January/February 2014
Volume 75, Number 1
www.ncmedicaljournal.com

NORTH CAROLINA MEDICAL JOURNAL

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6 Summary of the 2013 Child Health Report Card

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Published by the North Carolina Institute of Medicine and The Duke Endowment
For 19 years, the North Carolina Child Health Report Card has tracked child well-being in our state. The Report Card compiles 40 indicators of child health and safety into one easy-to-read document.

Though findings are mixed, this year’s Report Card shows progress for children in several areas. These gains reflect sustained investments made by the North Carolina General Assembly, as well as past policy changes:

- Although child poverty rates remain elevated, the share of uninsured children in North Carolina continues to decline.
- Enrollment in Medicaid and North Carolina Health Choice remains strong. Participation has increased 27% since the start of the economic downturn.
- The school nurse ratio has improved slightly in recent years.

Yet challenges remain. Despite long-term progress in infant mortality there has been a non-significant increase in the rate for two consecutive years as racial disparities have widened. North Carolina continues to compare poorly with other states ranking 46th in the nation for infant deaths.

For county level data on these and other indicators of child health and wellness, visit the North Carolina state profile on the KIDS COUNT Data Center at datacenter.kidscount.org/nc.

Tar Heel Footprints in Health Care

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

Thomas J. Bacon, DrPH

Thomas J. Bacon, DrPH, served for 17 years as the executive associate dean and the director of the North Carolina Area Health Education Centers (AHEC) program prior to stepping down from these positions in August 2013. Currently, Bacon holds a faculty appointment in the Department of Social Medicine at the University of North Carolina (UNC) School of Medicine and is a senior research fellow at the Cecil G. Sheps Center for Health Services Research at UNC-Chapel Hill.

Looking back on his time as the leader of AHEC, Bacon reflected on the program's 3 greatest accomplishments. First, he lauded the continued production of primary care physicians through AHEC's residency programs; compared with residents in other training programs, a higher percentage of AHEC-trained primary care physicians remain in North Carolina to practice following their residency. Second, Bacon highlighted AHEC's strategic efforts to enhance the diversity of the health professions workforce through a variety of efforts in middle schools and high schools across the state. Finally, Bacon noted the broader use of technology to expand access to health education and to deliver more cost-effective training. In particular, AHEC's digital library provides health professionals access to invaluable resources including online book and journal subscriptions.

Bacon anticipates that AHEC will face several challenges in the upcoming years related to decreased funding and increased competition among consolidated health systems. AHEC's state funding has been cut more than 20% in the past 5 years; while Bacon believes that AHEC's increased efficiency will compensate for some of this loss, it cannot make up for all of it. Also, Bacon posits that the ongoing consolidation of hospitals, physician practices, and other providers into large, competing, integrated systems makes it more difficult to maintain the spirit of collaboration around educational programs that has been critical to AHEC's success over its 40-year history. Still, Bacon believes AHEC has a bright future because of the talented and dedicated people who are part of AHEC across the state.

Bacon has contributed much time, energy, and dedication to improving the quality of health care across North Carolina in his decades of service. Dean and chief executive officer of the UNC School of Medicine and UNC Healthcare William Roper, MD, MPH, commented, “Tom Bacon has had a remarkable career in North Carolina health care. We are all much better off for his fair-minded, principled, and steady leadership.” Bacon also acknowledged the role others have played in AHEC's accomplishments, saying “I value the long spirit of collaboration across North Carolina between AHEC, universities, professional associations, and medical providers over the years.” NCMJ

Elizabeth Chen, North Carolina Institute of Medicine, 630 Davis Dr, Ste 100, Morrisville, NC 27560 (Liz_Chen@nciom.org).

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0029-2559/2014/75120
The National Center for Injury Prevention and Control estimates that, in any given year, approximately 1.7 million Americans suffer a traumatic brain injury (TBI) resulting in death (n = 52,000), hospitalization (n = 275,000), or treatment in an emergency department (ED; n = 1,365,000) [1]. There may be up to another 3.8 million TBIs for which patients receive care in other settings or receive no medical care [2]. Furthermore, findings suggest that recurrent TBIs in sports settings may accelerate the onset of mental health outcomes such as depression or mild cognitive impairment [3-7].

Advocacy organizations such as the Brain Injury Association of North Carolina maintain active TBI prevention campaigns in the state. However, prevention efforts could be better tailored to the state’s needs if there were timely descriptive data on the incidence and circumstances of TBIs. This study examines the epidemiology of TBI-related ED visits in North Carolina in 2010 and 2011, with the goal of providing epidemiologic data to assist in the development and distribution of TBI prevention programs.

Methods

Data collection. ED visit data for the period from January 1, 2010, through December 31, 2011, were obtained from the North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT). Designed as “a statewide public health surveillance system that provides hospital users and public health officials with the capacity for statewide early event detection and timely public health surveillance” [8], NC DETECT draws from the following sources: EDs that are open 24 hours a day, 7 days a week, in acute care civilian hospitals; EDs in Department of Veterans Affairs hospitals; the Carolinas Poison Center; the Pre-hospital Medical Information System; statewide school absenteeism data; and pilot data from select urgent care centers. Our analyses were limited to data from 24/7 EDs at acute care civilian hospitals.

In 2010 and 2011, NC DETECT captured ED records from 115 such EDs in North Carolina; on average, 99.5% of all eligible ED visits were captured. Each hospital performs its own medical coding for internal purposes. Each hospital also codes its data in Health Level Seven (HL7)-like format and transmits it to a data aggregator. (HL7 is a widely recognized and implemented standard developed by Health Level Seven International for the exchange and transmission of health care data [9].) The data are then received securely and validated by NC DETECT every 12 hours.

Definition of TBI. This study used the code-based case definition for TBI developed by the Centers for Disease Control and Prevention.
and Prevention (CDC) [10, 11]. An ED visit was characterized as TBI-related if it contained 1 or more of the following International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes: fracture of the vault or base of the skull (800.0–801.9); other and unqualified and multiple fractures of the skull (803.0–804.9); intracranial injury, including concussion, contusion, laceration, and hemorrhage (850.0–854.1); injury to optic nerve and pathways (950.1–950.3); shaken baby syndrome (959.55); or head injury, unspecified (959.01) [11]. Visits were classified as injury-related if they had an ICD-9-CM diagnosis code of 800–999 in any of the 11 possible diagnosis fields or an external cause of injury code (E-code) in any of 5 possible E-code fields.

**Statistical analyses.** Counts, proportions, and rates of TBI-related ED visits were produced by year, sex, age, and mechanism of injury. The North Carolina population used for the denominator in the calculation of all rates was obtained from the National Center for Health Statistics’ bridged-race US Census counts for April 1, 2010 [12]. We analyzed data using SAS software version 9.2 (SAS Inc). This study was approved by the institutional review board at the University of North Carolina at Chapel Hill.

**Results**

Of the 9,000,085 injury- and illness-related ED visits reported in 2010–2011, 1.6% (n = 140,234) contained at least 1 diagnosis code for TBI. Most of the patients with a TBI who visited the ED arrived by private transportation (56.5%); another 34.4% arrived by ambulance. The majority of patients were discharged to home from the ED (84.0%). Another 6.4% were admitted to the hospital, 1.0% were admitted to the intensive care unit (ICU), 5.4% were transferred to another hospital, 1.3% left without or against medical advice, 1.6% were placed in an observation unit, less than 0.1% died in the ED, and 1.6% had some other disposition. In terms of patients’ expected source of payment for care, 30.1% of patients had private health insurance, 21.0% had Medicare, 18.9% had Medicaid, and 20.2% paid out of pocket.

The 2010–2011 rate of TBI-related ED visits in North Carolina was 7.3 ED visits per 1,000 person-years (Table 1).

**Table 1.** North Carolina Emergency Department Visits With a Diagnosis Code for Traumatic Brain Injury Reported in Any Diagnosis Field, 2010–2011

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Count (%)a</th>
<th>Rateb</th>
<th>Increase from 2010 to 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Count difference</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>66,805 (47.6%)</td>
<td>6.8</td>
<td>3,751</td>
</tr>
<tr>
<td>Male</td>
<td>73,408 (52.4%)</td>
<td>7.9</td>
<td>3,108</td>
</tr>
<tr>
<td>Missing data</td>
<td>21 (&lt;0.1%)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–4</td>
<td>16,508 (11.8%)</td>
<td>13.1</td>
<td>802</td>
</tr>
<tr>
<td>5–9</td>
<td>8,193 (5.8%)</td>
<td>6.4</td>
<td>387</td>
</tr>
<tr>
<td>10–14</td>
<td>9,251 (6.6%)</td>
<td>7.3</td>
<td>827</td>
</tr>
<tr>
<td>15–19</td>
<td>13,861 (9.9%)</td>
<td>10.6</td>
<td>489</td>
</tr>
<tr>
<td>20–24</td>
<td>12,027 (8.6%)</td>
<td>9.0</td>
<td>505</td>
</tr>
<tr>
<td>25–29</td>
<td>8,757 (6.2%)</td>
<td>7.0</td>
<td>205</td>
</tr>
<tr>
<td>30–34</td>
<td>7,124 (5.1%)</td>
<td>5.7</td>
<td>278</td>
</tr>
<tr>
<td>35–39</td>
<td>6,450 (4.6%)</td>
<td>5.0</td>
<td>210</td>
</tr>
<tr>
<td>40–44</td>
<td>6,374 (4.5%)</td>
<td>4.7</td>
<td>304</td>
</tr>
<tr>
<td>45–49</td>
<td>6,545 (4.7%)</td>
<td>4.7</td>
<td>287</td>
</tr>
<tr>
<td>50–54</td>
<td>5,969 (4.3%)</td>
<td>4.4</td>
<td>393</td>
</tr>
<tr>
<td>55–59</td>
<td>5,263 (3.8%)</td>
<td>4.3</td>
<td>267</td>
</tr>
<tr>
<td>60–64</td>
<td>4,793 (3.4%)</td>
<td>4.3</td>
<td>199</td>
</tr>
<tr>
<td>65–69</td>
<td>4,374 (3.1%)</td>
<td>5.3</td>
<td>338</td>
</tr>
<tr>
<td>70–74</td>
<td>4,397 (3.1%)</td>
<td>7.3</td>
<td>321</td>
</tr>
<tr>
<td>75–79</td>
<td>5,136 (3.7%)</td>
<td>11.3</td>
<td>154</td>
</tr>
<tr>
<td>80–84</td>
<td>5,957 (4.2%)</td>
<td>17.9</td>
<td>271</td>
</tr>
<tr>
<td>≥85</td>
<td>9,210 (6.6%)</td>
<td>30.6</td>
<td>620</td>
</tr>
<tr>
<td>Missing data</td>
<td>45 (&lt;0.1%)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Total</td>
<td>140,234 (100%)</td>
<td>7.3</td>
<td>6,866</td>
</tr>
</tbody>
</table>

*aDenominator is the total number of North Carolina emergency department visits in 2010–2011 with a diagnosis code for traumatic brain injury reported in any diagnosis field (N = 140,234 visits).

*bRates are reported per 1,000 person-years; they were calculated using the estimated 2010–2011 North Carolina population reported in the National Center for Health Statistics Bridged Population File [12].
The TBI rate for males (7.9 visits per 1,000 person-years) was 16% higher than the TBI rate for females (6.8 visits per 1,000 person-years). Every demographic subgroup showed an increase in the rate of TBI-related ED visits between 2010 and 2011.

Looking at the number of TBIs in each age group, children 0–4 years of age had the highest number of TBI-related ED visits (16,508 visits; Table 1). The number of visits dropped precipitously after 1 year of age but increased again at age 10 years, with a second peak observed at 15–19 years (13,861 visits). The number of visits then remained relatively steady until age 85 years, with a final peak observed among individuals 85 years of age or older (9,210 visits).

Rates of TBI-related ED visits were also highest in the early and later parts of life (Figure 1). Specifically, the highest rates occurred among individuals 0–4 years of age (13.1 visits per 1,000 person-years), 15–19 years of age (10.6 visits per 1,000 person-years), 75–79 years of age (11.3 visits per 1,000 person-years), 80–84 years of age (17.9 visits per 1,000 person-years), and 85 years of age or older (30.6 visits per 1,000 person-years). Rates were higher for males than for females across most age categories; however, rates for women were higher among adults aged 65 years or older.

Rates of TBI-related ED visits varied by the patient’s county of residence (Figure 2). The 5 counties with the lowest rates of TBI-related ED visits were Clay (1.0 visits per 1,000 person-years), Cherokee (1.3 visits per 1,000 person-years), Polk (1.7 visits per 1,000 person-years), Buncombe (2.0 visits per 1,000 person-years), and Madison (2.1 visits per 1,000 person-years). The 5 counties with the highest rates of TBI-related ED visits were Carteret (17.1 visits per 1,000 person-years), Scotland (15.9 visits per 1,000 person-years), Surry (15.1 visits per 1,000 person-years), Chowan (13.4 visits per 1,000 person-years), and Craven (12.9 visits per 1,000 person-years).

Among TBI-related ED visits with an E-code indicating the intent and mechanism of an injury, the majority of visits were related to unintentional injuries (72.3%); an additional 8.6% of visits were related to assault (Table 2). The percentage of ED visits due to intentional injuries was higher among males (10.8%) than among females (6.7%). TBI-related ED visits were principally the result of falls (39.0%), being struck (17.6%), or motor vehicle traffic-related crashes (14.1%). Falling was the leading mechanism of injury for both females (45.6%) and males (33.0%). Among females, motor vehicle traffic-related crashes were the second-leading mechanism of injury (13.9%), followed by being struck (10.0%). Among males, being struck was the second-leading mechanism of injury (15.1%), followed by motor vehicle traffic-related crashes (14.3%). Falling was the most common mechanism of injury among both the youngest individuals (those 0–4 years of age; 73.4%) and the oldest individuals (those 65 years of age or older; 87.8%; Figure 3). For individuals aged 15–19 years, the most common mechanisms of injury were motor vehicle collisions (32.4%), being struck (31.2%), and falls (24.8%). Discharge dispositions varied across different mechanisms of injury. Of patients who visited the ED with a TBI...
related to falling, 84.2% were discharged to home, 5.8% were admitted to the hospital, 0.8% were admitted to the ICU, 6.1% were transferred to another facility, and 0.1% died in the ED. Among patients whose TBI-related ED visits were due to motor vehicle traffic–related crashes, slightly higher percentages were admitted to the hospital (8.6%) and the ICU (1.1%); the remainder were discharged to home (81.4%), transferred (6.0%), or died in the ED (0.5%). Patients who visited the ED with a TBI due to being struck by or against an object were somewhat more likely to be discharged home (92.5%); another 1.8% were admitted to the hospital, 0.3% were admitted to the ICU, 2.3% were transferred to another hospital, and less than 0.1% died in the ED. On the other hand, patients who visited the ED with a firearm-related TBI were considerably more likely to be admitted to the hospital or the ICU; 23.6% of these patients were discharged to home, 30.9% were admitted to the hospital, 12.2% were admitted to the ICU, 21.2% were transferred, and 9.0% died in the ED.

Discussion

Using ED visit data, this study examined both intent of injury and the mechanism of injury for TBIs, by demographic characteristics. The ED visit data from NC DETECT for the period 2010–2011 captured more than 99% of eligible ED visits in North Carolina. The 2011 rate of 7.6 TBI-related ED visits per 1,000 person-years represents an 8.6% increase over the 2010 rate (7.0 ED visits per 1,000 person-years). An even more dramatic increase of 30.4% was observed between the 2010–2011 rate (7.3 visits per 1,000 person-years) and the rate reported for 2008 (5.6 visits per 1,000 person-years) [13]. This increase in the utilization of ED services for the treatment of TBIs has also been noted in the national literature. The CDC observed a 14% increase in TBI-related ED visits from 2002 to 2006 [1]. For ED visits due to sports-related TBIs among individuals 19 years of age or younger, there was a 57% increase from 2001 (190 visits per 100,000 population) to 2009 (298 visits per 100,000 population) [14]. The higher rates observed at the state and national levels in recent years may be associated with better detection, better diagnosis, and better data capture of TBIs, both in the community and in the ED. In addition, patients are becoming more knowledgeable and cautious about TBIs as a result of increased media coverage in recent years [15, 16]; thus they may be more likely to visit the ED when a TBI is suspected.

However, not all TBIs are seen in the ED. In particular, individuals with sports-related TBIs may seek care from other clinicians, such as certified athletic trainers. Public health campaigns should continue to inform the public about the risks associated with TBIs and should emphasize the need to seek appropriate and well-informed care. The percentage of ED visits in which the patient was admitted to the hospital or the ICU was similar for TBI-related ED visits (7.4%) and for ED visits for all types of injury (10.8%) [8], but it is unknown how many of these individuals required follow-up care in an outpatient setting. In a study of 2005 data, an estimated 1.1% of individuals who reported to an ED due to a TBI had an injury that resulted in some form of serious long-term disability [17]. Even mild TBIs that do not require hospitalization may be associated with impairment. Adults commonly experience some form of cognitive deficit for the first 3 months after injury [18].

Among individuals younger than 65 years of age, TBI
rates were lower for females than for males. This differs from the results of previous research regarding high school athletes, which found that females had higher concussion rates than males [19-22]. However, these studies were restricted to sports played by both males and females (eg, basketball, soccer, lacrosse). Among those 65 years of age or older, our study found that TBI rates were higher for women than for men. This sex difference may reflect the high incidence of falls among women in this age group [23, 24].

Rates of TBI-related ED visits also varied by county, with the highest rates occurring in the Coastal Plain region of North Carolina, particularly in counties bordering the Pamlico Sound. As mentioned earlier, the higher rates observed in this region may be associated with better detection, better diagnosis, and better data capture of TBIs. At the same time, lower rates of TBI-related ED visits in other counties may be attributable to factors such as the presence or absence of an ED within the county’s boundaries. For example, Clay County has no ED, and the closest hospital is located in northern Georgia; data about North Carolina residents who received out-of-state care would not be transmitted to NC DETECT, so some cases may have been missed. In addition, an Indian Health Service hospital is located in Cherokee County, and data for anyone seeking treatment there would not be included in this study. Finally, although hospitals generally report data every 24 hours, there may be brief periods during which individual hospitals fail to report data. As a result, these findings should be interpreted with caution until additional years of data are collected.

The majority of TBI-related ED visits were associated with falls, being struck, or motor vehicle traffic–related crashes. Our findings suggest that interventions designed to prevent falls (eg, balance exercises), assault (eg, late-night campus police escorts), and motor vehicle crashes (eg, education regarding distracted driving) might contribute to a reduction in the incidence of TBIs.

Limitations of this study originate from the secondary nature of the ED visit data in NC DETECT. Hospitals collect these data as a part of routine ED processes, primarily for the purposes of patient care, billing, and administrative

<table>
<thead>
<tr>
<th>Intent and mechanism of injury</th>
<th>Female No. (%)</th>
<th>Male No. (%)</th>
<th>All No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unintentional injuries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Falls</td>
<td>49,715 (74.4%)</td>
<td>51,635 (70.3%)</td>
<td>101,359 (72.3%)</td>
</tr>
<tr>
<td>Motor vehicle traffic-related crashes</td>
<td>30,484 (45.6%)</td>
<td>24,210 (33.0%)</td>
<td>54,697 (39.0%)</td>
</tr>
<tr>
<td>Struck</td>
<td>9,311 (13.9%)</td>
<td>10,528 (14.3%)</td>
<td>19,843 (14.1%)</td>
</tr>
<tr>
<td>Other/unspecified</td>
<td>3,270 (4.9%)</td>
<td>5,808 (7.9%)</td>
<td>9,072 (6.5%)</td>
</tr>
<tr>
<td>Intentional injuries</td>
<td>4,448 (6.7%)</td>
<td>7,933 (10.8%)</td>
<td>12,384 (8.8%)</td>
</tr>
<tr>
<td>Assault</td>
<td>4,375 (6.5%)</td>
<td>7,692 (10.5%)</td>
<td>12,068 (8.6%)</td>
</tr>
<tr>
<td>Cutting/piercing instruments</td>
<td>56 (0.1%)</td>
<td>199 (0.3%)</td>
<td>256 (0.2%)</td>
</tr>
<tr>
<td>Firearms</td>
<td>14 (&lt;0.1%)</td>
<td>98 (0.1%)</td>
<td>112 (0.1%)</td>
</tr>
<tr>
<td>Other/unspecified</td>
<td>2,044 (3.1%)</td>
<td>2,664 (3.6%)</td>
<td>4,708 (3.4%)</td>
</tr>
<tr>
<td>Self-inflicted injuries</td>
<td>58 (0.1%)</td>
<td>143 (0.2%)</td>
<td>203 (0.1%)</td>
</tr>
<tr>
<td>Firearms</td>
<td>12 (&lt;0.1%)</td>
<td>66 (0.1%)</td>
<td>80 (0.1%)</td>
</tr>
<tr>
<td>Other/unspecified</td>
<td>46 (0.1%)</td>
<td>77 (0.1%)</td>
<td>123 (0.1%)</td>
</tr>
<tr>
<td>Other causes of violence</td>
<td>15 (&lt;0.1%)</td>
<td>98 (0.1%)</td>
<td>113 (0.1%)</td>
</tr>
<tr>
<td>Injuries of undetermined intent</td>
<td>53 (0.1%)</td>
<td>69 (0.1%)</td>
<td>122 (0.1%)</td>
</tr>
<tr>
<td>Adverse effects of medical treatment</td>
<td>120 (0.2%)</td>
<td>112 (0.2%)</td>
<td>232 (0.2%)</td>
</tr>
<tr>
<td>Unclassifiable external cause of injury</td>
<td>12,469 (18.7%)</td>
<td>13,659 (18.6%)</td>
<td>26,137 (18.6%)</td>
</tr>
<tr>
<td>E-code for place of occurrence</td>
<td>3,174 (4.8%)</td>
<td>3,381 (4.6%)</td>
<td>6,556 (4.7%)</td>
</tr>
<tr>
<td>External cause status E-code</td>
<td>1,340 (2.0%)</td>
<td>1,560 (2.1%)</td>
<td>2,903 (2.1%)</td>
</tr>
<tr>
<td>Activity E-code</td>
<td>1,001 (1.5%)</td>
<td>1,754 (2.4%)</td>
<td>2,755 (2.0%)</td>
</tr>
<tr>
<td>Missing E-code</td>
<td>6,954 (10.4%)</td>
<td>6,964 (9.5%)</td>
<td>13,923 (9.9%)</td>
</tr>
<tr>
<td>Total</td>
<td>66,805 (100%)</td>
<td>73,408 (100%)</td>
<td>140,234 (100%)</td>
</tr>
</tbody>
</table>

*An emergency department visit may have up to 5 external cause of injury codes (E-codes); the visit was categorized based on the E-code in the first listed position.

