and retention. Nurses of color, for example, stay in the workforce longer than white nurses—possibly related to the economic status of their families. A properly working system would then have future nurses of color overrepresented in the educational system, rather than grossly underrepresented. Similarly, nurses with an associate degree in nursing—who are often from lower socioeconomic backgrounds—are overrepresented in the ranks of nurses doing bedside care. Do we really want to diminish the supply of nurses willing and able to do bedside care, in pursuit of other goals? We must pay more attention to high-impact/large-scale solutions that address the economic and sociological frames, rather than tinkering around the periphery of these long-standing issues. **NCMJ**

Allen J. Smart, director, Health Care Division, Kate B. Reynolds Charitable Trust, Winston-Salem, North Carolina.

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Reply to Smart

Margaret C. Wilmoth

To the Editor—I thank Mr. Smart for his thoughtful reading of and response to the policy forum on the future of nursing in North Carolina that was recently published in the North Carolina Medical Journal.

He is correct that employers play a role in shaping the nursing workforce, in terms of setting acceptable levels of educational preparation, creating diversity within the workforce, and including or excluding nurses in the development of solutions to the problems in the care delivery system. It is important to note that the goal of educating the nursing workforce to a minimum of a baccalaureate degree in nursing is to improve patient outcomes, which is in the interest of the employer. Aiken and colleagues [1] documented that a 10% increase in the proportion of nurses holding a bachelor of science in nursing degree was associated with a 5% decrease in the likelihood of patients dying within 30 days of admission. Nurses holding a bachelor of science in nursing degree or a clinical nurse leader certification are educated to provide clinical care and leadership at the point of care, regardless of setting. Employers should also be encouraged to pay nurses on the basis of their educational qualifications, much as they do those in administrative and other positions.

The policy forum was not meant to be an all-inclusive analysis of every problem facing the nursing profession or the care delivery system in which nurses work. The development of the structure of this policy forum followed from the work that was initiated at the Statewide Summit for Creating the Future of Nursing in North Carolina, held in April 2011. At that meeting, attendees identified 4 recommendations that would become the primary focus of efforts for the Future of Nursing initiative in the state, from the 8 that were presented in the Institute of Medicine report [2]. These 4 recommendations are (1) to remove scope-of-practice barriers, (2) to expand opportunities for nurses to lead and diffuse collaborative improvement efforts, (3) to increase the proportion

of nurses with a baccalaureate degree, and (4) to prepare and enable nurses to lead change to advance health. These 4 recommendations then composed the primary organizing mechanism for this policy forum. Authors invited to contribute to the issue were carefully selected on the basis of their expertise relative to 1 of the 4 recommendations.

There are many challenges facing the profession, and I believe that the health care leaders who are working collaboratively to ensure the future of nursing in North Carolina, to benefit the health of the population, would welcome input from Mr. Smart on creative, realistic solutions to the challenges we face. North Carolina has been first in nursing for more than 100 years—implementing “high-impact/large-scale solutions” that address these challenges is our forte! *NCMJ*

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References

1. Aiken LH, Clarke SP, Cheung RB, Sloane DM, Silber JH. Educational levels of hospital nurses and surgical patient mortality. *JAMA*. 2003;290(12):1617-1623.
2. Institute of Medicine of the National Academies. *The Future of Nursing: Leading Change, Advancing Health*. Washington, DC: The National Academies Press; 2011.

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Arthritis Foundation.....	438	NC Carelink	473
Carolinas HealthCare System, Levine Cancer Institute	425	NC Family Health Resource Line	483
Department of Health and Human Services, USA	446	ProAssurance Companies.....	IFC
EPA	465	The Cancer Project.....	470
FeedingAmerica.org.....	IBC	Time Warner Cable Business Class.....	431
Let's Move.gov	BC	US Department of Transportation	496
March of Dimes.....	453	Walker Allen Grice Ammons & Foy LLP	428



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