*Denominator is the total number of North Carolina emergency department visits in 2010-2011 by females with a diagnosis code for traumatic brain injury reported in any diagnosis field (N = 66,805 visits).

*Denominator is the total number of North Carolina emergency department visits in 2010-2011 by males with a diagnosis code for traumatic brain injury reported in any diagnosis field (N = 73,408 visits).

*Denominator is the total number of North Carolina emergency department visits in 2010-2011 with a diagnosis code for traumatic brain injury reported in any diagnosis field (N = 140,234 visits).
management. ED visit data provided to NC DETECT are limited to those data elements that each hospital captures electronically and do not include several elements that would be useful for TBI surveillance—for instance, indicators of injury severity, such as Glasgow Coma Scale scores. Furthermore, only injuries treated in EDs are captured; less severe injuries that did not receive any medical attention or were treated in other health care settings are not included in this study. Another limitation is that the unit of analysis is the ED visit rather than the individual; thus patients treated more than once for the same injury are counted multiple times.

In addition, patients who are transferred between hospitals (5.4% of visits) are likely to be counted twice. Although this could lead to an overestimation of the incidence of TBIs in North Carolina, we believe transfers had minimal impact on our results. A 2004 CDC report [25] of TBI surveillance in South Carolina found that the rate of readmission to the hospital was 4% and the rate of readmission to the ED was 5%-6%; other studies have estimated double-counting because of transfers to be 2%-3%. Our data indicate that 5.4% of TBI-related ED visits resulted in transfers.

A final limitation of this study is the lack of accuracy caused by using an ICD-9-CM–based case definition to identify TBIs. The use of ICD-9-CM diagnosis codes can result in both undercounting and overcounting of TBI cases, particularly cases of mild TBI [18]. One study of a single ED over a 6-month period in 2003 [26] found that the CDC’s ICD-9-CM–based definition had a sensitivity of 45.9% and a specificity of 97.8% for identifying mild TBIs. Although using a case definition based on a series of predefined clinical indicators is often preferable for research purposes, such a definition is often not useful for real-time data surveillance.

Timely data from EDs across North Carolina are useful for many types of public health surveillance, including injury surveillance. Continued surveillance from NC DETECT will help to describe the epidemiology of TBIs in the state. To date, surveillance data indicate that TBIs are a common cause of injury resulting in ED visits in North Carolina. Based on these analyses, children younger than 5 years of age, males aged 15-24 years, and adults aged 65 years or older may benefit from targeted interventions and evidence-based injury prevention strategies to decrease the incidence and burden of TBIs in these at-risk groups. We hope these analyses will lead to an increased number of resources aimed at TBI prevention, treatment, and management in North Carolina.
A Cross-Sectional Study of Medical Students’ Knowledge of Patient Safety and Quality Improvement

Rachel C. Blasiak, Claire L. Stokes, Karen L. Meyerhoff, Rachel E. Hines, Lindsay A. Wilson, Anthony J. Viera

BACKGROUND The Association of American Medical Colleges and the World Health Organization have endorsed formal patient safety and quality improvement (QI) education for medical students. We surveyed medical students to assess their current level of patient safety and QI knowledge and to identify factors associated with increased knowledge.

METHODS A literature review, focus groups with medical students, and local expert interviews were used to develop an electronic survey, which was distributed to all medical students at a single medical school in the spring of 2012.

RESULTS Fifty-seven percent of the medical school student body (N = 790) participated in the survey. A greater proportion of students reported previous exposure to patient safety education than to QI education (79% vs 47%). Students scored an average of 56% and 58% on the patient safety and QI knowledge tests, respectively. Having or pursuing an advanced degree (P = .02) and previous exposure to patient safety education (P = .02) were associated with higher knowledge scores. After adjusting for confounding variables, only previous exposure to QI education (P = .02) was associated with higher QI knowledge scores.

LIMITATIONS There is a risk of measurement bias due to the use of an unvalidated instrument. Students who have greater knowledge of patient safety or QI might recall exposure at a greater frequency, inflating the association between exposure and knowledge. Also, this is a cross-sectional study, so we cannot draw conclusions about causality.

CONCLUSIONS Medical students’ knowledge of patient safety and QI is low. Previous formal or informal education about these topics is associated with increased knowledge.

The need for education on patient safety and quality improvement (QI) was formally introduced in the landmark reports To Err Is Human [1, 2] and Crossing the Quality Chasm [3]. Using 1984 data, To Err Is Human estimated that medical errors lead to 98,000 deaths per year [1], and an updated estimate based on 4 recent studies found that at least 210,000 deaths per year are associated with preventable harm [4]. By the latter estimate, if medical errors were included among the leading causes of death in the United States, they would rank third [5]. QI research shows that education can improve patient outcomes, costs, and safety [3, 6, 7]. Previous efforts to reduce medical errors and improve health care quality have focused on education of residents and physicians [8].

Recent research has highlighted the need for patient safety and QI education starting during medical school, in order to help change the culture of medicine and to integrate medical students into the health care team [9-11]. The Association of American Medical Colleges (AAMC) and the World Health Organization (WHO) recently endorsed formal patient safety and QI education for medical students [10, 12, 13]. Despite consensus on the importance of patient safety and QI education during medical school, few schools have implemented formal integrated curricula, and the most effective strategy for teaching these principles to medical trainees is unknown [14, 15].

The literature on patient safety education for medical students is underdeveloped, and even less is available regarding QI education for medical students. The majority of the literature consists of pre- or post-survey studies of stand-alone piloted curricula [8]. In a systematic review of medical student patient safety education, 6 of 7 studies found that student knowledge improved with the piloted curriculum [8]. Included studies varied significantly with regard to hours of instruction, educational format, evaluation of change in knowledge, and the year during medical school when the curriculum was offered. Components of piloted curricula include lectures, readings, and interactive discussions, as well as exercises during which students could practice medication reconciliation or explain a medical error to a standardized patient [16-21]. A multi-institutional study of patient safety knowledge among residents and medical students [22] found that knowledge was affected by year of training, degree program, specialty, and country of medical school. The WHO has developed a comprehensive guide to help medical schools around the world design and implement a patient safety curriculum [10]. The curriculum is currently being piloted in 6 WHO regions, and the results of
this study will help to improve future patient safety education and will further the development of a comprehensive, integrated, systems-based curriculum.

Research on QI education has mainly focused on residents and attending physicians [6, 14]. A systematic review of QI education for clinicians [6] found that a piloted curriculum improved physicians’ knowledge of QI and their confidence in performing QI activities. Literature on QI education for medical students is in short supply. A study conducted at the University of Connecticut School of Medicine [7] demonstrated that student-led diabetes QI projects improved patient care and taught students QI principles. A longitudinal curriculum started at Mayo Medical School showed that active learning techniques (exercises, simulation games, storytelling, and practical experience) were superior to lectures in improving student knowledge [23].

We examined students’ current patient safety and QI knowledge and factors associated with greater knowledge. In particular, we wondered whether students who report previous exposure to patient safety or QI education actually attain greater knowledge of these topics. We also wondered whether students who pursue additional education, such as a Master of Public Health (MPH) degree, have greater knowledge of these topics.

Methods

Survey development. We used a literature search, a series of 3 focus groups with medical students, and key informant interviews with local experts to develop a survey that was distributed electronically from April 20, 2012, to May 7, 2012 to all medical students enrolled at the University of North Carolina (UNC) School of Medicine. This survey collected information about demographic characteristics and previous exposure to patient safety and QI education, asked students to rate their level of knowledge about patient safety and QI, and assessed students’ current patient safety and QI knowledge. (See Appendix 1; online version only). Students were also asked to rate their own knowledge of patient safety and QI compared with that of other students at their level of training. The 4 questions designed to assess students’ knowledge of patient safety were adapted from the content-validated patient safety curriculum (error prevention and systems theory) of the Risk Management Foundation [22]. The 5 questions designed to assess students’ knowledge of QI were adapted from the QI curriculum of the Institute for Healthcare Improvement’s Open School [24]. Our study was exempted from review by UNC’s Office of Human Research Ethics.

Survey administration. All students enrolled at the UNC School of Medicine were contacted by e-mail and asked to participate in the online survey. We also sent 2 follow-up e-mails encouraging students to participate; the e-mails were sent to the students by a medical student involved in the study. Students consented electronically to participate in this study. To incentivize student participation, we offered entry into a drawing for a free iPad (Apple).

Survey of course directors. As part of our initial research, we conducted a survey of all medical school clerkship directors to determine how UNC is currently teaching students about patient safety and QI. We found that diagnostic errors are discussed in the second-year clinical epidemiology class and in the transition-to-internship course that occurs at the end of the fourth year. A transition course taken by all UNC medical students between their second and third years addresses the role that third-year medical students play in patient safety. During the third-year surgical clerkship, students participate in time-outs in the operating room. During their fourth year, all students participate in a full-day program during which they attend a lecture on the National Committee for Quality Assurance and the Medicare Quality Improvement Organization Program, and they write an essay on a patient safety or QI topic of their choosing. Finally, a small number of students took elective courses during which they were exposed to QI projects on lung transplantation and reduction of central line–associated infections, and/or they participated in small-group discussions of QI policy topics. Students who had received or were working toward an MPH degree had significant exposure to patient safety and QI education through required and elective courses.

Data analysis. We report student characteristics, previous exposure to education about patient safety and QI, self-rated knowledge of patient safety and QI, and relative importance of patient safety and QI in the medical school curriculum using percentages and means, with a standard deviation (SD) when appropriate. For each student, we determined scores for patient safety knowledge and QI knowledge using the percentages of correct answers to patient safety questions and QI questions, respectively. A bivariate analysis was used to compare each factor of interest to the patient safety and QI knowledge scores, using a 2-sample t-test or 1-way analysis of variance for variables with more than 2 categories. Factors that were significant in bivariate analysis at a P-value less than or equal to .10 were placed in a multiple linear regression model to provide adjusted estimates. Initially we included race in our models; however, race was not associated with any of our exposures of interest and therefore was dropped from the models. For final reporting, we used a significance level of P=.05. All analyses were performed using Stata 12 (StataCorp).

Results

Participants. A total of 450 of 790 students participated in the survey, for a response rate of 57%. Overall, the demographic characteristics of students who participated in our survey were very similar to those of the medical student body as a whole. Seven percent of respondents were black, compared with 8% of all medical students, and 46% of respondents were male, compared with 49% of all medical students (Table 1). Thirty-nine percent of survey participants were in their preclinical years (first or second year); 47%
of participants were in their clinical years (third or fourth year); and 14% of participants were classified as “other” because they were doing research, studying for an MPH or PhD degree, or taking a leave of absence; corresponding percentages for the medical student body as a whole were 42%, 44%, and 13%, respectively. Among survey participants, 33% of students were currently working on or had already received an advanced degree, such as an MPH, PhD, master of business administration (MBA), or master of science (MS) degree. The most commonly pursued advanced degree was an MPH, which was sought or held by 42% of advanced-degree students. Thirty-seven percent of respondents planned to go into primary care; 10% intended to enter a medical or pediatric subspecialty; 28% planned to go into general surgery or a surgical subspecialty; and 26% intended to enter other specialties.

**Patient safety and QI education and self-rated knowledge.**

More than three-quarters (79%) of students reported previous formal or informal education about patient safety, whereas only 47% of students reported previous formal or informal education about QI (Table 2). Almost half of students (45%) rated their knowledge of patient safety as better than average, whereas only 30% of students rated their knowledge of QI as better than average.

**Knowledge scores.** The average knowledge score (percentage of answers that were correct) on the 4-item test of patient safety knowledge was 56% (SD = 25%), with a range of 0% to 100%. The most frequently missed item asked about the number of deaths in the United States each year that are attributable to medical errors.

The average score on the 5-item QI knowledge test was 58% (SD = 20%), with a range of 0% to 100%. The question that was most frequently answered incorrectly asked about the effect of systems on improvement of outcomes. Students who did not provide answers to the QI and patient safety items were similar to other respondents in terms of race, sex, year in medical school, and proportion with an advanced degree.

**Factors associated with greater knowledge of patient safety.** On the patient safety knowledge items, the average score for those holding or currently pursuing an advanced degree was 60%, versus 54% for those without an advanced degree (P = .048; Table 3). Students who reported previous formal or informal education on patient safety performed significantly better than those who did not (57% vs 47%; P = .023). Sex, year in medical school, self-rated patient safety knowledge, and intended specialty were not significantly associated with students’ performance on the patient safety knowledge items.

### Table 1

**Demographic Characteristics of Medical Students Who Responded to a Survey About Patient Safety and Quality Improvement**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race (n = 352)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>250 (71%)</td>
</tr>
<tr>
<td>Black</td>
<td>26 (7%)</td>
</tr>
<tr>
<td>Asian</td>
<td>48 (14%)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>22 (6%)</td>
</tr>
<tr>
<td>Other</td>
<td>6 (2%)</td>
</tr>
<tr>
<td>Sex (n = 356)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>164 (46%)</td>
</tr>
<tr>
<td>Female</td>
<td>192 (54%)</td>
</tr>
<tr>
<td>Year in medical school (n = 358)</td>
<td></td>
</tr>
<tr>
<td>Preclinical (year 1 or 2)</td>
<td>140 (39%)</td>
</tr>
<tr>
<td>Clinical (year 3 or 4)</td>
<td>168 (47%)</td>
</tr>
<tr>
<td>Other</td>
<td>150 (42%)</td>
</tr>
<tr>
<td>Holds or is pursuing an advanced degree (n = 356)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>118 (33%)</td>
</tr>
<tr>
<td>No</td>
<td>239 (67%)</td>
</tr>
<tr>
<td>Intended specialty (n = 355)</td>
<td></td>
</tr>
<tr>
<td>Primary care</td>
<td>131 (37%)</td>
</tr>
<tr>
<td>Medicine/pediatrics subspecialty</td>
<td>35 (10%)</td>
</tr>
<tr>
<td>Surgical specialty</td>
<td>98 (28%)</td>
</tr>
<tr>
<td>Other specialty</td>
<td>91 (26%)</td>
</tr>
</tbody>
</table>

Note. Due to rounding, not all percentages add up to 100%.

### Table 2

**Medical Students’ Self-Rated Level of Knowledge, Previous Education, and Knowledge Scores for Patient Safety and Quality Improvement (QI)**

<table>
<thead>
<tr>
<th>Measure</th>
<th>No.</th>
<th>Percentage or Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean self-rating of knowledge of patient safety (on a scale of 1 to 5')</td>
<td>404</td>
<td>3.5 (0.69)</td>
</tr>
<tr>
<td>Mean self-rating of knowledge of QI (on a scale of 1 to 5')</td>
<td>371</td>
<td>3.2 (0.81)</td>
</tr>
<tr>
<td>Proportion of respondents claiming previous formal or informal education about patient safety</td>
<td>450</td>
<td>79%</td>
</tr>
<tr>
<td>Proportion of respondents claiming previous formal or informal education about QI</td>
<td>450</td>
<td>47%</td>
</tr>
<tr>
<td>Average percentage of correct answers to 4 questions about patient safety</td>
<td>374</td>
<td>56% (25%)</td>
</tr>
<tr>
<td>Average percentage of correct answers to 5 questions about QI</td>
<td>349</td>
<td>58% (20%)</td>
</tr>
</tbody>
</table>

Note. SD, standard deviation.

On the 5-point scale for self-rating one’s knowledge of patient safety or QI compared with the knowledge of one’s peers, 1 is “poor,” 3 is “average,” and 5 is “excellent.”
### TABLE 3.
Demographic Characteristics Associated With Knowledge About Patient Safety

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean percentage of questions answered correctly</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race (n = 351)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>249</td>
<td>59%</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>102</td>
<td>51%</td>
</tr>
<tr>
<td>Sex (n = 355)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>191</td>
<td>55%</td>
</tr>
<tr>
<td>Male</td>
<td>164</td>
<td>57%</td>
</tr>
<tr>
<td>Year in medical school (n = 358)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preclinical (year 1 or 2)</td>
<td>140</td>
<td>54%</td>
</tr>
<tr>
<td>Clinical (year 3 or 4)</td>
<td>168</td>
<td>57%</td>
</tr>
<tr>
<td>Other b</td>
<td>50</td>
<td>59%</td>
</tr>
<tr>
<td>Holds or is pursuing an advanced degree (n = 356)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>117</td>
<td>60%</td>
</tr>
<tr>
<td>No</td>
<td>239</td>
<td>54%</td>
</tr>
<tr>
<td>Self-rated knowledge of patient safety (n = 373)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At or below average</td>
<td>198</td>
<td>54%</td>
</tr>
<tr>
<td>Above average</td>
<td>175</td>
<td>58%</td>
</tr>
<tr>
<td>Intended specialty (n = 352)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary care a</td>
<td>129</td>
<td>58%</td>
</tr>
<tr>
<td>Medicine/pediatrics subspecialty</td>
<td>35</td>
<td>58%</td>
</tr>
<tr>
<td>Surgical specialtyd</td>
<td>98</td>
<td>57%</td>
</tr>
<tr>
<td>Other specialtyb</td>
<td>90</td>
<td>54%</td>
</tr>
<tr>
<td>Previous formal or informal education about patient safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n = 374)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>339</td>
<td>57%</td>
</tr>
<tr>
<td>No</td>
<td>35</td>
<td>47%</td>
</tr>
</tbody>
</table>

*Means and P-values are based on 2-sample t-tests or 1-way analysis of variance for variables with more than 2 categories; correlations and P-values are based on Pearson’s correlation.

bIncludes students doing research, pursuing an MPH or PhD degree, or taking a leave of absence.

cPrimary care specialties include medicine, family medicine, medicine/pediatrics, and pediatrics.

dSurgical specialties include general surgery, orthopedics, ophthalmology, otolaryngology, plastic surgery, thoracic surgery, vascular surgery, urology, obstetrics and gynecology, and neurosurgery.

Factors associated with greater knowledge of QI. On the QI knowledge items, students in their clinical years performed the same as preclinical students, with an average score of 56% for both groups; however, students who were pursuing an advanced degree, doing research, or on a leave of absence performed significantly better than the other 2 groups, with an average score of 64% (P = .02; Table 5). Students who reported previous formal or informal education about QI performed significantly better than those who did not (60% vs 54%; P = .004). Students’ intended specialty was also associated with their QI knowledge score; the average score for students entering primary care was 62%, compared with 55% for students entering surgery, 54% for students entering medical or pediatric subspecialties, and 57% for those entering other specialties. Sex, having or pursuing an advanced degree, and self-rated QI knowledge were not associated with students’ QI knowledge scores.

After adjustment, previous exposure to QI continued to be significantly associated with higher QI knowledge scores (Table 6). Students who had previous exposure to QI had an adjusted average knowledge score of 60%, versus 55% for students with no previous patient safety education (P = .02).

**Discussion**

Our study found that, overall, students’ knowledge of patient safety and QI is low. Exposure to formal or informal QI education during medical school is limited—only 47% of respondents to our survey reported previous exposure to such education. Patient safety education is more common, with 79% of students reporting previous exposure. Overall, we found that previous exposure to patient safety or QI is associated with improved knowledge of the topic, which suggests that patient safety and QI education is effective.

Previous studies have also found that education on patient safety or QI improves students’ knowledge [7, 8]; our study helps to affirm this finding. A study of residents and medical students at Harvard Medical School [22], which used the same validated patient safety knowledge questions from which we adapted our patient safety questions, had results similar to those of our study. The Harvard study participants answered a mean of 58.4% (SD = 15.5%) of questions correctly, compared with 56% (SD = 25%) for our participants. Participants in the Harvard study who were in a

<table>
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<tr>
<th>TABLE 4. Adjusted Comparisons Between Student Characteristics and Patient Safety Knowledge Scores</th>
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<tbody>
<tr>
<td>Characteristic</td>
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<tr>
<td>-----------------------------------------------------------------------------------------------</td>
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<tr>
<td>Holds or is pursuing an advanced degree</td>
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<tr>
<td>Yes</td>
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<td>No</td>
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<tr>
<td>Previous formal or informal education about patient safety</td>
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<tr>
<td>Yes</td>
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<td>No</td>
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*Based on beta estimates from a multiple linear regression model, adjusted for advanced degree and previous exposure to patient safety.
in medical school (n = 347)
  Preclinical (year 1 or year 2)  136  56%  .02
  Clinical (year 3 or year 4)  162  56%  .02

Year in medical school (n = 347)
  Preclinical (year 1 or year 2)  136  56%  .02
  Clinical (year 3 or year 4)  162  56%  .02

Race (n = 341)
  White  242  60%  <.001
  Nonwhite  99  50%  .14

Holds or is pursuing an advanced degree (n = 346)
  Yes  115  60%  .07
  No  231  56%  .02

Self-rated knowledge of QI (n = 349)
  At or below average 240  56%  .06
  Above average 109  61%  .12

Adjusted Comparisons Between Student Characteristics and Quality Improvement (QI) Knowledge Scores

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean percentage of questions answered correctly</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Race (n = 341)</td>
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<tr>
<td>White</td>
<td>242  60%</td>
<td>&lt;.001</td>
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<tr>
<td>Nonwhite</td>
<td>99   50%</td>
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<tr>
<th>Year in medical school (n = 347)</th>
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<tr>
<td>Preclinical (year 1 or year 2)</td>
<td>136  56%</td>
<td>.02</td>
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<tr>
<td>Clinical (year 3 or year 4)</td>
<td>162  56%</td>
<td>.02</td>
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<tr>
<th>Intended specialty</th>
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<tr>
<td>Primary care</td>
<td>126  62%</td>
<td>.04</td>
</tr>
<tr>
<td>Medicine/pediatrics subspecialty</td>
<td>35   54%</td>
<td>.05</td>
</tr>
<tr>
<td>Surgical specialty</td>
<td>93   55%</td>
<td>.02</td>
</tr>
<tr>
<td>Other specialty</td>
<td>88   57%</td>
<td>.03</td>
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<table>
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<tr>
<th>Previous formal or informal education about QI (n = 349)</th>
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<th></th>
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<tbody>
<tr>
<td>Yes</td>
<td>198</td>
<td>60%</td>
</tr>
<tr>
<td>No</td>
<td>151</td>
<td>54%</td>
</tr>
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*Means and P-values are based on 2-sample t-tests or 1-way analysis of variance for variables with more than 2 categories; correlations and P-values are based on Pearson’s correlation.
+Includes students doing research, pursuing an MPH or PhD degree, or taking a leave of absence.
Secondary care specialties include medicine, family medicine, medicine/pediatrics, and pediatrics.
Surgical specialties include general surgery, orthopedics, ophthalmology, otolaryngology, plastic surgery, thoracic surgery, vascular surgery, urology, obstetrics and gynecology, and neurosurgery.
Other specialties include anesthesia, dermatology, emergency medicine, medicine/psychiatry, neurology, nuclear medicine, pathology, physical medicine and rehabilitation, preventive medicine, psychiatry, radiation oncology, and radiology.

In our study, students’ intended specialty was not associated with their patient safety knowledge scores; similarly, our study found that students holding or pursuing an advanced degree performed better. We are unsure whether the better performance is due to increased education, increased interest in these topics, or both.

In the Harvard study, however, medical specialty was associated with participants’ patient safety knowledge scores; students and residents intending to specialize in emergency medicine or medicine performed better than those entering other specialties [22]. This difference could be explained by differences in residency education, since the Harvard study included residents as well as medical students; in contrast, our study only included medical students, all of whom receive similar education regardless of their intended specialty.

The literature on QI education for medical students is sparse, but studies have found that previous exposure is associated with improved knowledge. Two single-center studies of implemented QI curricula found that students’ knowledge improved [7, 23]. The results of our study are consistent with this finding, which adds to this growing body of evidence.

Our study has several possible limitations. There is a risk of measurement bias due to the use of an unvalidated instrument to generate a QI knowledge score. Items in the patient safety knowledge test were adapted from a validated test, but our version was shortened, possibly limiting the applicability of the previous validation. There is also a risk of recall bias, as students who have greater knowledge of patient safety or QI might recall exposure to patient safety or QI education at a greater frequency, inflating the association between exposure and knowledge. There are many factors that influence changes in students’ knowledge and attitudes; given that this is a cross-sectional study, we cannot draw conclusions about causality. There is minimal risk of nonresponse bias, as we have shown that the demographic characteristics of survey participants were similar to those of the entire medical school student body. We did not require that the students respond to every question on the survey, which resulted in a variable number of participants for each question. Our study may have limited generalizability because it was conducted at only one medical school. The UNC School of Medicine is a large public institution.
with a focus on primary care and research. Therefore, UNC students might have more exposure to patient safety and QI education than students at other institutions. Finally, a large number of students attending the UNC School of Medicine also participate in the university’s MPH program, which significantly increases their exposure to patient safety and QI topics.

Conclusion

Our study found that previous exposure to patient safety and QI education is associated with improved knowledge about these topics, which helps to support the argument for increased education on patient safety and QI during medical school. Further multicenter research is needed to determine the most effective methods for teaching these topics and to determine whether teaching medical students about patient safety and QI actually helps to improve patient care and to decrease morbidity and mortality [25]. Given the AAMC endorsement of patient safety and QI education for medical students, curriculum development and assessment are currently at the forefront of medical education. NCMJ

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Acknowledgments

Potential conflicts of interest. All authors have no relevant conflicts of interest.

All authors read and approved of the final manuscript.

References


POLICY FORUM

Training Tomorrow’s Health Professionals

Introduction

It is tempting to say that what goes around comes around. Certainly the new educational projects and programs described in this issue of the NCMJ have built on prior innovations, and the popularity of various educational methods sometimes seems as cyclic as fashion trends. At the same time, some of what seems new really is new, and when it comes to health professions education, the difference between today’s initiatives and their progenitors is akin to the shift from black-and-white television to Technicolor.

During my medical school training, much if not all of our classroom time was offered as self-learning modules. The instructors gave regular lectures, but it was acceptable to pick and chose—to attend all of them or to skip the lecture hall altogether to study page after page of the Xeroxed curriculum in all its detail (and all its obfuscation, to tell the truth). We did not have to take exams at the end of each module. Instead we would study for what we felt was most urgent and then anonymously take the test, labeling our papers with any eccentric identifier we adopted. The catch was that the end-of-year tests were required, and pass or fail were the only possible outcomes. My cohort was also among the first to take full advantage of the North Carolina Area Health Education Centers (AHEC) program, which encouraged—and sometimes required—that we attend clinical rotations off site, leaving our collegial learning and peer-support networks miles behind.

Those days are a far cry from today’s health professions education. Computers, webcasts, and telelearning are now the norm, and additional dedicated faculty have been added to AHEC, enhancing on-the-ground training. We not only allow but often require that students leave the golden towers of academia to learn in the community, and longitudinal clerkships and similar programs are offering alternatives to intermittent, short, and joltingly unrelated clinical rotations. Today we also try to make it easier for students to choose a career in nursing, pharmacy, or clinical practice that acknowledges their commitments to their family and their community, not to mention the financial debt that can strangle ongoing career advancement. By recruiting talented and ambitious students and providing immersive experiences, we make it more likely that students will bring advanced health care to the communities where we live, work, play, and learn.

Peter J. Morris, MD, MPH, MDiv
Editor in Chief
Innovations in the Education of Health Professionals

Thomas J. Bacon, Warren P. Newton

Dramatic and unprecedented changes in health care have altered the health care landscape and have significant implications for health professions education. This issue of the NCMJ explores these changes and highlights innovative models across the health professions that are designed to prepare graduates to practice in the emerging health care system and to deliver high-quality care in a cost-effective manner. These new educational programs—which include training for future doctors, nurses, dentists, pharmacists, and various allied health professionals—aim to prepare providers to meet the needs of North Carolina communities, and they use new educational models to give graduates the competencies they need to practice in health care teams and to contribute in other ways to improved health outcomes for the people of the state.

Health care is in a period of dramatic and unprecedented change. Responding to society’s demands for high-quality, lower-cost health care, health systems are consolidating into large integrated networks of institutions and providers. Accountable care organizations are being formed to align goals and resources, to improve efficiency, to focus on the overall health of the population, and to give patients a better experience of care [1]. The greater focus on population health also means that the definition of health care must be broadened beyond traditional clinical settings to include community organizations and new types of health professionals and auxiliary staff.

The rapid changes in health care organization have significant implications for health professions education. Numerous reports have emphasized the need for clinicians who can practice evidence-based medicine, make better use of technology to deliver high-quality care, and work as members of interdisciplinary teams to provide patient-centered care [2]. Reflecting the spirit of the times, the American Medical Association recently announced that it was offering $11 million to fund innovations in undergraduate medical education, and 82% of the nation’s 141 medical schools applied to compete for funding. Ten schools received grants, including the Brody School of Medicine at East Carolina University (ECU). In nursing education, the Institute of Medicine’s report The Future of Nursing: Leading Change, Advancing Health [3] and work by the Robert Wood Johnson Foundation have catalyzed programs to increase the number of baccalaureate-degree nurses, to further the development of nurse clinicians, and to offer doctorate of nursing practice (DNP) degrees [4-6].

North Carolina is experiencing the same dramatic changes in the organization of health care as those occurring nationwide. According to President of the North Carolina Hospital Association William Pully, the number of independent hospitals has decreased in the past 2 years from 142 to 24 (personal conversation; August 22, 2013). The North Carolina Medical Society has reported similar consolidation in the ownership of physician practices, including a decline in the number of independent cardiology practices from 196 to 4 between 2009 and mid-2011 [7]. Moreover, almost all of the integrated health systems in North Carolina have adopted either Epic or Cerner electronic health record systems over the past several years, and there has been rapid growth in the numbers of patient-centered medical homes and accountable care organizations.

Demographic changes are amplifying these effects. Over the past 2 decades, North Carolina has been one of the fastest-growing states in the United States, and as the state’s population approaches 10 million, North Carolina is now the 10th most populous state in the country [8]. The state's population is also aging at a slightly higher rate than the national average, accelerating the ongoing increase in the number of patients with chronic diseases. Finally, the growth rate of North Carolina’s Latino population is one of the highest in the country, and underrepresented minorities now make up approximately 33% of the state’s population [9]. North Carolina thus needs to increase its supply of health professionals, to update their skills to practice 21st-century health care, and to improve the diversity of the workforce—all at a time when the model of care is changing dramatically and state investments in education are shrinking.

In response to the dramatic changes occurring in the health care system, changes are also under way in the education of North Carolina’s health professionals. This issue
of the NCMJ explores these changes and highlights how educational programs across various health professions are using innovative models to prepare graduates to practice in a rapidly changing health care system.

**Health Professions Education in North Carolina**

North Carolina has a rich set of resources for educating its future health care workforce and for retraining the existing workforce to meet the demands of the changing health care system. The state is home to 5 medical schools, 16 baccalaureate-degree nursing programs, 59 associate-degree nursing programs, 3 pharmacy schools, 2 dental schools, and a wide array of allied health degree programs at community colleges, private colleges and universities, and campuses of the University of North Carolina (UNC) system.

The North Carolina Community College System is the largest producer of nursing and allied health graduates in the state. The commentary by Batts in the current issue [10] describes the breadth of health science programs that are offered at the state’s 58 community colleges and the contributions these programs have made to the state’s health care workforce. In addition to providing an overview of these programs, Batts describes a comprehensive effort to improve the retention of at-risk students, thereby strengthening the capacity of community colleges to prepare graduates for service in the state’s health sector.

The academic health centers have experienced substantial student growth in the past 5 years, both through increased enrollment at existing campuses and through the addition of a new osteopathic medical school at Campbell University. The UNC School of Medicine has increased enrollment from 160 students per class to 180 students per class [11], and it has accommodated that growth by adding 2 clinical campuses—one at Carolinas Medical Center in Charlotte and another in Asheville, the latter of which is operating in association with Mission Health and the Mountain Area Health Education Center. ECU Brody School of Medicine has also grown modestly in the past 3 years, from 75 students per class to 80 students per class [12]. Finally, Campbell University admitted its first class of 160 medical students in 2013, and it will be the second largest school in the state once it reaches a full complement of classes in 2016 [13].

The number of advanced practice nurses in North Carolina has grown significantly in the past 25 years, primarily as a result of the large number of degree programs for nurse practitioners (NPs). Eight universities in the state (6 public and 2 private) offer NP graduate programs, and enrollment in these programs has grown steadily in recent years. In addition, most of these programs are in the process of seeking approval (or have already received approval) to convert their master’s level NP programs to doctoral programs that would allow students to earn a DNP degree.

For some time, North Carolina has been home to 4 physician assistant (PA) programs—at Duke University, Wake Forest University, Methodist University, and ECU. In the past 2 years, new PA programs have been established at Campbell University, Elon University, High Point University, and Gardner-Webb University. UNC Chapel Hill also recently announced its intention to establish a PA program in collaboration with the US Army Special Forces Command at Fort Bragg; this program is designed to give Special Forces medics an educational pathway to a PA degree. Finally, there is a new rural-track PA program that is a joint venture between Wake Forest University and the College of Health Sciences at Appalachian State University (ASU).

Several UNC campuses have created new schools of allied health sciences, and others are consolidating allied health degree programs that were historically housed elsewhere, such as in schools of education. As noted by Thomas in his commentary in this issue [14], ASU has opened a new College of Health Sciences with both new and relocated degree programs in the health fields. Similar consolidations are occurring at UNC-Charlotte and UNC-Wilmington. Private universities are also adding new allied health programs, including several new programs in physical therapy, occupational therapy, and other allied health fields. Although there has been a modest expansion of health programs at the campuses of the UNC system and at community colleges, the largest growth over the past decade has been at a number of private colleges and universities. In addition to a new PA program, High Point University is planning a new doctor of pharmacy (PharmD) program. New nursing and allied health degrees are also being planned or are already being offered at a number of other campuses.

The North Carolina Area Health Education Centers (AHEC) program serves as an important resource in developing health professionals for the state. Through its many programs across the state, AHEC promotes opportunities in health professions for underrepresented minorities. AHEC also serves as a primary vehicle for coordinating and supporting the placement of health science students from academic health centers in community sites for part of their clinical training; nearly 2,000 community preceptors across the state give students real-world experiences that complement their on-campus course work and clinical experiences. AHEC’s 16 primary care residencies are a major source of family physicians, pediatricians, general internists, obstetricians, and general surgeons. AHEC is also the largest provider of continuing education for health professionals in the state; nearly 200,000 providers attend AHEC-sponsored continuing education programs each year. In addition, AHEC provides site-based education for providers through its practice support services; it currently works with more than 1,100 practices in the state, which have a total of more than 4 million patients [15].

**Trends Affecting the Education of Health Professionals**

Several trends have implications for the education of health professionals: changes in the organization of health...
care, shortages of providers, suboptimal distribution of providers, and changes in the setting of care. More emphasis is also being placed on interprofessional teams, population health improvement, technology-assisted simulation, and distance learning.

Changes in health care organization. Dramatic changes are occurring in the way that health care is organized, and health care institutions and providers are seeking to develop systems that can enhance quality of care while reducing waste and lowering costs [16]. As the development of accountable care organizations and patient-centered medical homes continues, care will increasingly be moved out of the hospital and into primary care and community settings, which will create a need for enhanced care coordination, more effective use of information technology in the clinical setting, and improved care transitions. Health professions education lags behind on many of these changes because of the separation of the educational process from care delivery and because of the silo effects of having separate schools of medicine, nursing, pharmacy, and other health care fields [17]. This separation must be bridged if the health care system of the future is to function effectively.

Shortage and distribution issues. With a rapidly growing and aging population and a larger-than-average cohort of health professionals who are due to retire over the next decade, it seems increasingly likely that North Carolina will experience a shortage of primary care providers, nurses, rehabilitation professionals, and other types of health professionals in the years ahead. North Carolina has been a net importer of health professionals of all types for many years, and it may be that future needs can be met by increasing efforts to recruit and retain providers from other states. However, if we assume that other states are going to redouble their efforts to keep graduates closer to home, then the educational infrastructure in North Carolina will likely need to expand to keep up with the growing demand for providers.

Although there are differing views regarding the severity of the shortage of health professionals in the state, there is broad consensus that North Carolina has serious problems with regard to specialty distribution and to the geographic distribution of both primary care providers and specialists. Of the state’s 100 counties, 86 are currently designated by the federal government as whole-county or part-county primary care health professional shortage areas (HPSAs) [18]. Numerous policy and programmatic efforts have been made over the years to address these geographic imbalances, including scholarship and loan repayment programs, targeted recruitment efforts, and educational programs whose location and focus is designed to prepare graduates who are more likely to remain in the state and to practice in underserved communities. AHEC primary care residencies, especially in family medicine, were established to address this issue, and 2011 data show that 53% of AHEC primary care residency graduates remained in the state to practice, compared with only 32% of those who completed a non-AHEC residency; AHEC residency graduates were also slightly more likely to settle in a nonmetropolitan county [19]. Two articles in this issue [20, 21] describe innovative residency programs that are extensions of the AHEC concept and are designed to prepare family physicians and primary care pediatricians for practice in rural areas or smaller communities.

Previous studies of rural-track family medicine residencies have shown that graduates of such residencies are much more likely to practice in rural areas or other communities in which there is a shortage of providers. A study of residents who trained in safety-net settings showed that higher percentages of graduates of these programs chose to practice at safety-net sites, such as rural health clinics, federally qualified health centers, and critical access hospitals [22, 23]. A sidebar in this issue by Crane and Jones [20] highlights the outcomes of the rural-track family medicine residency program in Hendersonville and shows that more graduates of this program have settled in rural communities and in counties designated as HPSAs. Both the kinds of residents recruited to the program and the curriculum are designed to maximize the likelihood that graduates will eventually practice as family physicians in a rural community, preferably in North Carolina.

The Pediatrics Primary Care Residency Program at the UNC School of Medicine, which is described in this issue by Byerley and Gable [21], was started in 2011 and will graduate its first class in 2014. The program is a joint effort of the UNC Department of Pediatrics and the Pediatric Teaching Program at Cone Health in Greensboro, and it is designed to prepare primary care pediatricians who will practice in North Carolina. An unexpected benefit of the program is that the residents in this program are thus far more racially and ethnically diverse than are residents in the standard pediatrics program at the UNC School of Medicine.

Changes in educational settings. As care increasingly moves out of the hospital and into ambulatory and primary care settings, the education of health professions students is moving as well. North Carolina has a long history of reliance on community preceptors for providing a substantial portion of students’ educational experiences, and many of these preceptor arrangements are facilitated by the AHEC infrastructure. For example, nearly 60% of the required clinical experiences of students at the UNC School of Medicine occur at AHEC sites across the state (unpublished data from W.P.N., former vice dean for education, UNC School of Medicine). Although the trend to move training out of the hospital and into the outpatient setting is usually positive for students, it has significant implications for how education is paid for, how faculty and community preceptors are organized and prepared to teach, and the administrative infrastructure required to assure high-quality educational experiences for students.

Several articles in this issue speak to innovations in community-based teaching of students. The commentary by
Chadwick, Wilson, and Anderson [24] provides an overview of the community service learning centers being developed by ECU School of Dental Medicine. ECU is effectively creating mini-campuses at 10 sites across the state, which will have full-time faculty, residents, and students—along with all of the clinical staff needed to operate a teaching dental practice.

Another new program designed to prepare primary care providers for rural practice in the state is a joint venture between the PA program at Wake Forest University and the College of Health Sciences at ASU. As described in this issue by Bushardt, Whitt, and Gregory [25], this program will admit its first class in 2014 and will focus on recruiting students from the mountains. Students will spend most of the first year of the program on the ASU campus in Boone, North Carolina, which will hopefully stimulate their interest in practicing in a rural mountain community.

**Health care teams and interprofessional education.** Increasingly, care is being organized around teams of providers as a strategy to improve care and reduce costs. The educational system must therefore adapt and develop new models for interprofessional education in the classroom and in the clinical practice setting. Creating high-quality interprofessional experiences at specific sites—such as hospitals, primary care practices, or health departments—has proven challenging historically, due to differing lengths of rotations, differing curricular objectives for each health professions school, and the need for additional staff and faculty to coordinate such experiences.

In spite of these challenges and the lack of clearly identified funding streams, there are encouraging signs that interprofessional education will receive a much stronger focus in the coming years. The commentary by Baxley and Cunningham [26] speaks to the important role that health professions education can play in systems improvement, including controlling costs and reducing errors. They describe a series of initiatives under way at ECU, both within the Brody School of Medicine and in partnership with the other health science schools on the campus. These initiatives offer a multidimensional, multidisciplinary approach to educating health professionals with the aim of preparing graduates who can function effectively in a changing health care system.

**New competencies needed in an era of reform.** As dramatic change continues to take place in how health care is organized and delivered, new competencies are required. In addition to a strong foundation of medical knowledge, health professionals also need to have a thorough knowledge of population health, systems of care, quality improvement, and behavioral health. Providers must also learn how to work in teams and how to use health information technology to enhance care and care coordination, and they must have strong communication skills. These competencies are increasingly being included in the requirements of national educational accrediting bodies, but it can be challenging to operationalize them effectively in the didactic and practicum curricula.

Improving the health of populations is a critical societal need. Over the past decade, several new public health training programs have opened at universities in North Carolina, the UNC School of Medicine has added population health as a core competency for all medical students, and a number of DNP programs have begun to include population health in their curricula. The commentary by Sheline and colleagues [27] describes efforts by Duke University School of Medicine to incorporate population health and leadership into its curriculum, both for medical students and for family medicine residents. The Primary Care Leadership Track at Duke, which was launched in 2011, offers a special curriculum in population health, leadership, quality improvement, and related topics to a select group of students who plan to pursue leadership positions in primary care. The curriculum includes both didactic work and community-based experiences, including an 8-month longitudinal integrated clerkship. For family medicine residents, the Population Health Improvement and Leadership curriculum includes topics specific to primary care, a journal club, and small-group discussion sessions.

In response to the need for new competencies, a number of schools and programs are changing how the educational process is organized. The commentary by Heck, Latessa, and Beaty [28] describes the longitudinal integrated curriculum offered to third-year medical students at the Asheville campus of the UNC School of Medicine. Launched in 2009, the program’s longitudinal integrated clerkships are designed to enhance student participation in the comprehensive care of a group of patients over time. This longitudinal curriculum also gives students a continuous learning relationship with supervising clinician-preceptors, most of whom are practicing clinicians rather than full-time faculty. Heck and colleagues describe the success and growth of the Asheville campus, the early outcomes of the students participating in the longitudinal curriculum, and the high level of satisfaction with the model by patients, students, and faculty [28].

New models of education are also taking advantage of technology and simulation in organizing and delivering content for students and are changing the way faculty and students relate to one another. As described by Roth and colleagues [29], the Educational Renaissance initiative undertaken by the UNC Eshelman School of Pharmacy aims to prepare pharmacists for the role they will play in a health care system that provides high-quality, cost-effective, patient-centered care. Important elements of the new curriculum include delivering key content outside of class through self-directed modules, thus freeing up classroom time for faculty-student interaction and higher forms of thinking; fostering scientific inquiry and innovation to encourage critical thinking and to position students to be change agents; and rethinking the admissions process in order to admit students with the skills needed for the health care system of the future.

Campbell University School of Osteopathic Medicine is using technology-assisted simulation to strengthen the
training of students in order to achieve better outcomes in knowledge, skills, and behavior. As described in the commentary by Maddox and Schmid [30], the school is using simulation as an adjunct to patient care experiences. The school’s new simulation center includes objective structured clinical examination (OSCE) suites, for teaching and testing communication skills, physical exam skills, and clinical assessment skills; a virtual hospital, which offers training in a variety of advanced skill areas; and an acute care area, where patient simulators represent critically ill patients in a range of clinical case scenarios.

Nurses are the largest group of health professionals and are major contributors in transforming the way health care is delivered. Thus nursing is being challenged to significantly increase the educational preparation of its workforce. The commentary by Johnson [4] describes an innovative model for increasing the number of registered nurses who are able to complete a baccalaureate degree. By utilizing the strengths of both the community college system and the public university system in North Carolina, the Regionally Increasing Baccalaureate Nurses (RIBN) initiative allows students, particularly those in rural communities, to access an affordable bachelor of science in nursing (BSN) program early in their careers. Students are dually admitted to an associate degree in nursing (ADN) program at a community college and to a BSN program at a partner university, and they are able to complete both the ADN and the BSN degree in 4 years, while also gaining work experience. A sidebar by Dickerson [5] describes how the RIBN initiative is being implemented in a rural community college in Eastern North Carolina.

In an effort to address high-priority workforce issues and to maximize the strengths of existing institutions, universities are collaborating on several new degree initiatives. The commentary by Brandon and colleagues [6] describes a partnership between Duke University School of Nursing and Winston-Salem State University (WSSU) Division of Nursing that aims to increase the representation of ethnic minority nurses in research-focused doctoral programs. This Bridge to the Doctorate program combines a research honors track in WSSU’s master of science in nursing (MSN) program with mentored research experiences and enhanced course work, all of which are designed to ensure that participating students are highly competitive for entrance into Duke’s biomedical and behavioral science PhD programs in nursing and related disciplines.

Overton [31] describes another collaborative program: a new postprofessional baccalaureate degree program in neurodiagnostics and sleep science (NDSS), which is a joint effort of the Department of Kinesiology in the College of Health and Human Services at UNC-Charlotte and the Departments of Allied Health Sciences and Neurology at the UNC School of Medicine. The NDSS program uses distance-learning technology to give sleep science professionals an opportunity to earn a baccalaureate degree while remaining in their communities.

Looking Forward

Health care in North Carolina is undergoing transformative change, and this issue of the NCMJ highlights educational programs in various professions that are designed to anticipate and to catalyze that change. We need to prepare the next generation of health care professionals to practice in a health care system that must improve quality and patient experiences while lowering costs. As educators, our challenge is both to increase the workforce to keep up with population growth and the explosion of chronic disease, and to change the model of care to help improve the performance of the health care system.

As the articles in this issue illustrate, there is a natural opportunity for innovation in the collaboration between academic centers and community care, and such collaboration has long been a defining characteristic of health professions education in North Carolina. However, we are just at the beginning of the process, and our curricula must continue to evolve. To facilitate progress, we must insist on evaluating outcomes, sharing both successes and failures across communities and professions, and developing the organizational and financial structures necessary to sustain innovative curricula that produce good outcomes.

Finally, it is important to keep in mind that educational reform is broader than the initial phases of health professional training that are the focus of this issue. Health care reform and its associated changes are creating a demand for new kinds of professionals, including quality improvement consultants, primary care case managers, and new kinds of community workers. We must identify and evaluate these new professional roles, and the individuals filling these roles will need training paths, career ladders, and regulation. Even more important is the development of more effective ways of retraining the current health workforce. We do not have time to wait for the current workforce to age out; instead we must train both today’s and tomorrow’s health care professionals in the competencies required by the changing health care system. NCMJ

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Acknowledgments

Potential conflicts of interest. T.J.B. and W.P.N. have no relevant conflicts of interest.

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The Pediatrics Primary Care Residency Program at the University of North Carolina

Julie Story Byerley, Kaye Gable

The Pediatrics Primary Care Residency Program at the University of North Carolina School of Medicine will graduate its first class in 2014. Funded by the Health Resources and Services Administration through the Patient Protection and Affordable Care Act, this innovative program has a unique curriculum that offers several benefits, but sustainability of the program remains a challenge.

Like medical practice, graduate medical education is changing dramatically. Because of changes in regulations limiting duty hours and increasing expectations for documentation, residency schedules are more demanding than in the past. At the same time, the knowledge base in the literature has expanded and can overwhelm the resident learner. Greater pressure to be productive reduces residents’ contact with attending physicians, and increasing faculty subspecialization raises questions about the relevance of general training. In large programs with rotation schedules that place residents in different clinical settings every 4 weeks, mentoring relationships between faculty members and residents have little time to develop.

In an effort to meet workforce needs, US medical schools have expanded class sizes, and new medical schools have opened [1]. Although more physicians are being taught, shortages will not be adequately addressed unless residency training positions are available for these graduates. In addition to the need for more residency slots, pediatric graduate medical education must take into account that today’s patient population is more medically and socially complex than in the past, and residents in pediatric primary care must be prepared to provide a medical home for these patients [2]. Also, because of changes in medical practice, the knowledge and skills needed to succeed in a primary care practice after residency differ from those needed to succeed in a pediatric subspecialty fellowship.

One strategy for preparing physicians to function effectively in a more complex work environment is to focus their education. The pediatric education community has recognized this, and as of July 1, 2013, the American Medical Association’s Residency Review Committee for Pediatrics requires that each resident have “individualized” training for at least 6 of the 36 months of required training; training during those 6 months should be determined by the learning needs and career plans of each resident [3]. The Department of Pediatrics at the University of North Carolina (UNC) School of Medicine has begun to individualize training in a variety of ways. Although the department has 29 interns training in pediatrics each year, there are 6 different match lists to fill those spots, and within the categorical program, residents can choose from 4 different concentrations (Table 1).

In this commentary we would like to highlight one particular UNC program, the Pediatrics Primary Care Residency Program, which has an innovative curriculum that recognizes and addresses the challenges of today’s graduate medical education. This program provides an individualized education focused on the learner’s needs and offers a smaller setting that ensures mentorship. The curriculum is tailored to produce practicing pediatricians who will be better prepared...
Innovation in Rural Family Medicine Training: The Mountain Area Health Education Center’s Rural-Track Residency Program

Steven Crane, Geoffrey Jones

The Mountain Area Health Education Center (MAHEC) established the Hendersonville Family Medicine Residency Program in 1994 as a rural-track training program to address the growing shortage of primary care physicians in rural North Carolina. Designed to develop successful rural health physicians, the program originally started with only 2 residents per class (for a total of 6 residents) in Hendersonville, North Carolina, a small town with a population of only 12,000 people in 2012 [1]. The program now has 4 residents in each class. The curriculum features robust obstetrical and procedural training, flexible elective time, and a strong emphasis on practice management and community leadership. The program has been continually accredited and has filled all of the resident positions offered each year since 1996; the teaching practice now provides more than 20,000 outpatient visits per year.

In addition to training rural family physicians, the program has been a catalyst for improving the quality of primary care and increasing access to care. It has responded to a variety of community health needs by providing direct patient care to uninsured patients, to those with significant behavioral health needs, and to the region’s growing Latino population. The program has also provided medical leadership for the Henderson County Department of Public Health, and it was a key partner in the coalition of community health organizations that established the Free Clinics of Henderson County.

The program was an early adopter of practice redesign [2], team-based care, group medical visit models, and the integration of behavioral health care with primary care. It was also the first practice in Henderson County to achieve Level 3 recognition as a patient-centered medical home from the National Committee for Quality Assurance. In addition, the program conducted a regional pilot program on near-miss errors in ambulatory settings, which was sponsored by the Agency for Healthcare Research and Quality [3]; it created an innovative model of low-overhead outpatient practice [4]; and it adopted a drop-in group medical visit model for high-risk uninsured patients [5]. The program also allowed community physicians to use the same electronic medical record system as the residency practice at a greatly reduced cost, which resulted in a unified health record for most patients in Henderson County [6].

In 2007 the Hendersonville Family Medicine Residency Program was 1 of only 14 family medicine residency programs in the United States chosen to participate in the Preparing the Personal Physician for Practice (P4) project, which was designed to test new models of residency education and to train physicians to lead patient-centered primary care health teams [7]. The program also sponsors summer experiences designed to increase North Carolina medical students’ interest in rural health careers [8]. The program recently received a Teaching Health Center grant, which was authorized by the Patient Protection and Affordable Care Act of 2010; this grant allowed the program to increase its complement of residents to 4 per year while merging clinical operations with the local federally qualified health center [9].

Since 1999 the program has graduated 37 family physicians, all of whom passed their certification boards; 24 of these individuals were graduates of US allopathic medical schools, 6 were graduates of US osteopathic schools, and 7 were international medical graduates. Of these 37 graduates, 57% practiced in North Carolina for at least 3 years; to enter primary care and to provide high-quality care for children in a medical home setting.

Development of the UNC Pediatrics Primary Care Residency

The Department of Pediatrics at UNC has had a long-standing collaborative relationship with the Pediatric Teaching Program at Cone Health in Greensboro, North Carolina. Residents from UNC rotate through Cone Health’s community hospital to see general pediatrics cases and to gain experience at Guilford Child Health, an award-winning, public-private partnership clinic that serves high-need, low-resource children in Guilford County. Co-locating providers of primary care and subspecialty services with social workers, mental health providers, and nutrition professionals gives patients access to most services in their medical home. UNC adjunct faculty members teach and practice in these settings. We felt that the site was underutilized for teaching future pediatricians, but residency requirements demand that all pediatrics residents receive training from a significant number and variety of subspecialist pediatricians, who usually practice in children’s hospitals and academic health centers. Cone Health does not have the subspecialty faculty to house its own pediatric residency, but it is an outstanding place to collaboratively build a focused track. In this track, generalist pediatric education is concentrated in the clinics, nursery, and hospital setting in Greensboro, and subspecialty teaching takes place in Chapel Hill.

With the passage of the Patient Protection and Affordable Care Act in 2010, grants from the Health Resources and Services Administration (HRSA) became available for primary care residency expansion [4]. This opportunity catalyzed the initiation of the UNC Pediatrics Primary Care Residency Program, which was funded with a $3.7 million award to support 4 incoming interns per year for 5 years. This award provides salaries and benefits for the residents and covers their educational expenses; grant funds cannot be used to support faculty time or program administration.
65% practice in rural communities; 60% work in a location
that has been designated by the US Department of Health & Human Services as either a full or partial health profes-
sional shortage area; 16% are full-time faculty members
of family medicine residency programs; and 22% went on
to complete a 1-year fellowship in geriatrics, advanced ob-
stetrics, or international medicine. These results compare
very favorably with those of rural-track training programs
in other regions of the United States [10].

Rural-track training programs have generally been sig-
ificantly more successful than traditional family medicine
residencies in placing graduates in rural or underserved
Residency Program has also made significant contribu-
tions in terms of improving access to primary care in its
service area and developing new models of care. These
successes warrant further investigation to discover how
such training experiences can be scaled to address North
Carolina’s continuing shortages of rural primary care phy-
sicians. NCMJ

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Potential conflicts of interest. S.C. and G.J. are employees of
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For each of the 3 years since it began operating, the pro-
gram has successfully filled all offered positions through
the National Resident Matching Program. The first class
will not graduate until June 2014, so data are limited, but
the program appears to be meeting the goal of producing
primary care providers, especially those who will practice
in underserved areas. Currently all 12 of the residents who
are enrolled in the first, second, or third year of the program
intend to pursue a career in primary care pediatrics.

Curriculum

The curriculum of the Pediatrics Primary Care Residency
Program is unique. Each resident spends at least 6 months
per year in the Cone Health system, during which time they
have daily contact with a small group of 8 general aca-
demic pediatricians. These residents have continuity clinic
at Guilford Child Health, which is now a federally qualified
health center. The clinic experience of the pediatrics pri-
mary care residents is very different from that of residents
who participate in a traditional continuity clinic. Most pedi-
atrics residents spend only 1 half-day per week in the contin-
uity clinic, but pediatrics primary care residents work and
learn in the continuity clinic across many rotations. That
experience allows for longitudinal exposure to the same
patient population. And because the pediatrics primary
care residents work in newborn nursery, clinic, and hospi-
tal settings, they often have the opportunity to follow the
same patient across multiple clinical venues. Thanks to the
longitudinal design of the curriculum, the pediatrics primary
care residents spend approximately 50% more time at their
home continuity practice site than do categorical pediatrics
residents.

Another unique aspect of the pediatrics primary care resi-
dency program is that required experiences in ado-
lescent medicine, behavior and development, advocacy,
and acute care are delivered longitudinally rather than in
blocks. Pediatrics primary care residents have the oppor-
tunity to see their own continuity patients with pediatrics
subspecialists by following those patients to their consult visits. As part of their advocacy and outreach experiences, residents participate in a variety of community programs to learn about community-based health care resources for patients.

With a smaller resident-to-faculty ratio, these learners have more opportunities to tailor their experiences based on relationships. Regular self-assessment reveals which skills residents still need to learn, and the continuity of faculty relationships allows for feedback on skill development. Residents also have the opportunity to develop relationships with one another as peers and with faculty members who support the residents’ commitment to primary care pediatrics. Monthly lunches for residents are followed by seminars that address topics essential to the systems-based practice necessary when providing care in a medical home. Residents also are taught relevant skills in population health, including quality improvement techniques, and are required to do an advocacy project. A month-long rural health experience is also required.

The residents in the Pediatrics Primary Care Program rotate in Chapel Hill at the North Carolina Children’s Hospital to receive subspecialty education and exposure to tertiary care management, including education in pediatric and neonatal critical care, childhood cancer care, management of complex congenital heart disease, organ transplantation, and other conditions requiring subspecialty management. This rotation also allows the pediatrics primary care residents to interact socially with the large group of graduate medical learners at UNC.

The benefits of continuity in the educational setting have been well described by Hirsh and colleagues [5]. Continuity of care with patients allows students to learn about evolution of disease and promotes awareness of responses to recommendations. Continuity of curricular setting and of faculty relationships provides additional benefits for learners’ development and continued optimism. Similar to experimental models being considered in other primary care specialties, this model aims to make the continuity clinic experience of residency more fulfilling and educational [6].

Outcomes

The UNC Pediatrics Primary Care Residency Program will increase the number of pediatricians graduating this year in North Carolina from approximately 70 to 74, an increase of nearly 6%. In addition, all 4 graduates of the UNC Pediatrics Primary Care Residency Program plan to practice primary care, and each is actively considering opportunities in underserved areas.

Because of their more focused training, the residents in the pediatrics primary care track are better trained for primary care than are residents trained via a traditional model in a tertiary care setting. The pediatrics primary care residents have learned to provide team-based collaborative care, and they have been taught by community pediatricians who have mastered the skills necessary to care for children with complex health care needs. Faculty members have noticed that the pediatrics primary care residents “think like partners in a practice,” providing important information to the hospital team when a patient from their continuity team is admitted and providing acute follow-up care as needed for patients when their continuity provider is away.

The cohesive relationships within the small group of residents and faculty members allow more opportunities for direct observation and trusting responses to constructive feedback. As a result, pediatrics primary care residents seem to show greater improvement in clinical performance over the course of the residency experience compared with categorical track residents.

These well-trained pediatrics primary care graduates are likely to stay in North Carolina. Currently, at least 3 of the 4 residents who will soon be graduating from this program are hoping to find a practice location in the state. Having 4 new pediatrics primary care providers in the state will increase the capacity for primary care pediatrics by 10,000–15,000 patients per year, based on a standard primary care patient panel size. Given the diverse patient population these trainees have worked with at Guilford Child Health, they are well prepared to make a significant impact on primary care needs wherever they choose to practice.

An unexpected outcome of the program has been increased diversity of the UNC pediatrics residency cohort. Only 6% of the categorical track residents are members of an underrepresented minority, but of the 12 residents thus far enrolled in the pediatrics primary care track, there are 4 African Americans (3 women and 1 man). Research has shown that physicians from underrepresented minorities are more likely to practice in underserved settings [7] (see Table 2).

Concern for Sustainability

Educating residents is expensive. In our program, providing an annual salary and benefits costs approximately $70,000 per resident per year. That does not include costs in faculty time, facilities, recruiting costs, or administrative support. The estimated actual cost of graduate medical education is $143,000 per resident per year [8].

Although all stakeholders seem quite pleased with the results of the UNC pediatrics primary care track, securing sustained funding is challenging. Unfortunately, the HRSA grant will not be renewed. Graduate medical education funding comes largely from the Centers for Medicare & Medicaid Services; because positions in pediatrics are currently capped at UNC, the 4 positions created for the pediatrics primary care residency program do not receive Medicare funding. We are exploring other options for funding, including state, philanthropic, and clinic or hospital support. A recent report on graduate medical education from
the Cecil G. Sheps Center for Health Services Research at UNC encourages states to support funding of graduate medical education positions because of the direct impact of such funding on the physician workforce of the state [9].

Conclusion

Changes in the clinical environment and in the regulations surrounding resident education demand that training programs allow learners to shape their experiences to further their career goals. In this way, educational opportunities will improve residents’ effectiveness in practice after training. The UNC Pediatrics Primary Care Residency Program is accomplishing its goal of producing primary care pediatricians. We believe that because of their focused educational experience, continuity both with patients and with small groups of faculty members, and the social support they receive, these residents will enter the workforce better prepared to provide a medical home for children. By training in a community program that is focused on outcomes and good stewardship of health care resources, these primary care pediatricians will have the skills they need to thrive in the new value-based health care environment. The challenges of funding graduate medical education are significant, and there is a risk that this valuable program will have to be discontinued when the money from the current HRSA grant has been spent. NCMJ

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Acknowledgments

The HRSA grant funds the residents’ salaries, benefits, and expenses, but it does not provide any financial support to faculty members. Potential conflicts of interest. J.S.B. and K.G. are employees of the UNC School of Medicine.

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| TABLE 2. Comparison of Pediatric Residency Programs at the University of North Carolina School of Medicine |
|-------------------------------------------------|-----------------|-----------------|
| Total number of residents (in the first, second, and third years of the program) in 2013-2014 | Pediatrics primary care residency | Pediatrics categorical residency |
| Proportion of residents who are men | 17% | 28% |
| Proportion of residents who are members of an underrepresented minority | 33% | 6% |
| Number of residents who will graduate in 2014 | 4 | 17 |
| Number (%) of 2014 graduates intending to enter primary care practice (nonhospitalist) | 4 (100%) | 6 (35%) |
| Number of applicants in 2013 | 259 | 1072 |
| Number of applicants per available position in 2013 | 65 | 67 |
To help shape the future of health care in North Carolina, Duke University School of Medicine has implemented several new initiatives aimed at providing primary care providers with the knowledge, skills, and attitudes required to improve population health and health care.

Aging population, growing obesity rates, and increases in chronic disease are stressing the services of primary care practices in North Carolina. To adapt to these changes, primary care providers must learn to work smarter—by adopting public health viewpoints, analyzing health data, using teams, and partnering with the community. To this end, Duke University School of Medicine is developing population health training for medical students, residents, and faculty members that will help them address adverse health trends and disparities in health and health care.

Primary Care Leadership Track

In 2011 Duke University School of Medicine launched its Primary Care Leadership Track (PCLT), a 4-year curriculum that prepares a select cohort of medical students to serve as leaders in primary care. Students are chosen before matriculation based on their interest in primary care and community health and on their potential as change agents. Special components of the program include a longitudinal clerkship in primary care offices, training in the patient-centered medical home (PCMH) model, community service, research in community-engaged population health, and leadership training. Duke’s PCLT program also retains many elements of the university’s traditional medical school curriculum, including first-year basic science classes, second-year clinical training, third-year research, fourth-year electives, and the Capstone which prepares students for internship (see Figure 1).

In the first year, PCLT students participate with students enrolled in the traditional medical school curriculum to take basic science courses, an interdisciplinary prevention course, and a course on the doctor-patient relationship (the “Practice Course”). During the second year, PCLT students begin with short immersion experiences lasting 2–4 weeks each, during which they are exposed to inpatient surgery, neurology, psychiatry, medicine, and pediatrics. Later in their second year, PCLT students complete an 8-month longitudinal integrated clerkship, the majority of which is spent in primary care practices. Students follow a panel of patients throughout the year, learning about the health care system through those patients’ eyes. They follow their patients into the emergency department, the operating room, the physical therapy office, specialty offices, and back to the primary care provider. This experience allows students to more fully appreciate the gaps in the health care system and the ways in which it fails to address patients’ needs.

During the 8-month longitudinal integrated clerkship, PCLT students contribute a half-day of service each week to a program or community group that is working to improve the health of vulnerable patient populations in Durham County. Such organizations include Local Access to Coordinated Healthcare (LATCH); Project Access of Durham County, which provides coordinated access to free specialty care; Senior PharmAssist, which provides medication assistance for low-income elderly individuals; Healing with CAARE, Inc., a nonprofit organization supporting wellness for vulnerable populations; the Samaritan Health Center; and the Health Care for the Homeless Clinic.

Prior to beginning their community service, PCLT students participate in a 2-week orientation that prepares them for their work in the Durham community. They visit the Durham County Department of Public Health to discuss the county’s community health assessment and the services available through the department. Students are introduced to the federally funded Lincoln Community Health Center and satellite clinics in underserved neighborhoods that are supported by the center and by Duke University, and they visit free health clinics, the YMCA, and El Centro Hispano (a local advocacy and service organization). They also complete a windshield tour and scavenger hunt to learn about the poorer areas of Durham. These experiences help bring to life the social determinants affecting the health of the people of Durham. The community orientation also teaches students about community resources that can be useful to the students’ patients and preceptors during the longitu-
dinal integrated clerkship, demonstrates the need to integrate clinical medicine with public health, and illustrates the importance of addressing health and health disparities by focusing on the community and on population health.

The PCMH model offers learners an example of primary care that focuses on patients with chronic illness in a particular clinic. PCLT students support the PCMH mission of the Duke Family Medicine Center, which is a Level 3 PCMH, by completing a quality improvement project. To learn about the PCMH model, PCLT students take a short course in the spring of their clinical year. They take this course with students from the Duke Physician Assistant Program who are participating in the Underserved Community Scholarship Program, which places physician assistant students in underserved communities throughout North Carolina.

The PCMH course hosts an initial meeting to cover the concept and history of the PCMH. Students come to this initial session with a description of the practice in which they plan to conduct their quality improvement project; this information includes the number of provider and nonprovider personnel, the estimated patient population, the gender mix, the payer mix, etc. This preparatory work is directed by questions derived from a PCMH checklist created by the American Academy of Family Physicians [1]. Based on this information, students then plan their quality improvement projects during small breakout sessions with their advisors.

In the months following the initial meeting, students work on their projects with e-mail or in-person guidance from faculty advisors. The physician assistant students and PCLT students come together again 3 months later to share descriptions of their PCMH projects. Duke’s PCMH course allows students to appreciate one another as valuable team members. Students and faculty members offer feedback, discuss the feasibility of each project, and consider how well the project takes into account the culture of the community of patients it is trying to serve. The project report is then finalized, and a copy of the report is offered to the clinical site. Students may or may not implement the project based on the readiness of their clinical site.

Like all students at Duke University School of Medicine, PCLT students complete a research project during their third year. PCLT students must choose a population health research topic that addresses a concern of the community. The project requires ongoing collaboration with the community, and the intent is to give back to the community through the results of the research work. Students collaborate with faculty members in community health to connect with researchers who are conducting community-engaged research and to develop a project that they can complete in 1 year. For example, one student reviewed data on persons with disabilities to determine how to improve their access to the local health care system and how to make the system more useful to these patients; another student analyzed the effect of Healthcare Effectiveness Data and Information Set (HEDIS) measures on the behavior of primary care physicians who care for patients with chronic illness.

**FIGURE 1.**
The Primary Care Leadership Track (PCLT) at Duke University School of Medicine

<table>
<thead>
<tr>
<th>Year 1 Traditional and PCLT</th>
<th>Prevention</th>
<th>Practice course</th>
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<td></td>
<td>Basic science courses</td>
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<th>Year 2 Traditional</th>
<th>Practice course</th>
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<td>Clinical skills course</td>
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<tr>
<td>Medicine</td>
<td>Peds</td>
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<tr>
<th>Year 2 PCLT</th>
<th>Practice course</th>
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<td>Clinical skills course</td>
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| Community engagement, population health, leadership training |
| Surg/Neuro | Psych | * Medicine | Peds | 8-month longitudinal integrated clerkship / PCMH |

<table>
<thead>
<tr>
<th>Year 3 Traditional and PCLT</th>
<th>Scholarship/continuity clinic</th>
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<tr>
<td>Biostatistics</td>
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<tr>
<th>Year 3 PCLT</th>
<th>Scholarship: Community-engaged population health research/continuity clinic</th>
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<tr>
<td>Epidemiology</td>
<td>Leadership curriculum</td>
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<tr>
<th>Year 4 Traditional and PCLT</th>
<th>Clinic electives</th>
<th>Capstone</th>
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* Health care systems and global health

Note. Family med, family medicine; Ob/Gyn, obstetrics and gynecology; PCMH, patient-centered medical home; Peds, pediatrics; Psych, psychiatry; Surg/Neuro, surgery/neurology.
The leadership training for PCLT students consists of workshops on teamwork and understanding one’s own leadership style, and students receive training in communication skills based on their leadership style. They may also attend weekend workshops sponsored by Duke’s clinical leadership training program for practicing physicians. During the research year, each student receives individual leadership coaching. As the program matures, the upper-level students will mentor PCLT colleagues who are in earlier phases of the program.

Population Health Improvement and Leadership Curriculum

In 2012 Duke’s family medicine residency program began modifying existing training to create a curriculum based on the principles and skills of population health improvement. These principles and skills mirror the 4 domains laid out in a population health competency map developed by members of Duke’s Department of Community and Family Medicine in collaboration with other partners [2]; these 4 domains are public health, critical thinking, community engagement, and team skills. The Population Health Improvement and Leadership (PHIL) curriculum includes a 1-year mandatory course for second-year family medicine residents and specified faculty members. Faculty members of the Department of Community and Family Medicine cycle through PHIL in small cohorts with residents; all faculty members in this department will have completed this training by the end of 2014.

The core coursework for the PHIL curriculum consists of bimonthly discussion sessions, topic-specific readings, and Web-based modules. Learners participate in the Division of Family Medicine’s monthly journal club, which is open to all family medicine faculty members, staff members, and residents, as well as to students who are rotating through the Family Medicine Center. With the introduction of the PHIL curriculum, the journal club’s readings have become more diverse, moving beyond quantitative clinical studies to include policy analysis, research reviews, and qualitative research.

PHIL practice teams take on a project that will change their clinical practice and will engage the community. Faculty members participating in the course serve as team quality leaders, taking primary responsibility for propelling and managing team projects. Second-year residents are responsible for documenting project selection and improvement cycles; when the project has been completed, they also document what was planned, accomplished, and learned. PCLT students contribute to the PHIL project through their quality improvement project for the PCMH course. They also attend the PHIL course during their longitudinal clerkship months.

Beyond the core course, residents participating in the PHIL curriculum gain exposure to the community through community tours and by practicing at neighborhood community health sites run by Lincoln Community Health Center and Duke University. They complete community health assessments of individual patients that take into account each patient’s psychosocial characteristics and area of residence. They also host a health education forum as requested by the community, complete workshops on leadership and teamwork, and complete a “resident as clinical director” rotation that requires residents to take on a mentored leadership role in a practice.

Future Efforts

Future efforts at Duke University School of Medicine will include increasing teamwork training—by offering interprofessional courses for medical students, physician assistant students, physical therapy students, and nursing students—and by further focusing the Duke Family Medicine Residency Program on improving outcomes in the office and in the community. Complementing these programs is the development of an innovative national initiative, Public Health and Primary Care Together: A Practical Playbook. This initiative, scheduled to launch early in 2014, will be a free Web-based tool for public health and primary care groups that wish to work together to improve population health. Funded by the de Beaumont Foundation with support from the Centers for Disease Control and Prevention and other national partners, the Practical Playbook will support local, state, and regional primary care teams and public health professionals who are interested in partnering to improve population health. The tool will appeal to key influencers of both primary care and public health, including national stakeholders, health care investors, academic institutions, and health-related foundations.

To address the future health needs of North Carolinians, the state needs practitioners who are trained in population health and models of care that enable sustainable integration of primary care and population health.

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Acknowledgments

The authors would like to acknowledge Erin James for her help editing this commentary.

The authors also recognize the Fullerton Foundation for its financial support of the Population Health Improvement and Leadership program.

Potential conflicts of interest. All authors are employees of Duke University School of Medicine.

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Shaping Oral Health Care in North Carolina With East Carolina University's Community Service Learning Centers

D. Gregory Chadwick, Margaret B. Wilson, Carol F. Anderson

East Carolina University School of Dental Medicine is responding to the changes in today’s health care system by implementing an innovative model of community-based dental education that prepares tomorrow’s dentists to meet North Carolina’s future oral health challenges while also providing much-needed care in many underserved areas.

Major changes in today’s health care system are driving changes in health care education. Oral health care and dental education in North Carolina are no exception, and dentists are being challenged to meet the evolving oral health care needs of an increasingly diverse population. This commentary will discuss how East Carolina University (ECU) School of Dental Medicine is implementing an innovative model of community-based dental education to help meet these challenges.

The focus of ECU School of Dental Medicine is to educate the next generation of primary care dentists for the rural and underserved areas of the state. North Carolina has one of the lowest dentist-to-population ratios in the country, and this problem is more pronounced in rural areas, where there are fewer providers. Access to dental care is particularly limited among lower-income populations and those who depend on the Medicaid and Health Choice programs.

At the heart of ECU's innovative educational model is the experience that fourth-year students gain in the school's community service learning centers (CSLCs). ECU plans to build 8 to 10 CSLCs in rural and underserved areas across the state; these centers will be an integral part of the School of Dental Medicine and will allow faculty members, residents, and students to provide care in an educational environment. The CSLCs in Ahoskie (Hertford County) and Elizabeth City (Pasquotank County) are already open, with residents and faculty members providing patient care, and CSLCs in Lillington, Sylva, Spruce Pine, Davidson County, and Robeson County are under construction, with completion dates ranging from January 2014 to January 2015. Additional sites will be announced in coming months.

Student Selection and Preparation

ECU School of Dental Medicine has developed and implemented recruitment and admissions strategies that align with its vision statement: “Improving the health and quality of life of all North Carolinians by creating leaders with a passion to care for the underserved and by leading the nation in community-based, service learning oral health education” [1]. Beginning with its inaugural class in the fall of 2011, the school has been admitting approximately 50 students each year, all of whom are residents of North Carolina. The 154 students currently enrolled in the Doctor of Dental Medicine program hail from 54 different counties in North Carolina, nearly 50% of enrollees are women, and 15% are underrepresented minorities (African Americans, Hispanics/Latinos, and American Indians).

The admissions committee works to enroll a diverse student body by evaluating each applicant holistically and defining diversity broadly—going beyond race, ethnicity, and gender to also include rurality as a key dimension of diversity. Health professionals who come from disadvantaged backgrounds or are members of underrepresented minorities are more likely to provide care in communities of need [2], so the school's approach is to assume that the individuals most likely to practice in underserved and rural areas are those who would be returning to their communities to practice.

The costs associated with dental education continue to rise and have a substantial impact on all students, particularly those from low-income households. The school’s leaders are committed to keeping tuition and fees as low as possible, and they allocate a portion of tuition costs for need-based financial aid, which is awarded as scholarships to students whose professional goals align with the school’s mission.

The school's curriculum prepares students to meet the changing oral health needs of underserved communities in North Carolina. The curriculum includes a strong emphasis on clinical medicine, a comprehensive approach to public and population health, and robust clinical experiences, all...
of which are designed to prepare graduates to serve diverse underserved populations with complex medical and oral health needs.

**Site Selection**

Selection of appropriate sites for the CSLCs will be a significant element in the success of students’ community-based fourth-year experiences. The site identification process has involved extensive demographic analyses, the development of collaborative relationships and synergies with area practitioners, assessments of financial sustainability, and a tremendous number of personal visits. Three overarching, interrelated goals have played a role in the identification of sites that can optimize the school’s mission and its commitment to North Carolina: robust educational experiences for students and residents, improved access to patient care for communities, and sustainability.

First, the care students provide in the CSLCs must address both patients’ dental care needs and students’ educational needs. Having opportunities to provide a wide range of types of care, beyond what is typically covered by Medicaid, will ensure that students gain rich clinical experiences.

Second, providing care using a sliding-scale payment model and caring for child and adult dental Medicaid patients will improve access to care. More importantly, the CSLC model will recruit and educate well-qualified primary care dentists who will hopefully choose a lifetime of practice in rural and underserved areas.

Finally, several factors contribute to the sustainability of the CSLCs. Financial sustainability is essential, which means that revenues must exceed operational and staffing expenses. Continued governmental and institutional assistance will be needed to support faculty, staff, and residents and to supply adequate student housing. Another important factor is educational sustainability—assuring that students’ educational needs align with the dental care needs of patients who can afford to pay for care at discounted fees. Finally, maintaining community support ensures that individuals and organizations in the area will take ownership of and perceive value in the relationship between the CSLC and the community; local community advisory boards at each CSLC will play an essential role in sustaining long-term community support.

**The CSLC Model**

The CSLCs function as a network of practices that are owned, operated, and centrally managed by ECU School of Dental Medicine. The supervising dentists are full- and part-time members of the faculty of the School of Dental Medicine. Residents in the Advanced Education in General Dentistry (AEGD) program and dental school students treat patients alongside the CSLC’s faculty members; this environment allows students and residents to hone their clinical skills while learning to function in a real-world setting. In traditional dental school clinics, students’ collaboration with other dental team members is limited; in the CSLCs, however, daily interactions with dental assistants, dental hygienists, and administrative staff help students to appreciate the value of all team members and to understand their crucial roles in dental practice. Also, residents and students typically see 5 to 6 patients per day in the CSLCs, in stark contrast to most dental school settings, where students typically see 1 patient per clinic session. When faced with a full schedule of patients, students and residents learn about time management, the impact of poor planning, and unanticipated schedule changes.

The communities in which the CSLCs are located often suffer not only from lack of oral health care but also from a lack of health care in general. Therefore, students and residents must continue to build their skills in treating patients with complex medical and oral health care needs. With a strong foundation in clinical sciences, students and residents can make appropriate referrals for the evaluation of conditions such as high blood pressure, cardiovascular disease, diabetes, and other problems that may go undiagnosed in a rural community with inadequate access to health care.

Each CSLC site will have the same design and a similar footprint, including a reception area, 16 operatories, a sterilization area, and a business office. In addition, each site will be equipped with teleconferencing capabilities, a seminar room, and a resident/student office. In addition to treating patients, students can learn the administrative aspects of the CSLC’s business operations, allowing them to develop the practical skills they will need to manage their own community-based practices in the future. The CSLC network also offers a rich opportunity for clinical and population-based research for students, residents, and faculty alike.

**Technology**

The use of technology supports both education and patient care. Residents and students at the CSLCs can stay connected to the teaching programs at Ledyard E. Ross Hall (the School of Dental Medicine’s hub on ECU’s Health Sciences Campus in Greenville) and at other sites by using an expansive video teleconferencing system to attend lectures, participate in seminars, and consult with specialists. AEGD residents at each of the CSLCs participate in a seminar series several days each week—where they are connected with one another, with AEGD residents and faculty members in Ross Hall, and with General Practice Residents at ECU-affiliated Vidant Hospital—to discuss topics ranging from management of medical emergencies to surgical techniques to professional ethics. The residents’ ability to present cases to peers and faculty members at different sites and to consult with dental specialists and other general dentists enhances their educational experiences and optimizes patient care.

Specific patient care technologies at each of the CSLC sites and at Ross Hall optimize educational and patient care...
outcomes. The School of Dental Medicine’s electronic health record, which uses axiUm dental software [4], supports patient care, patient management, assessment of patient treatment, and research. A high-definition camera system captures real-time video of intraoral findings and allows students to receive live-video assistance from faculty members located at any of the school’s sites. The use of 3-dimensional cone-beam imaging, which is interpreted by the school’s oral and maxillofacial radiologist, not only enhances diagnosis but also supports treatment planning for implant cases. Finally, endodontic microscopes facilitate completion of complex endodontic therapy, and a wheelchair lift improves access to care for patients with mobility limitations.

Benefits for Communities

The CSLCs provide much-needed oral health care, especially in areas where dental care resources are limited or nonexistent. ECU accepts dental Medicaid, thereby boosting access to care for children and others who are covered by the program. Each CSLC will employ faculty dentists who will treat patients while mentoring students and residents, which will expand the CSLC’s capacity to provide care for more patients. Although treatment by a student or resident may take longer, patients receive high-quality care that is supervised by an attending faculty member, and the cost is lower than traditional dental fees. Even greater benefits could be realized if patient care were augmented with additional resources such as grants, reimbursement programs, and programs to support care for disadvantaged populations.

The CSLCs serve as a regional community resource, with their impact extending well beyond the borders of a single county. Since the sites in Ahoskie and Elizabeth City opened, these CSLCs have provided care for patients from 37 unique North Carolina counties. CSLCs can actively participate with community organizations to participate in National Children’s Dental Health Month activities, the Give Kids a Smile and Head Start programs, local health fairs, and free clinics. In addition, the meeting facilities of the CSLCs can serve as valuable resources for community organizations that need conference space. Finally, the CSLCs can assist regional practitioners and support the practicing community through referrals, collaborative patient care, and access to the CSLCs’ technologies.

Communities derive a direct economic impact from the CSLCs when the dentists, residents, and students at the CSLCs shop in local businesses, use local services, and rent or buy homes in the community. The CSLCs also initiate workforce development through employment and training of staff members and by mentoring young people within the community to further their education.

Benefits for Students and Residents

The residents’ and students’ training experiences in the CSLCs prepare them to function as practice leaders. By working within a real oral health care delivery system, they can build strong practice management skills and develop increased confidence and leadership skills through their interactions with other members of the dental team. Participating in practice-based research network activities builds their professional competence in critical thinking, and abundant opportunities for service, outreach, and mentoring engage the students and residents as ambassadors for ECU School of Dental Medicine and for the dental profession. For the dental students, who will spend approximately 9 weeks in 3 different CSLCs, smooth transitions between these settings are possible because the electronic health record, equipment, instruments, supplies, and educational and patient care philosophies are consistent across all sites.

Working in a CSLC and living in the community improves providers’ awareness of the challenges low-income individuals face in accessing oral health care. Residents and students learn how patients’ lives and environments impact their health and health outcomes. These experiences augment the training that residents and students receive and enhance their cultural competence, while encouraging them to consider establishing a rural practice or working in a safety-net clinic [5].

In these times of change in health care, ECU School of Dental Medicine’s integrated CSLCs offer a number of unique advantages for dental education, underserved communities, dental students, the practicing community, and the people of North Carolina. As additional CSLC sites open their doors and fourth-year dental students join faculty members and residents at these sites, ECU School of Dental Medicine will continue to need support and leadership—from local, state, and national government, the university, organizations, corporations, and private individuals—in order for the school to reach its full potential and to achieve its mission. NCMJ

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The RIBN Initiative: A New Effort to Increase the Number of Baccalaureate Nurses in North Carolina

To meet the increasing demand for a more educated nursing workforce, the Regionally Increasing Baccalaureate Nurses (RIBN) initiative provides an economically feasible educational pathway between community colleges and universities so that more North Carolina nursing students can achieve a baccalaureate degree at the beginning of their career.

To help transform our health care system and improve the nation’s health, the nursing profession is being challenged to significantly increase the educational preparation of its workforce over the next decade. As early as 2004, visionary North Carolina health care leaders saw that the state’s changing demographics might negatively impact health care delivery, and they recommended increasing the proportion of registered nurses (RNs) with a bachelor of science in nursing (BSN) degree. Specifically, they recommended that the number of RNs educated at the baccalaureate level be increased relative to the number of RNs educated at the associate-degree level, from a ratio of 40:60 to 60:40 [1]. More recently, in the 2011 publication Future of Nursing: Leading Change, Advancing Health [2], the Institute of Medicine of the National Academies called for the proportion of nurses with a BSN degree to be increased to 80% nationwide by 2020. The North Carolina Future of Nursing Action Coalition has set the goal of achieving that 80% benchmark by 2025 [3].

Demand for an increase in nursing education is being driven by a number of forces: an older and more diverse population, including an increasing number of both children and adults with complex chronic conditions; an urgent need to focus on wellness promotion and preventive care across the lifespan; and needed improvements in quality, safety, and cost containment across our fragmented health care delivery system. These improvements require nurses to employ high levels of critical thinking, problem solving, and patient management skills at all levels of care, and there is growing evidence that patients in acute care settings benefit when they receive care from nurses with higher-level degrees [4, 5]. Academic progression is also urgently needed to ensure that North Carolina has sufficient numbers of individuals with master’s or doctoral degrees who can serve as faculty members, administrators, and advanced practice nurses.

In North Carolina, the 2-year associate degree in nursing (ADN) program is the prevailing level of prelicensure nursing education; 55 community colleges and 4 private colleges offer ADNs, whereas only 20 programs offer prelicensure BSN degrees, and 4 of these 20 programs are in the initial phases of development. In 2012, ADN programs educated 58.5% of the state’s new RN graduates, BSN and entry-level Master of Science in Nursing (MSN) programs educated 37.2%, and diploma programs educated 4.3% [6]. Thus our challenge is to increase the number of nurses who pursue further education after initially being licensed at the associate-degree level.

Although 21 RN-to-BSN programs are available in North Carolina and there are multiple out-of-state, Web-based opportunities that allow ADN nurses to achieve a BSN degree, few of North Carolina’s ADN graduates continue their education. In 2011, 54.6% of the 95,335 RNs working in North Carolina held an ADN as their initial degree for licensure. Of these, only 16.7% went on to achieve higher nursing degrees: 12.5% obtained a BSN degree, 4.1% obtained an MSN degree, and 0.1% obtained a nursing doctorate (unpublished data from the North Carolina Health Professions Data System). Historically, the majority of ADN nurses who do pursue a BSN degree or other higher education do so well into their careers, which lessens the long-term impact of their educational progression. To help the state’s nursing workforce effectively participate in the transformation of health care and to build the necessary pipeline for future nursing faculty and advanced practice nurses, North Carolina must create new pathways that allow qualified nursing students to enter ADN programs and then seamlessly progress to the completion of a BSN degree at the beginning of their careers.
A Community College’s Perspective on the RIBN Initiative

Kent Dickerson

The Regionally Increasing Baccalaureate Nurses (RIBN) initiative pairs community colleges and private colleges with universities to help nursing students complete a bachelor of science in nursing (BSN) degree early in their career. In the Eastern North Carolina Collaborative of the RIBN initiative, East Carolina University is partnered with 5 community colleges: Beaufort County Community College, Pitt Community College, Lenoir Community College, Roanoke-Chowan Community College, and Craven Community College. All of the partners in this collaborative have rigorous nursing programs and know how valuable the RIBN program can be to our region. In this sidebar, I will specifically describe Beaufort County Community College’s perspective on the RIBN initiative.

Beaufort County Community College serves not just the county of Beaufort but also Hyde, Tyrrell, and Washington counties—essentially, the landmass between the Pamlico and Albemarle sounds. In total, our service area is slightly more than 2,000 square miles [1]. In addition, students from neighboring Martin County who wish to pursue nursing may also attend Beaufort County Community College, because Martin Community College does not offer a nursing program. The North Carolina Department of Commerce currently designates all of these counties as tier 1 counties (a designation given to counties that are most economically distressed); residents of these rural counties face barriers such as limited infrastructure, a higher unemployment rate, limited access to health care, and limited access to higher education [2].

When the leaders of the nursing program at Beaufort County Community College were approached about the RIBN concept, we immediately realized that participation in this initiative would allow our program to become part of an affordable solution for students who wanted to earn a BSN degree. Our program’s nursing graduates overwhelmingly choose to stay in the rural communities in which they live. They are employed by long-term care facilities, small community hospitals, physician offices, and agencies that provide home health care or hospice care. These employers have not had access to an applicant pool of nurses with baccalaureate degrees, but we believed that the RIBN initiative could change that. Thus the RIBN program will have a significant positive impact on rural students who wish to pursue a BSN degree and on health care establishments in the region.

The RIBN initiative has also prompted a frank discussion of how we can better prepare students in the traditional associate degree in nursing (ADN) program so that they are better positioned to pursue further education once they graduate from Beaufort County Community College. This conversation led to a paradigm shift in the way we advise students. Historically, we gave our prenursing students a curriculum plan that could be completed in 2 years. If they wanted to continue their education and earn a BSN degree after completing the ADN program, they faced the challenge of having to take college algebra, statistics, microbiology, additional courses in the humanities, and other transfer courses; this meant having to study for an additional year and a half—while working a full-time job—before they could apply to a RN-BSN program. However, we now encourage prenursing students to take the more advanced courses needed to satisfy transfer credit requirements, instead of taking lower-level courses that fulfill only the minimum requirements for the ADN. Currently, approximately 20% of our students take courses that would fulfill BSN requirements, but we hope to increase this percentage. Our lofty goal is that 75% of ADN graduates will need only the university-level nursing courses to obtain their BSN degree. As part of this shift, we are currently in the process of reviewing articulation agreements for the RN-BSN programs; these agreements provide a simplified, guaranteed transfer process. We are also increasing enrollment in transfer courses, providing information to students regarding the RN-BSN admission requirements of nearby universities, and realigning our ranking procedure to give “points” to students who take more advanced courses that provide transfer credits.

Over the next few years, we hope to significantly increase the percentage of nursing students at Beaufort County Community College who enroll in the RIBN program. The RIBN program and other initiatives are better preparing our students to function in and lead the health care establishments in our communities. With the changes that are now taking place in national health care policy, we are going to need many new leaders to help our rural communities navigate through the storm.

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Acknowledgments

Potential conflicts of interest. K.D. is an employee of Beaufort County Community College.

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The Regionally Increasing Baccalaureate Nurses Initiative

In 2008 North Carolina began implementing a new 4-year BSN educational pathway called the Regionally Increasing Baccalaureate Nurses (RIBN) initiative. This initiative partners community colleges and private colleges with universities to help more students achieve a BSN degree at the beginning of their career. Key components of the RIBN initiative include the establishment of dual-admission criteria and enrollment processes, a seamless 4-year curriculum, and financial aid agreements between the partnering academic institutions. The specific goals of the RIBN initiative are to increase the proportion of RNs educated at the BSN level at the beginning of their careers; to provide access to an economically affordable BSN education, especially for students living in rural and/or economically depressed regions; to improve health outcomes by strengthening the educational preparation of nurses, particularly in gerontology, community health, leadership, and evidenced-based nursing practice; to increase the diversity of the nursing workforce to better represent the communities served; and to maximize the use of faculty members and educational resources in university and community college programs.

Dually enrolled RIBN students are based at a community college for the first 3 years of study and concurrently take a university-based course each semester to satisfy baccalaureate degree requirements. The student progresses through the 4-year pathway as follows: In year 1, the student completes educational prerequisites for both the ADN and the BSN programs. In year 2, the student enters the 2-year ADN program. In year 3, he or she completes the ADN portion of the RIBN program; the student must achieve licensure as an RN at the end of this year in order to progress. In year 4, the student completes a full-time course of study at a university; this includes classes about community and population health, a more intense focus on geriatric patients and other vulnerable populations, and leadership development related to interdisciplinary teamwork, critical thinking, and evidence-based practice. While completing these final requirements toward the BSN degree, the student also has the option of working part time as an RN.

Expanding the RIBN Educational Pathway Across North Carolina

Asheville-Buncombe Technical Community College and Western Carolina University developed the RIBN model and enrolled their first cohort of students in 2010. Interest in this model quickly spread to other regions of the state, with academic institutions, health care providers, and funders strongly embracing the concept of dual admission and seamless educational progression from a community college or private college to a university. More than 40% of all ADN and BSN prelicensure nursing education programs in North Carolina are now participating in the development or implementation phases of the RIBN pathway (see Figure 1). Seven of these academic institutions are located in counties that the North Carolina Department of Commerce has designated as being economically depressed [7].

Given the rapid expansion in the number of institutions involved in the RIBN initiative to date, it is projected that 55 of North Carolina’s 59 ADN programs and 15 of the univer-

FIGURE 1.
North Carolina Counties With Institutions That Are Participating in RIBN Educational Partnerships in October 2013

Note. RIBN, Regionally Increasing Baccalaureate Nurses. Asterisks denote counties that the North Carolina Department of Commerce has designated as being economically depressed. The names of these regional educational partnerships and the partnering institutions are available at http://www.ffne.org/library/library/ribn/ribn-map-2013.pdf.
The number of students admitted into the RIBN track is decided within each region based on the size of the partnering ADN programs and the number of students the university can accommodate in the fourth year of the program. As this new educational pathway unfolds, participating ADN programs are reserving, on average, 20% of available slots for RIBN students. It is hoped that partnerships will increase the number of RIBN students as the pool of qualified applicants expands, depending on available resources at the university level. As of fall semester 2013, 190 students were enrolled in the RIBN track across 5 regions of the state—105 students in the first year of the program, 66 students in the second year, 13 students in the third year, and 6 students in the fourth year (oral communication with Kellie Monacell, RIBN project coordinator, Foundation for Nursing Excellence; October 4, 2013). While there has been some attrition of students, this trend mostly reflects the growth of the program: In 2010 and 2011 only 1 community college and 1 university were admitting students, but by 2012 the program included 14 community colleges and 5 universities. Given the number of academic RIBN partners projected in 2020, we expect to have 175 students graduating with a RIBN BSN degree in 2020 (see Table 1).

As part of the rollout of the RIBN initiative, a wide range of data are being collected to identify the variables and best practices that contribute most to the success of the program. To date, the following factors have played key roles in moving this project forward: A standardized, concept-based curriculum is being used across all 55 community colleges offering the ADN program. Accelerated learning modalities, including online and shared video conferencing, are being used to accommodate students across a wide geographic region. Student Success Advocates (SSAs) are marketing the RIBN model, counseling and screening applicants, and providing information and support for students as they enter and progress through this new academic pathway. Upper-level administrators and nursing faculty members at the statewide level and on individual campuses are committed to collaborating across academic institutions. The North Carolina Area Health Education Centers are invested in the RIBN initiative. Employers, recognizing the need for more nurses with BSN and higher degrees in their workforce, are also interested and invested in the initiative. Finally, state and national funders are providing financial support to integrate this new educational pathway into nursing education across the state.

Of special value are the SSAs, who work for the RIBN partnership but spend most of their time at the community colleges; these individuals have also moved out into each of the communities served by the RIBN pathway to inform high school students, faculty members, and counselors about requirements for the program. SSAs participate in career fairs and partner with other community leaders involved in increasing the diversity of our future health care workforce. In addition, SSAs are the primary advisors and advocates for RIBN applicants and students; they carefully monitor and support the students’ progression, particularly through the first 3 years of the program, when students are based at the community college.

### Economic Impact and Benefits

Understanding the immediate and long-term costs and benefits of this new educational initiative is critically important both for the individuals and organizations directly involved in the initiative and for the communities being served. Based on the projected statewide RIBN enrollment and graduation figures through 2020, a study by faculty members of Kenan-Flagler Business School at the University of North Carolina at Chapel Hill identified economic impacts on 3 types of primary stakeholders [8]. The main effect on nursing students is that the tuition cost for the RIBN pathway is approximately $9,200 less than for a traditional BSN degree program, although the cost for the RIBN pathway is $7,000 greater than for an ADN. Also, RIBN BSN graduates have higher career financial benefits (a measure that includes not only salary but also the time and money invested in educational preparation) compared with either ADN or traditional BSN graduates. The second group of stakeholders is made up of community colleges, private colleges, and

### TABLE 1.
Actual and Projected Participation of Academic Institutions and Students in the RIBN Initiative, by Academic Year

<table>
<thead>
<tr>
<th></th>
<th>No. participating in, enrolled in, or graduating from the RIBN initiative</th>
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<td>Community colleges and private colleges (ADN)</td>
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<tr>
<td>Universities (BSN)</td>
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<tr>
<td>Students enrolled</td>
<td>16</td>
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<tr>
<td>Students graduating with RIBN BSN degree</td>
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Note. ADN, associate degree in nursing; BSN, bachelor of science in nursing; RIBN, Regionally Increasing Baccalaureate Nurses.
Source: Foundation for Nursing Excellence.
universities, all of which receive at least some additional revenue in the form of student fees. However, additional costs are incurred in the form of salaries for SSAs, and universities must hire additional faculty and support staff. Finally, the third group of stakeholders, consisting of hospitals and other employers who hire RIBN BSN graduates, experience a significant reduction in tuition reimbursement expenses. In addition, nursing staff turnover is reduced because RIBN graduates tend to remain in their local communities, with subsequent reductions in nursing recruitment costs and “onboarding” costs.

By 2020, the RIBN pathway will result in an annual projected cost savings for employers that is more than 3 times as great as the overall annual expense incurred by community colleges and universities (see Figure 2). Such cost savings create the impetus for strong economic partnerships between educational institutions and health care institutions to help meet the need for improved health care across the state.

Sustaining the RIBN Educational Pathway Into the Future

The RIBN educational pathway must be embedded as a core component of nursing education in North Carolina at both the regional and state levels. Regional partnerships across academic institutions and employers are fundamental to creating and sustaining this new pathway, which offers more students an economically feasible opportunity to achieve a BSN degree at the beginning of their careers while remaining in their home communities. Involving health care and community leaders in these partnerships reinforces the value of this program in each region. Statewide coordination is also integral to successfully spreading this model across the state. Replication guidelines, samples of shared curricula, agreements among academic institutions, diversity initiatives, and other resources that are useful in RIBN pathway development are available online [9].

To ensure sustainability of the RIBN program as an ongoing basic option for BSN education once current grant support ends, a statewide coordinating structure will be needed to regularly review program challenges and outcomes; in addition, this structure should identify and disseminate best practices and other success factors to ensure the quality and ongoing integration of the RIBN pathway as an entry-level educational option for the future nursing workforce. Continued success in this important journey toward improving the health and health care outcomes of all North Carolinians will be built on strong academic and practice partnerships at both community and state levels.

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Acknowledgments

The RIBN initiative is supported by grants from The Duke Endowment, the North Carolina Area Health Education Centers program, the Robert Wood Johnson Foundation, and the Jonas Center for Nursing Excellence. Each partnering educational program has provided significant in-kind contributions to program planning and implementation.

Potential conflicts of interest. P.J. has no relevant conflicts of interest.

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New Initiatives in Allied Health in North Carolina

Stephen W. Thomas

In addition to providing a well-prepared and diverse workforce of allied health professionals, North Carolina universities are helping to improve access to care and outreach to underserved communities. This commentary will discuss workforce preparation initiatives and innovations that help all North Carolinians access timely and high-quality services.

The myriad disciplines that constitute allied health have become an integral part of health care, health promotion, disease prevention, and wellness services. With an aging population and the advent of the Patient Protection and Affordable Care Act, an expanded allied health workforce is needed to ensure timely access to care. Most allied health professionals are cost-effective frontline health care providers who are currently in high demand as important members of interdisciplinary health care teams.

This commentary will highlight the increased emphasis on preparation of the allied health workforce and will describe the university-based allied health education programs that have implemented innovative approaches to meeting the challenges of patient access and outreach.

The anticipated increase in the number of new patients accessing health care may put additional strain on an already overburdened health care system, which will require a larger well-prepared workforce. Also, the difficulty of providing high-quality health care services to underserved populations in rural and urban areas of the state is a continuing concern that must be addressed.

Workforce Preparation

Workforce preparation and expansion is currently one of the greatest needs in the allied health professions in North Carolina. A 2012 report from the Cecil G. Sheps Center for Health Services Research of the University of North Carolina at Chapel Hill (UNC-CH) found that allied health graduates from universities and community colleges make up roughly 34% of the health care workforce in the state, holding 129,920 out of 376,930 jobs; registered nurses make up 24% of the state’s health care workforce, and physicians comprise only 5% of this workforce [1]. (There is debate about which professions should be included in allied health, but the report defined allied health professionals as “all health professionals with the exception of physicians, nurses, chiropractors, dentists, optometrists, pharmacists, podiatrists, nurse aides, orderlies and attendants.”) Since 2000 the number of allied health jobs has grown at a fast pace—increasing by 61%, versus 54% for the health care sector overall [1]—which indicates potential for increased future growth in the number of allied health positions.

This increasing demand for allied health professionals has resulted in the expansion of existing allied health degree programs, departments, schools, and colleges in public and private universities across North Carolina, and in the development of new degree programs. East Carolina University (ECU), UNC-CH, UNC Greensboro (UNCG), Western Carolina University, and Winston-Salem State University (WSSU) have long been recognized as offering a variety of allied health degree programs. Allied health education at these 5 universities has seen an expansion in enrollment, the development of new degree programs, and the merger of related degree programs and departments into existing allied health units. Allied health deans at these institutions communicate regularly and attend meetings sponsored by the Council for Allied Health in North Carolina [2].

Several universities in the UNC system have begun to establish and expand allied health degree programs. For example, Appalachian State University (ASU), UNC Charlotte, and UNC Wilmington have created allied health academic units (colleges, schools, or departments) on their campuses, and ASU, ECU, and UNCG have relocated degree programs from other colleges or schools to their allied health units. In 2012 ASU opened a College of Health Sciences, and they are partnering with Wake Forest University School of Medicine to create a master of physician assistant studies degree program. ECU College of Allied Health Sciences has opened a new program offering a master of science degree in health informatics and information management, and ECU is in the early stages of getting approval to relocate the Department of Nutrition Science into the College...
of Allied Health Sciences. The physician assistant degree program that was recently established by the UNC School of Medicine to provide an educational pathway for US Army Special Forces Medical Sergeants has been relocated to the school’s Department of Allied Health Sciences; plans are for the first class to be accepted as early as 2015. Finally, some universities in the UNC system already offer an allied health degree in an academic unit that is unrelated to allied health; for example, the School of Education at North Carolina Central University offers a master’s in education degree in speech-language pathology.

In the fall of 2011, Northeastern University opened a campus in Charlotte, where it currently offers 2 graduate programs in allied health: a master of science degree in health informatics, and the Transitional Doctor of Physical Therapy (t-DPT) degree for individuals who hold a master’s degree in physical therapy. On December 2, 2011, Lenoir-Rhyne University’s School of Occupational Therapy was accredited to offer a master of science degree in occupational therapy; it had provisionally offered graduate courses in occupational therapy prior to that date. Degree programs at the graduate level in health informatics and bioinformatics are also available at a growing number of North Carolina universities, including Duke, ECU, Northeastern, UNC-CH, and UNC Charlotte. Finally, although physician assistant studies are not considered to be an allied health program under the definition of allied health provided in the Code of Laws of the United States [3], physician assistant programs often exist outside of medical schools. In recent years, Campbell University, High Point University, Wingate University, and Gardner-Webb University have opened, or are preparing to open, graduate programs in physician assistant studies and/or physical therapy.

Access, Outreach, and Community Engagement

In underserved communities, lack of transportation prevents some patients from accessing health services, so more innovative forms of outreach are required. Mobile units and telemedicine are 2 approaches that are being applied in a growing number of university-based allied health programs and clinics.

Mobile units. One example of successful mobile outreach to underserved intercity areas is the RAMS Know H.O.W. (Healthcare on Wheels) mobile clinic run by WSSU School of Health Sciences [4]. The mobile unit offers free, convenient, preventive health services to residents in the community who are uninsured or underinsured. The mobile clinic operates 3–4 days a week, including Saturday, and provides high-quality, accessible, integrated wellness services to help reduce health disparities. The mobile clinic team—which consists of health sciences faculty members, staff, and students from allied health and nursing—creates an excellent environment in which to engage in interprofessional education and practice. This mobile team measures blood pressure, determines serum levels of glucose and cholesterol, and provides health education and referrals to local providers when needed. Over the past 3 years, the clinic has served more than 4,000 people; more than 80% of these individuals were African Americans, 70% were overweight or obese, 30% had diabetes (many without realizing it), more than 30% had hyperlipidemia, and 70% had hypertension or hypertension (oral communication with Peggy Valentine, dean of WSSU School of Health Sciences; October 3, 2013).

Another mobile unit that deserves mention is run by ECU College of Allied Health Sciences. ECU’s Department of Addictions and Rehabilitation Studies recently received a 3-year continuation grant totaling $828,956 from the Substance Abuse and Mental Health Services Administration of the US Department of Health & Human Services to fund Operation Reentry North Carolina: Veteran Resiliency and Reintegration through Technology. The project will send a clinical team in a technology-equipped van through rural Eastern North Carolina to conduct mobile outreach to veterans who are homeless or underserved and will provide state-of-the-art, evidence-based interventions. The service area includes Craven, Cumberland, Onslow, and Wayne counties; together with surrounding counties, this area is home to an estimated 125,000 veterans [5]. Using tele-health technology, team members in the mobile clinic will be able to access the services of ECU’s Navigate Counseling Clinic, Family Therapy Clinic, Psychophysiology Lab and Biofeedback Clinic, and Psychiatric Outpatient Clinic (written communication from Paul Torigello, professor and chair of the Department of Addictions and Rehabilitation Studies at ECU College of Allied Health Sciences; September 28, 2013). Services will be provided face-to-face by team members in the mobile clinic, including students, or will be delivered via telecounseling, with clients in the van being counseled by a team member at ECU Brody School of Medicine’s Telemedicine Center. The project will commence service at the beginning of 2014.

Telemedicine. Another innovation designed to increase access to allied health services is telemedicine, also referred to as telehealth, telepractice, or telerehabilitation. A telepractice application began to be evaluated in 2008 in the Department of Communication Sciences and Disorders in the School of Health and Human Sciences at UNCG. A successful 2008 pilot project involved the delivery of speech-language pathology services to 4 public school districts and 200 students in grades prekindergarten through middle school. Later, speech-language services were delivered to public schools in a remote mountain area in Yancy County. Over several years, UNCG telepractice speech-language evaluations and treatments were expanded to include school systems in rural Eastern North Carolina, including Washington County, where speech-language pathologists were not available. Assessment and treatment services were offered 2 days per week to 12–15 students with articulation and fluency difficulties, aphasia, hearing impairment, autism, traumatic brain injury, and other difficulties. These
services were funded through a local physician’s telehealth practice grant and public school contracts. Although the telepractice service was considered to be a success, lack of sustainable funding limited further delivery of services.

Another telehealth program began in 1992 when the Department of Physical Therapy in the College of Allied Health Sciences at ECU entered into an arrangement with the North Carolina Department of Corrections to offer evaluation and treatment services to inmates at a medium-security prison. Prisoners were evaluated by a nurse under the guidance of a state-licensed physical therapy faculty member, and consultation was ordered by an onsite physician through telerehabilitation. Follow-up revealed physical improvement among inmates who were motivated to attend the physical therapy sessions and to perform their home exercise programs. Today, the telerehabilitation physical therapy services are offered to inmates at Maury Prison, where some prisoners are transported for physical therapy evaluations, and at Central Prison in Raleigh, where this service is used to lessen the caseload of the onsite physical therapist or to provide a second opinion.

Another example of telemedicine aims to improve hearing screenings for newborns. Legislation establishing North Carolina’s Early Hearing Detection and Intervention Program was formally adopted in July 2000 [6], and administrative rules were put into effect governing newborn hearing screening [7]. In September 2009 the North Carolina Department of Health and Human Services received “lost to follow-up” funding from the Health Resources and Services Administration. As a result of this legislation and funding, a teleaudiology project developed by the North Carolina Division of Public Health and the ECU Department of Communication Sciences and Disorders in 2011 provided diagnostic evaluations of infants living in 36 rural northeastern North Carolina counties where access to such services is very limited. Audiology faculty members and doctoral students at ECU provide teleaudiology diagnostic evaluations to 19 birthing centers in the catchment area. Over a 1-year period (from June 2011 to June 2012), 41 infants received diagnostic evaluations after rescreening warranted the service. Eleven of those infants (3 females and 8 males) were referred to the teleaudiology project, and services were rendered and reported within the required 90-day period [8]. This teleaudiology service is ongoing.

An audiology professor in the Department of Communication Sciences and Disorders and a professor in the Department of Engineering at ECU have obtained 5 patents for a hearing evaluation system consisting of a device and software. The system makes it possible for audiology evaluations to be conducted over a broadband network between any 2 locations. The system is currently being tested in a pilot study at the Veterans Affairs hospital in Los Angeles and at another satellite Veterans Affairs office in California. This system makes it possible to offer teleaudiology evaluations to individuals in rural and underserved areas at any local physician office, health center, or clinic where the device is installed. Teleaudiology services continue to collect research data on the effectiveness of the system and to expose students to its potential as a platform for evaluation and treatment.

Conclusion

Allied health innovations at North Carolina universities will continue to be stimulated by the quest to improve the efficiency and effectiveness of interprofessional services through education, research, and engagement. Opportunities for community engagement are available to universities that are committed to clinical research, community improvement, student involvement, and delivery of innovative, high-quality, state-of-the-art allied health services. NCMJ

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Acknowledgments

The author wishes to thank the deans, department chairs, faculty, and clinical staff at the participating universities for providing information on their programs for this article.

Potential conflicts of interest. S.W.T. is an employee of East Carolina University.

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6. NCGS 130A-125, SL2000 CH67 S11.31aS.
7. 10A NCAC 43F1201-1204.
The UNC Eshelman School of Pharmacy is transforming its doctor of pharmacy program to emphasize active engagement of students in the classroom, foster scientific inquiry and innovation, and immerse students in patient care early in their education. The admissions process is also being reengineered.

The US health care system is in need of change to improve the quality and delivery of patient care and to reduce health care costs [1]. Numerous calls have emerged for reform in health professions education to better prepare students for the continual improvement of health and health care [2, 3]. To best position students, we must foster habits of inquiry, critical thinking, and innovation and ensure that students are immersed in real-world patient care settings earlier and more often in their education and training. Employers within and outside health care are increasingly seeking inquisitive individuals who are able to think critically, communicate clearly, and work effectively in teams to solve complex problems [4]. All too often, students possess great discipline-specific knowledge but lack the skills essential to survive in an increasingly competitive and global society. Despite evidence suggesting a need for change, little has changed in the way that education is delivered to aspiring health professionals. Lecture continues to prevail in the vast majority of health sciences schools, with minimal time devoted to higher forms of thinking and problem solving. Students are coming to us in a highly digital age where information is a commodity and technologies abound to support student learning. No longer can we assume as faculty that our job is to teach them everything they need to know. We must better prepare students with the skills they will need to positively impact human health and health care. This requires that we change not only what we teach but also how we teach, to better position students for success.

Toward a Curriculum Transformation

The UNC Eshelman School of Pharmacy has a long-standing reputation of providing one of the best pharmacy educations in the world. The school’s Educational Renaissance initiative is an integral component of the school’s strategic plan, and it speaks to the school’s aspirations to transform education, enlighten students, and advance health care [5].

In summer of 2011, a faculty workgroup was charged with critically examining curricular change. The group outlined a conceptual framework for change, desired program outcomes, defining elements, and guiding principles of a new curriculum (Table 1). Strengths of the existing curriculum were also considered in an effort to capitalize on the successes that already set the school apart. Aside from required fourth-year clinical rotations, differentiating experiences were largely extracurricular or were limited to students or student organizations intrinsically driven to pursue such opportunities; these differentiating experiences included engagement in direct patient care and service learning, leadership opportunities, and hypothesis-driven research or quality improvement–driven inquiry. In many respects, our students were sending us a message about the skills they longed to develop and their potential to do more. This insight and a sound rationale for change formed the foundation for the defining elements of the new curriculum. The workgroup presented its findings to the faculty in May 2012, and 86% of the faculty voted (anonymously) in support of the defining elements of the new curriculum.

The next step was to critically examine the value and feasibility of each of the defining elements. In August 2012 the school’s dean charged the Curriculum Transformation Steering Committee (CTSC) with presenting a more detailed proposal of the new curriculum for faculty endorsement in December 2012. Subcommittees were formed to address the following issues: foundational content, immersion in patient care, scientific inquiry and scholarship, technology and pedagogy, assessment of student learning, and admissions. This effort involved more than half of the school’s faculty members as well as various partners, staff members, and students.

The committee’s work was influenced by prior curricular innovations, particularly in medicine and engineering [6-8]. In addition, the faculty considered the job to be done by
future graduates of the program. The theory of the “job to be done” is a well-regarded framework described by Clayton Christensen for guiding change and innovation, and its application has been linked to successful transformations [9]. We reflected on the careers that our graduates currently consider (eg, clinical specialists or generalists in university health systems, community hospitals, and community care settings as well as positions in the pharmaceutical and managed care industries, academia, and community/retail practice) as well as the fact that nearly 50% of them pursue postgraduate training opportunities. We considered all of this in light of the job to be done by future graduates in addressing the costly and unmet medication-related needs of patients and society [1], including that of the pharmacist as an integral member of the health care team in providing high-quality, patient-centered care. Although it is impossible to predict the future of health care and pharmacy practice, it is clear that pharmacists must play a more active role in assuring the safe, effective, and affordable use of medications for patients and populations. Likewise, they must possess the skills needed to function in interdisciplinary teams and lead teams toward continuous change and improvement of human health and health care. This will require much more than a curriculum rich in pharmacy-focused knowledge and skills. We must also train our students to think deeply and critically; to identify, understand, and address problems; to communicate clearly; and to work well in teams. They must be able to thrive in an evolving health care environment and to contribute meaningfully to improving patient care.

The work of the CTSC and subcommittees culminated in the inaugural Educational Renaissance Symposium on December 17-18, 2012; this marked the date when the school was planning to seek endorsement to move forward with the design of the new curriculum. The symposium convened faculty members, partners, and students and included keynote speakers from medicine, higher education, and engineering. Topics included health care reform, pharmacy practice innovations, accountabilities in higher education, and models of curricular reform. Notably, student leaders made a compelling case for change. The event resulted in 96% of attendees voting (anonymously) to participate in the design of a new curriculum. The symposium has been a highlight of the school’s efforts to transform the curriculum, and it speaks to the commitment of faculty members, staff, and students to enriching student learning and advancing pharmacy education. In addition to the design of a new curriculum, several important initiatives have been implemented over the past 2 years. These initiatives have been instrumental in fostering a culture of change (Table 2) and in encouraging and rewarding excellence in teaching.

Executing a Transformative Curriculum

The CTSC was charged in January 2013 with facilitating the design of a transformative curriculum that would create graduates who are exemplary practitioners, leaders, innovators, and lifelong learners and would ensure that they are well positioned to have a positive impact on patient care and health care delivery. The defining elements and key features of the new curriculum are discussed below and are depicted in Figure 1.

Self-directed learning outside of class and active engagement of students in the classroom. The first year of the new curriculum will foster students’ in-depth understanding of the foundations of pharmacy and of the pharmaceutical sciences. Nine courses serve as the foundation for student learning and will be taught using a “flipped classroom” approach—that is, factual content will be thoughtfully packaged and made available to students for self-directed learning outside of class, and class time will emphasize faculty-student interactions and higher forms of thinking and problem solving. The school has demonstrated early

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### Table 1. Desired Outcomes, Defining Elements, and Guiding Principles of the New Curriculum of the UNC Eshelman School of Pharmacy

<table>
<thead>
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<th>Desired outcomes*</th>
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<tr>
<td>• Exemplary pharmacy practitioners who provide high-quality, team-based, patient-centered care.</td>
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<tr>
<td>• Leaders and innovators who recognize the health care needs of patients and society and who lead teams toward improvement and change for the betterment of patient care.</td>
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<td>• Lifelong learners who continually strive for positive impact.</td>
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<tr>
<th>Defining elements</th>
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<tr>
<td>• Self-directed learning outside the classroom and active engagement of students in higher forms of thinking and problem solving inside the classroom.</td>
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<tr>
<td>• Fostering of scientific inquiry and innovation.</td>
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<tr>
<td>• Early immersion in direct patient care as a member of an interdisciplinary team.</td>
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<tr>
<td>• Reengineering of the admission process to emphasize both cognitive and noncognitive skills critical to student success in the new curriculum.</td>
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<th>Guiding principles</th>
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<tr>
<td>• Faculty will instill in students habits of inquiry, curiosity, and critical thinking and inspire students to be lifelong learners and leaders in pharmacy.</td>
</tr>
<tr>
<td>• Ensure a rigorous and intensive curriculum that provides the necessary breadth to shape student development while providing students with a deeper understanding of medicines and the pharmaceutical sciences.</td>
</tr>
<tr>
<td>• Integrate active learning throughout the educational experience to build upon knowledge and skills and to develop higher forms of thinking and problem solving.</td>
</tr>
<tr>
<td>• Work collaboratively with other health professions to create opportunities to develop students as members of an interdisciplinary team.</td>
</tr>
<tr>
<td>• Implement an assessment plan to guide the development of student learning.</td>
</tr>
<tr>
<td>• Innovate, evaluate, and continually refine the curriculum ensuring a process of continuous quality improvement.</td>
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*Core competencies have been identified to support achievement of the desired program outcomes.
successes in using a team-based approach for teaching pharmacokinetics, which serves as a model for educating students in large classrooms [10]. Furthermore, the school’s flipped classroom experience in pharmaceutics has received widespread attention as a model for transforming student learning [11, 12].

**Fostering scientific inquiry and innovation.** In the spring semester of students’ first year, they will take the first of an integrated series of courses and will participate in project-based experiences designed to foster inquiry and innovation. The goal is to instill in our students a mindset for solving problems and addressing health care needs through innovation, which will position them to be inquisitive professionals, change agents, and leaders. The project-based experience will focus on real-world problems and is grounded in the understanding that there is a common process for identifying and framing problems and developing innovative and effective solutions. Flexner proposed that, just as scientists must inquire, analyze, think critically, identify solutions, and continually refine their approach toward discovery, so too must medical practitioners, if they are to advance the practice of medicine and health care [2]. To cultivate these habits of mind, students must learn how to approach and solve complex problems through inquiry, critical thinking, and innovation rather than relying on memorization of facts [2, 3, 13].

In addition to offering these integrated courses, the school will design and pilot a longitudinal scholarship track, in which students will be mentored by faculty in their respective areas of research. We believe this track will be an ideal mechanism for fostering scientific inquiry and innovation; however, faculty members wish to pilot the program before implementing it on a broader scale, in order to gain more experience in terms of capacity, process, and outcomes.

**Early immersion in direct patient care as members of an interdisciplinary team.** Throughout their second and third
years, students will be immersed in direct patient care experiences (eg, primary care, community pharmacy, health systems, and internal medicine); these experiences will alternate with school-based learning. Students will be involved in caring for patients and will learn to function in complex systems as members of an interdisciplinary team. The faculty-facilitated, school-based learning component will occur in both large-classroom and small-group settings. This learning provides several opportunities for students: reflection following patient care experiences; integration and connection of learning; exposure to advanced concepts, emerging topics, and leadership development; and career path exploration.

An important component of the second and third years will be the use of online modules to deliver content focused on contemporary therapeutics. These modules will be developed by teams of clinical experts, with the goal of supplementing student learning in patient care settings. The modules can be viewed immediately prior to the start of a clinical rotation or “just in time” as new therapeutic areas present in the context of patient care.

Finally, the goal of the fourth year is to build upon early immersion experiences by providing students with the opportunity for advanced and/or specialized clinical rotations and built-in flexibility for defining their career paths.

Reengineering the admissions process. The school has a highly competitive admissions process. Approximately 80% of students admitted to the program have a prior bachelor’s degree and an average admissions GPA greater than 3.5. Although academic performance is important, debate surrounds the reliance on academic indicators for assessing a student’s postbaccalaureate potential [14]. In addition to academic performance, student motivation and soft skills (eg, empathy, collaboration, communication, adaptability) are essential for success; these skills are also directly related to the skill sets that are desired of the future workforce [4]. The school has invested time in understanding the role of cognitive and noncognitive characteristics in student selection and has worked to develop strategies to identify students with the potential to excel in our program. We have reached out to programs with recognized successes in transforming their admissions process [8, 15]. The new admissions process will place greater emphasis on identifying and assessing noncognitive skills that are critical to students’ success in the new curriculum and will immerse prospective candidates in our academic culture.

Conclusion

Calls for reform in the delivery of health care and health professions education have been clearly stated. Reengineering a curriculum is not without its challenges, but the need for change, the desire to change, and a will to execute change are part of our culture. Society and our accrediting bodies are demanding that we better prepare students to continually improve health and health care and that health professions work together to create meaningful experiences for students that foster team-based approaches to the delivery of patient care. Therefore, we have an unprecedented opportunity to make a positive impact on the next generation of health professionals and to shape the future of health care delivery. NCMJ

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Acknowledgments

The authors would like to thank Liz Billings, Marti Guidotti, and Joe Moore for their leadership roles and vision in transforming the curriculum. Their insight and contributions to date have been invaluable.

The authors would also like to thank the faculty, staff, and students of the UNC Eshelman School of Pharmacy and our key partners. The school’s efforts to transform the curriculum would not be possible without their dedication and continued support. Finally, the authors and the school would like to thank the Carolina Partnership and the Pharmacy Network Foundation, Inc., for their generous financial support of the school’s Educational Renaissance initiative.

Potential conflicts of interest. All authors are employees of the UNC Eshelman School of Pharmacy.

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Wake Forest School of Medicine and the College of Health Sciences at Appalachian State University are partnering to train physician assistants (PAs) to practice as primary care providers in rural, medically underserved areas in the Appalachian region of North Carolina. The Wake Forest University Physician Assistant Program has received approval from the Accreditation Review Commission on Education for the Physician Assistant (ARC-PA) to expand its existing program by up to 32 students per year, with a target launch date of June 2014 (when training begins for the class of 2016). One-third of the students in this class will complete the majority of their first-year education on the ASU campus in Boone, North Carolina; these students will be encouraged to practice after graduation in medically underserved areas. Recruitment efforts are focusing on students who want to work in such locations, particularly those who are from the Appalachian region or who are US military veterans with field experience as medics. Partial funding for this new initiative comes from a 3-year grant of $375,000 from The Duke Endowment in Charlotte, North Carolina.

A Natural Partnership

Wake Forest School of Medicine is located in Winston-Salem (Forsyth County), which is on the eastern edge of Appalachia. Wake Forest University offers doctor of medicine (MD), doctor of philosophy (PhD), master of science (MS), and master of medical science (MMS) degrees, including an MMS in Physician Assistant Studies, as well as several joint degree programs. The program to train PAs utilizes a curriculum centered on self-inquiry and team-based learning; in 2011 US News and World Report ranked this program 18th on a list of 123 accredited PA educational programs in the nation [1].

ASU is located in Boone, North Carolina, among the Blue Ridge Mountains near the state’s western border. ASU’s College of Health Sciences was established in 2010 to address growing health care needs in Western North Carolina and beyond. Committed to teaching, research, and service through interprofessional education, ASU’s College of Health Sciences includes undergraduate and graduate programs in nursing, nutrition and dietetics, health care management, social work, communication sciences and disorders, health promotion, and exercise sciences.

Within North Carolina’s rural Appalachian counties, many residents face challenges due to high poverty rates, rural isolation, a lack of health insurance, poor access to health care, and a low number of primary care providers. These factors have contributed to increased rates of mental illness, substance abuse, overweight, and obesity; poor nutrition and poor oral health in both children and adults; low health literacy; a decreased number of preventive care visits for children; and increased mortality [2]. For example, some children in Ashe County live more than 2 hours away from the nearest primary care provider, and the age-adjusted mortality rate for chronic lower respiratory disease is 52% higher in Ashe County than in North Carolina as a whole. Furthermore, 20 of the 29 federally designated Appalachian counties (out of 100 counties in North Carolina) have suicide rates that are among the highest in the state [3, 4].

To better meet the health care needs of this high-risk population, Wake Forest School of Medicine and ASU’s College of Health Sciences seek through their partnership to increase the number of PAs working in primary care in North Carolina’s rural Appalachian counties. The collaboration is intended to expand training opportunities for PA students in the Appalachian counties and to enhance the curriculum.

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NC Med J. 2014;75(1):53-55. ©2014 by the North Carolina Institute of Medicine and The Duke Endowment. All rights reserved. 0029-2559/2014/75113
of Wake Forest’s PA program by focusing specifically on the needs of medically underserved people in rural areas. The philosophy underlying the partnership is that the best way to increase the number of health care providers in an area is to make it possible for health professions students to train within these communities and to form relationships with potential employers. Current initiatives are already bringing together ASU students who are studying nutrition and dietetics or nursing with medical and PA students from Wake Forest School of Medicine, and additional collaborations designed to foster improved interprofessional practice are being developed.

**Program.** The Boone campus program will use the Wake Forest School of Medicine PA curriculum, which provides 24 months of training—approximately 1 year each of preclinical and clinical education. The entire class of 88 to 96 students will attend a month-long basic science leveling block in Winston-Salem; one-third of these students will then receive 9 months of preclinical training on the ASU campus in Boone. The preclinical component—which consists of didactic study as well as classroom, small-group, laboratory, and experiential learning activities—will be delivered consistently and simultaneously to students on the Wake Forest and ASU campuses. After the preclinical year, all students will begin 12 months of required and elective supervised clinical rotations. New clinical rotation sites are being identified in communities in and around Boone to meet the objectives of the program. Nearly 2 years of workforce development activities with regional health systems, physician practices, and other employers preceded the application for expansion, and these workforce efforts are ongoing. Students studying at the Boone campus will be enrolled in the Wake Forest PA program and will graduate with an MMS degree from Wake Forest University.

**Faculty.** Program faculty will primarily be employees of Wake Forest School of Medicine. Strategies that allow faculty members to hold joint appointments at Wake Forest and ASU are in place to optimize cross-campus synergies. All faculty will be required to participate in faculty meetings, curriculum planning retreats, and quality improvement activities by video conference, teleconference, or in person. A lead faculty member or distant campus coordinator who is an employee of Wake Forest School of Medicine will direct distant campus operations and will report to the chair of PA studies at Wake Forest.

**Responsibilities.** The 2 schools will share responsibility for selection of faculty and staff, student recruitment and admissions, health workforce and access-to-care projects, academic activities, interdisciplinary opportunities, and research. Wake Forest School of Medicine will be solely responsible for managing the curriculum, directing and overseeing faculty responsibilities, and evaluating students. Wake Forest School of Medicine will also appoint a senior faculty administrator to advocate for and facilitate collaborative interprofessional education and scholarship.

The first extramurally funded initiative born from the collaboration is a health professional pipeline and curriculum enhancement project funded by the Health Resources and Services Administration. This project has successfully attracted students, provided community-based internships centered on caring for the community, and created opportunities to help increase students’ competitiveness for PA education in several target groups (for example, individuals who belong to an underrepresented minority or those who are from economically or educationally disadvantaged backgrounds).

ASU will provide physical space and support services for students on the Boone campus, including student health services, career counseling, library services, and information technology support and maintenance. ASU has also dedicated the time and effort of faculty members and key leaders within the College of Health Sciences to support interprofessional education and interdisciplinary research.

**Interdisciplinary Inquiry-Based Learning**

Among the accreditation requirements set forth by ARC-PA is a requirement that programs “must include instruction to prepare students to work collaboratively in interprofessional patient centered teams.” ARC-PA further specifies that this instruction should include “content on the roles and responsibilities of various health care professionals, emphasizing the team approach to patient centered care beyond the traditional physician-PA team approach,” that it should “assist students in learning the principles of interprofessional practice,” and that it should include “opportunities for students to apply these principles in interprofessional teams within the curriculum” [5].

The PA program curriculum is anchored by an inquiry-based learning model that brings teams of students and faculty members together to solve complex patient problems. This model integrates disease management and health maintenance with real-life issues facing patients and caregivers. Issues include cultural competency, biomedical ethics, interprofessional practice, value-based care, models of care, payment systems, community resources, and barriers to care.

While the PA program at ASU’s Boone campus has not yet begun, pilot projects conducted at both Wake Forest and ASU have already demonstrated the effectiveness of inquiry-based learning methods when applied to interprofessional teams of students and faculty. Over the past 2 years, such teams have been tasked with solving complex medical cases under the guidance of an interdisciplinary group of faculty mentors. These pilot projects have included students from various health and other graduate programs, including programs in medicine, law, and divinity, and programs of study for PAs, nurses, and social workers. Faculty members from both institutions and clinicians from Wake Forest Baptist Medical Center are working to promote interprofessional education through feasibility studies and curriculum rede-
sign. These curriculum enrichment activities focus on the application of 4 domains of core competencies for interprofessional collaborative practice: values and ethics; roles and responsibilities; communication; and teams and teamwork [6]. The premise is that both institutions, with strong connections to regional health systems and clinical leaders, can shift the paradigm for health professions education in Western North Carolina toward one that produces highly effective health care teams that can succeed in an era of value-based purchasing and patient-centered care.

Program Evaluation

A comprehensive program evaluation plan is in place and will assess several measures: applicant and matriculate demographics; percentage of applications from targeted groups, including North Carolina residents, military veterans, and individuals from educationally and/or economically disadvantaged backgrounds; cognitive measures and preceptor evaluations of student achievement, with comparison across campuses; graduate interest; selection of primary care careers; employment rates 6 months after graduation; graduate performance on national certification examinations; and various workforce development assessments, including regional job growth and retention of graduates within Appalachian counties. Because the program will not be implemented until June 2014, no outcome or performance data are available at this time.

Overall Goals of the Collaboration

In addition to expanding Wake Forest School of Medicine’s PA program with the primary objective of addressing unmet health care needs in Western North Carolina, Wake Forest University and ASU also seek to enhance the curriculum for training health professions students at both institutions by taking advantage of regional opportunities and by using the key strengths of each institution. Objectives include development of new training experiences, both in rural underserved communities and in academic medical center environments, as well as development of interprofessional education and team-based training activities. There is also a shared interest in enhancing opportunities to work together on additional grant applications and research collaboration.

Wake Forest University and ASU hope to stimulate intellectual exchange for the purposes of envisioning new models for health professions education and designing novel models to address current and future health workforce challenges. The overall goals of the partnership are clearly ambitious, but once achieved, the current effort to establish an expanded PA training program on the Boone campus will provide a firm foundation for growth. NCMJ

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Acknowledgments

The authors acknowledge the participation of collaborators from numerous physician practices as well as several regional health systems integral to program development and planning, including Appalachian Regional Healthcare System, Cornerstone Health Care, Mission Health, Novant Health Forsyth Medical Center, and Wake Forest Baptist Health. Potential conflicts of interest. R.L.B. and T.G. are employees of Wake Forest School of Medicine. F.K.W. is an employee of Appalachian State University.

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Consumers, health delivery planners, and public officials are calling for patient-centered, primary care–based, cost-effective health care. The Asheville campus of the University of North Carolina School of Medicine has responded to this need by developing a longitudinal integrated clerkship that trains third-year medical students to provide such care.

The University of North Carolina (UNC) School of Medicine launched its Asheville campus in July 2009 with 4 third-year medical students. The regional campus—a collaboration of the UNC School of Medicine, Mission Health System, and the Mountain Area Health Education Center—is part of UNC’s broader strategy of expanding enrollment to meet North Carolina’s need for more physicians [1]. The Asheville campus now has 10 third-year medical students, and this established program has outcomes data demonstrating its academic effectiveness and its positive impact on both students and faculty members.

Longitudinal integrated clerkships (LICs) are increasingly being recognized as an effective alternative to traditional block rotations for medical students [2, 3]. Key features of an LIC curriculum include students’ participation in providing comprehensive care for an identified group of patients over time, and a continuous learning relationship with supervising clinician-preceptors. Through these experiences, LICs help students meet core clinical competencies across multiple disciplines simultaneously [4].

The Asheville campus of the UNC School of Medicine was the first location in North Carolina to offer an LIC curriculum. The LIC pairs students with attending physicians in each of the core third-year outpatient-based specialties; students participate in each specialty for a half-day per week throughout the third year. The typical third-year schedule is shown in Table 1. As a result of this schedule, students experience continuity with patients and physicians. Students also follow their patients over time through the health care system. The small class size and gradual expansion of the LIC program have enabled academic and clinical leaders in Asheville and Chapel Hill to refine the curriculum as needed, and this program has emerged nationally as an innovative educational companion to the changing health care system.

Traditionally third-year clinical training in US medical schools is structured such that the reference point is the clinical specialty or hospital service. In contrast, the patient is the educational reference point of the clinical experience in an LIC. The LIC patient-centered learning method allows the student to experience the health system from the patient’s perspective as a series of specialties and silos that are often unconnected. From this perspective, the student can clearly see both the primary care provider’s role as the care connector and the value of a better integrated health care system. Objective evidence shows that students become more aware of the patient’s perspective because of this experience; compared with national norms, the patient-centeredness of LIC students (measured using the Patient-Practitioner Orientation Scale [5]) remains high after the third year.

Here is a typical scenario of a medical student enrolled in the LIC curriculum: Mrs. Smith is seen by medical student AJ at Dr. L’s internal medicine office. An abdominal mass is detected on physical examination, and Mrs. Smith is scheduled for a computed tomography scan of the abdomen, which AJ attends. The mass is suspicious for an ovarian malignancy, and Dr. L and AJ meet with Mrs. Smith to discuss the results and plan their next steps. The patient is referred to a gynecological surgeon; again, the student is present with the patient both for the consultation and the subsequent surgery. The scenario might continue with visits to an oncologist, a geneticist, or even hospice care.

The LIC model offers several benefits. In traditional block rotations, students have blocks that last 4–8 weeks and concentrate on 1 discipline; thus faculty members and residents have little opportunity to get to know the student well enough to offer meaningful feedback and mentoring. In the LIC curriculum, students develop longer-term relationships with faculty, staff, patients, and other students in their cohort. End-of-year evaluations indicate high levels of stu-
dent and faculty satisfaction (average score, 4.6 on a 5-point scale). Low faculty turnover has resulted in an experienced cadre of clinical teachers who have refined their teaching and evaluation methods and have learned to allow students a great degree of responsibility in patient care.

Because the LIC curriculum involves less time in the hospital setting, some educators have questioned students’ depth of medical knowledge and readiness for internships. However, we have reviewed 4 years of data for the Asheville LIC program—including results of “shelf exams” (National Board of Medical Examiners Subject Exams), scores on Step 2-CK (Clinical Knowledge) of the United States Medical Licensing Examination (USMLE), overall clinical grades, evaluations of students during their fourth-year acting internships, and follow-up interviews with graduates—and we have found no evidence that such concern is warranted. All of our students had higher USMLE scores on Step 2-CK than on Step 1, in some cases by more than 2 standard deviations (see Table 2); in addition, clinical grades, shelf exam scores, and evaluations of acting internships have been higher for the Asheville LIC cohort than for the third-year class as a whole. The clinical logs of Asheville students indicate that they have consistently completed a higher percentage of their core clinical cases and procedures than have their peers in Chapel Hill, and almost all of the Asheville LIC students have matched in their first choice of residency. Finally, although influencing students’ choice of specialty has not been a specific focus of the Asheville campus program, a higher percentage of these students (80%) have entered internal medicine, family medicine, pediatrics, or psychiatry.

Table 3 summarizes the unique aspects of the LIC model compared with traditional block rotations; these features allow the LIC model to address particular issues in the emerging health care system and to help students make informed career choices. Much of this flexibility comes from the unscheduled half-days and from focusing on more than one specialty at a time.

Given the successes of the Asheville LIC program, expansion from 10 students to 20 students is planned for the 2014–2015 academic year. In addition, 7 first-year students at the UNC School of Medicine were selected in January 2013 for the first class of the Sarah Graham Kenan Rural and Underserved Medical Scholars Program. As part of this experience, students will complete a 6-week summer internship in rural Western North Carolina between their first and second years. The students in this rural scholars program are automatically accepted into the Asheville LIC track. This innovative program is another example of the UNC School of Medicine’s commitment to adapt its educational strategies to meet the changing health care needs of our state.

In summary, the Asheville campus of the UNC School of Medicine has developed a successful program utilizing an LIC curriculum. Academic evaluations have been positive, and preliminary results suggest that graduates are more patient-centered, more likely to see a broad range of conditions and procedures, better informed for career decisions, highly competitive for residencies, and more likely to pursue primary care or psychiatry. If possible, the LIC model should be expanded throughout the state to meet the needs of North Carolinians in the emerging health care system.
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Acknowledgments

Potential conflicts of interest. J.E.H. and R.A.L. are faculty in the University of North Carolina School of Medicine. N.B. is the director of curriculum and student affairs, University of North Carolina School of Medicine, Asheville Campus.

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Campbell University School of Osteopathic Medicine is using a variety of medical simulation systems in the training of its medical students. The simulators allow students to learn and practice skills in a controlled environment, and they enable faculty to challenge students with a broader range of conditions than might ordinarily be encountered during medical training.

A changing medical practice environment is requiring new models for training health care professionals, and medical educators are rapidly incorporating technology into medical education curricula [1]. Technology-enhanced simulation is one component of this new educational paradigm [1]. A combination of factors has led to increased use of clinical simulation across the continuum of health care education. Among these factors are an increased focus on patient safety; the call for a new training model not based solely on apprenticeship; the need to practice and hone skills in a controlled environment; and a desire for standardized, on-demand educational opportunities with outcomes-based evaluation [2]. Medical simulation training has been fostered by the valuable lessons learned from other professions that use simulation for training, such as aviation, the military, and astronautics [3]. In addition, a 2011 review of the literature on technology-enhanced simulation training for health care professionals [1] found that, compared with no intervention, such training is associated with improved outcomes in knowledge, skills, and behaviors.

Simulation is best used as an adjunct to patient care experiences, and its integration into the curriculum should be well planned and outcome-driven [3, 4]. Before simulation is incorporated into the curriculum, medical educators should first determine the circumstances under which such training will have the most impact. The simulation experience must be planned, scheduled, implemented, and evaluated in the context of a broader medical curriculum. Integration of simulation can occur at the course level or across an entire curriculum [3, 4]. However, it has been demonstrated that simulation exercises are most successful when they become part of the standard curriculum rather than being an additional component [5, 6].

Simulations that cover a broad range of patient abnormalities and treatment responses allow students to confront a wider range of disease experiences than they might encounter in clinical training with patients [5]. Simulation may be of particular benefit to prepare students to handle disease processes in a rural area where specialists may not be available. Simulation training also allows for standardization of experience, which will ensure that students are uniformly evaluated on all course competencies.

Campbell University School of Osteopathic Medicine, whose first class of students began training in August 2013, utilizes a variety of medical simulation mannequins, task trainers, and virtual clinical skill systems. The selected systems were targeted to complement the outcomes-based curriculum developed by the faculty. The school has the capability of providing students with realistic simulated experiences that allow them to practice their clinical skills before evaluating and treating real patients. In the simulation lab, students are exposed in a structured environment to both common and uncommon patient situations, some of which are potentially life-threatening.

The Simulation Center

Campbell University has a 9,600-square-foot high-fidelity simulation center in the Leon Levine Hall of Medical Sciences. The simulation center replicates several patient care environments and can train students in a wide range of clinical scenarios. It contains an operating room, an emergency department, an intensive care unit, a birthing suite, a virtual simulation room, 12 objective structured clinical examination (OSCE) suites, an 8-seat computer lab, a 75-seat classroom, and debriefing rooms.

The OSCE center is a versatile 12-bed exam room area, in which each suite is a functioning replica of a real patient exam room. Here students practice their interpersonal com-
munication, physical examination, and clinical assessment skills with standardized patients (actors who present symptoms in a standardized way). All exam rooms are equipped with digital audio and video recording equipment that is hosted by streaming servers, which allows faculty members to provide students with specific feedback regarding their clinical performance.

There is also a virtual hospital, a 9-bed hospital unit where students can care for high-fidelity mannequins in faculty-driven clinical scenarios that encourage problem solving, assessment, intervention, and debriefing. This area of the facility supports training in suturing, airway management, intravenous pump insertion, and other advanced skills.

In the acute care area of the simulation center, patient simulators represent critically ill patients in a range of clinical case scenarios. The area can be used to replicate a recovery room, a preoperative holding area, or a triage bay.

In addition to replicating several clinical settings, the simulation center has several advanced simulation mannequins. For example, the Noelle labor and delivery simulator (Gaumard Scientific) [7] allows each simulated delivery to be precisely controlled while devices track students’ actions. The fetus can be manipulated to resolve a delivery dilemma, and students receive instant feedback regarding force and torque on the fetus as well as fetal head position. All data are graphed and synchronized with the fetal monitor for debriefing and evaluation. The fetus is released on command after the instructor has observed and logged required competencies.

The Human Patient Simulator (HPS; CAE Healthcare) [8] uses patented cardiovascular, respiratory, neurological, and pharmacological modeling to simulate breathing, which allows for training in anesthesia, respiratory care, and critical care. The simulator has oxygen and carbon dioxide gas exchange, and it can present complex surgical, critical care, and drug interaction scenarios. The HPS can simulate several patient conditions, including acute ventricular failure, anxiety/pain/stress, hypertension, hypotension, chronic hypertension, bradycardia, tachycardia, and ventricular failure.

Another patient simulator, SimMan 3G (Laerdal Medical) [9], measures the quality of cardiopulmonary resuscitation, providing real-time feedback regarding compression rate, depth, release, and hands-off time. In addition, SimMan 3G can respond appropriately to treatment; it automatically registers the amount, speed, and type of drug and activates the appropriate physiological responses.

“Harvey,” a cardiopulmonary patient simulator used with the UMedic Multimedia Computer Curriculum in Cardiology [10], simulates nearly any cardiac disease by varying blood pressure, pulse, heart sounds, and murmurs. The simulator is structured to start with common, less complex conditions and then progress to more rare and complex diseases. For example, the software packages include normal heart sounds, innocent murmurs, aortic valve stenosis, hypertension, angina pectoris, pulmonary stenosis, and ventricular septal defect. In addition, the current version of Harvey’s software covers history, bedside findings, all laboratory data, and medical and surgical treatment.

The SonoSim Ultrasound Training Solution [11] provides didactic, knowledge assessment, and hands-on training modules that use real patient ultrasound cases. The opportunity to practice in a risk-free virtual environment allows students to perfect their skills, and clinical scenarios subsequently challenge users to apply their newly acquired skills in ultrasound image acquisition and interpretation.

Finally, SimCapture (B-Line Medical) [12] allows the recording of each simulation training activity and automatically creates a portfolio for each student. The SimCapture debriefing software generates trend lines for physiological data and log files for each training event. Educators are able to generate numerous reports in multiple formats to track the usage and effectiveness of their simulation programs.

Curriculum integration is critical to the success and effectiveness of simulation-based health care education [5]. Outcomes are achieved more effectively when simulation is incorporated into a new or existing curriculum using an organized and systematic approach [5]. A comprehensive approach will lead to improved outcomes if it begins by defining or identifying learning outcomes and then matches the learning objectives to the educational methods best suited to teach those objectives [3]. When incorporating simulation into an educational program, simulation technology leaders should meet with and enlist the cooperation of curriculum planners, such as the curriculum planning committee or course director. Providing faculty support—in the form of training, protected time, scenario development tools, and technical support—is also incredibly important in encouraging faculty members to embrace this modality [3]. As with all educational interventions, simulation should be assessed in terms of learning outcomes and participant satisfaction, and modifications can be made as needed [3].

Team Approach

Evidence increasingly shows that conducting simulation training in the context of team training and systems-based practice is a crucial component to improving patient outcomes [3, 13, 14]. If practitioners are expected to function in an interprofessional practice, then schools and colleges must provide students with interprofessional training opportunities. Campbell University has initiated an interprofessional education program to enhance the training of all of its health care students, including those in its pharmacy, physician assistant, public health, and osteopathic medicine programs. (Physical therapy and nursing students will also be included once these programs are fully implemented.) This pathway will begin in the first year of each discipline’s educational program and will continue through the final advanced clinical experiences.

Campbell University recently hosted its initial interpro-
fessional education event for first-year students, which included 3 small-group discussions facilitated by faculty from all programs, and a panel discussion on the current status of rural health in North Carolina. Fifty-four faculty facilitators helped with this program: 19 from pharmacy practice, 6 from pharmaceutical sciences, 7 from physician assistant studies, 2 from clinical research, 3 from physical therapy, 2 from public health, and 15 from osteopathic medicine. Student evaluations were collected and showed consistently excellent evaluations. The interprofessional education committee also collected many constructive comments that will facilitate the planning of future events. We believe that multidisciplinary examination of patient processes will help students better understand the diversity of issues they will encounter in their medical practice.

**Conclusion**

The goal of health care education is to develop competent and caring health care practitioners who are capable of providing the highest level of care to their patients. Determining the optimal path and the elements needed to arrive at this destination remains a challenge and is a work in progress. Over the past 2 decades, electronic simulation has entered the scene in a dramatic fashion, and its use has grown exponentially [1]. Borrowing from other high-risk fields that have been using simulation for quite some time, such as aviation and astronautics, we have begun to deter-

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**Acknowledgments**

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Potential conflicts of interest. R.W.M. and R.J.S. are employees of Campbell University.

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Retention Initiatives in the North Carolina Community College System

Renee Godwin Batts

Over the past 15 years, the North Carolina Community College System has provided education and instruction to 258,713 allied health professionals, 183,059 nurse aides, 27,125 associate-degree nurses, and 9,926 practical nurses. Innovations that can increase program retention will have a positive impact on the state’s future health care workforce.

The North Carolina Community College System (NCCCS) is committed to meeting the educational needs of the state’s current and future health care workforce. All 58 community colleges in the NCCCS offer one or more health science programs, and the system currently has 57 health science program titles available, which provide education at the associate, diploma, or certificate level.

Between 1997 and 2012, the NCCCS provided education and instruction to more than a quarter of a million (258,713) allied health professionals. Of these, 56% received training in emergency medical science (EMS), 12% in diagnostic services, 10% in health information, approximately 4% in dental or visual care, and 3% in therapy/rehabilitative programs (health and fitness science, occupational therapy assistant, physical therapy aide, physical therapy assistant, rehabilitation assistant, speech-language pathology assistant, therapeutic massage, and therapeutic recreation assistant). Another 16% received training in a range of other subjects, including medical assisting, surgical technology, and respiratory therapy. During the same period, 183,059 nurse aides, 27,125 associate-degree nurses, and 9,926 practical nurses received their education in the NCCCS (unpublished data from the NCCCS data warehouse; February 2013). Overall the NCCCS provides educational instruction to approximately 85% of the students enrolled in allied health programs in the state [1]. The NCCCS also provides prelicensure education for the majority of graduates in North Carolina who sit for the National Council Licensure Examinations for registered nurses (NCLEX-RN) and practical nurses (NCLEX-PN).

North Carolina’s need for nursing and allied health professionals will continue to grow not only because of the influx of new residents into North Carolina but also because of the state’s aging population and its aging workforce. In 2011, there were 53 counties in North Carolina in which the number of residents older than 60 years was greater than the number of residents younger than 17 years. It is projected that by 2025 the state will have 86 counties in which residents older than 60 years outnumber those younger than 17 years [2].

One major issue affecting the health care workforce is attrition in nursing and allied health education programs, which is costly both to the educational system and to students [1, 3, 4]. Because community colleges play a key role in the education of health care providers, reducing attrition in this setting would have a positive impact on students, community colleges, and the state’s health care workforce.

A 2008 report on the success of programs in the NCCCS that offer an associate degree in nursing (ADN) noted that 90% of the 2002 graduates of those programs worked in the state after graduation, which is a compelling reason to reduce the attrition rate of community college programs [3]. After publication of this report, many community colleges began evaluating their attrition rates, identifying contributing factors, developing strategies and interventions, and implementing changes. For example, colleges have looked at their individual admission requirements and orientation sessions to ensure that students are fully aware of program expectations. Schools have also developed remediation activities and early alert systems for students who experience academic difficulties.

Five community colleges received funding from the US Department of Education’s College Access Challenge Grant Program during the period from November 18, 2011 through June 30, 2012, and 16 different colleges received such funding during the period from November 1, 2012 through June 30, 2013; these funds were used to implement strategies to improve retention rates of at-risk students enrolled in health science programs. The amount of funding given to individual colleges ranged from $5,011 to $12,005 over a 6-month period. At each of the colleges selected for funding, health science personnel identified the disciplines they would target—nursing, surgical technology, pharmacy technology, EMS, etc. Students considered to be at risk for attrition included first-generation college students; those with

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a certificate of high school equivalency rather than a high school diploma; students who had taken remedial courses; those working more than 20 hours per week; those lacking family support and/or transportation; students with significant family responsibilities, such as caring for children or other dependents; students who had been readmitted into the program; those who scored less than 80% on a course test; and those receiving a rating of “unsatisfactory” on a clinical evaluation.

Each of the 21 colleges that received College Access Challenge Grant funding identified specific strategies they would employ to reduce attrition among at-risk students. Strategies included administering a learning style test to the students and providing faculty members with professional development in learning styles and instruction modalities; establishing program-specific tutors to work with students; and providing students with individualized supplemental instruction plans that cover topics such as test-taking strategies, study skills, critical thinking skills, problem-solving activities, time management, and organization. Another strategy is to increase the use of technology to deliver content at the student’s convenience. Such technologies included SmarThinking—a live, on-demand, online tutorial that provides access to expert nursing and allied health educators 24 hours a day, 7 days a week; Livescribe smartpens, which have an embedded computer and digital audio recorder; and video learning modules.

Other approaches to reduce attrition include developing and using clinical reasoning and simulation scenarios to help meet students’ learning needs, both in the classroom and in clinical areas; providing a retention counselor, facilitator, nursing success coach, or advisor for students; and providing standardized practice tests that give students an opportunity to practice test-taking, improve their knowledge of content, and enhance their problem-solving skills. In some cases, mandatory tutoring sessions are required for students who do not achieve the required test score in the course. Finally, students may be screened for Irlen syndrome, a light-perception disorder that inhibits reading skills and can be alleviated by using color overlays over materials.

Most of the funded colleges initiated their interventions with students in the spring semester and reported a slight increase in their spring retention rate compared with that of the fall semester or the previous year. The number of students in each cohort was small and any long-term impact is unknown at this time, but colleges will continue to evaluate these cohorts to determine whether the implemented strategies and interventions had long-term impacts on retention.

Several other initiatives in the health sciences may also have an impact on education for health science students in the NCCCS. A comprehensive study of the system’s ADN programs was conducted by the Cecil G. Sheps Center for Health Services Research at the University of North Carolina at Chapel Hill [3], and a curriculum improvement project was carried out from 2006 to 2008 to redesign the ADN curriculum. This resulted in a new, concept-based curriculum standard and new nursing courses for community colleges. Another initiative was a curriculum accreditation alignment project in 2012–2013 that brought the EMS curriculum standard in line with changes in national EMS education standards. The revision allows more flexibility, expands content, strengthens alignment with the North Carolina Career and College Promise program, and facilitates diploma and certificate options for colleges. Finally, a practical nursing and nursing assistant curriculum review project was initiated in October 2013 and is scheduled to be completed by June 2014. Changes to the practical nursing program are needed to provide a seamless concept-based transition for licensed practical nurses entering an ADN program.

In the 2010 summary report The Future of Nursing: Leading Change, Advancing Health [5], the Institute of Medicine of the National Academies recommended that educational systems promote seamless academic progression. One effort to fulfill this goal is the Regionally Increasing Baccalaureate Nurses (RIBN) initiative [6], which involves collaboration among the community college system, the university system, and the Foundation for Nursing Excellence. In this collaborative partnership, a student is dually admitted into both a community college program and a university program. During the first 3 years of study, the student completes general education and nursing courses at the community college and takes 1 course per semester at the university. After successfully completing these courses, the student will receive an ADN from the community college and will be eligible to sit for the NCLEX-RN examination. The student then completes a fourth year of study on the university campus, where he or she will take nursing courses in gerontology, community health nursing, and nursing leadership. On completion of the fourth year, the student will be awarded a bachelor of science in nursing (BSN) degree.

In 2010, students in the first cohort of the RIBN program were dually admitted to Asheville-Buncombe Technical Community College and Western Carolina University. Statewide, 25 of the 55 community colleges that are approved to offer an ADN are partnering with neighboring universities to participate in the RIBN initiative [6]. [Editor’s note: For more information on the RIBN initiative, see the commentary by Johnson on pages 39–44 and the sidebar by Dickerson on page 40.]

Another important transfer initiative includes the review and revision of the Comprehensive Articulation Agreement between the NCCCS and the University of North Carolina (UNC) system. The agreement governs the transfer of credits when students complete 2 years of undergraduate study at a community college followed by 2 years of study at one of the state’s public universities.

Also, a subcommittee comprised of UNC system RN-to-BSN program directors is working on developing a common
A common core of required courses would smooth the educational pathway for RNs who have an ADN and would remove a barrier for those seeking a BSN degree.

On October 18, 2013, the State Board of Community Colleges approved a new curriculum standard for Health Science: Therapeutic and Diagnostic Services [7], which will take effect in fall of 2014. The proposed standard consists of general education courses that provide a foundation for success in nursing and allied health programs, including biology, psychology, critical thinking, and mathematics. Additional non-general education courses include orientation to the health sciences, medical terminology, cardiopulmonary resuscitation, and other technical courses that form the foundation of 6 program majors: EMS, medical assisting, nursing assistant, pharmacy technology, phlebotomy, and therapeutic massage.

The new curriculum standard serves as a guidance tool to help students choose specific courses that will provide a foundation for success in nursing and the allied health programs. The new standard also provides additional Career and College Promise pathway options for high school students and establishes program coding that facilitates accurate data collection for students enrolled in pre-health science programs. Finally, the standard will strengthen the applicant pool and increase completion rates in health science programs.

Initiatives in health care education will continue, because educating the state’s health care workforce is a top priority of the NCCCS. We are proud that colleges in the system provide qualified health care professionals (nursing and allied health) for the state, and we will continue to strive to ensure that North Carolinians have qualified health care practitioners wherever they are needed: at the scene of accidents and in hospitals, long-term care settings, physician offices, clinics, community centers, and patients’ homes.

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Acknowledgment
Potential conflicts of interest. R.G.B. is an employee of the North Carolina Community College System.

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Meeting North Carolina’s Health Care Needs Through Interprofessional Education and Practice

Elizabeth Griffin Baxley, Paul R. G. Cunningham

To meet the future health care needs of North Carolinians, health professions students must learn how to work together as part of an interdisciplinary team. This commentary describes how interprofessional education and team-based care can decrease the number of adverse events, improve health care delivery, and support consistent outcomes.

Medicine has experienced dramatic changes since the pre-penicillin era, when doctors could often offer their patients only hope, rather than a cure. Now there are many more diagnoses, more diagnostic modalities, more therapies, and many additional complexities in our systems of care. Patients are living longer but often have more chronic conditions, and these conditions are frequently compounded by mental health comorbidities that make self-management more challenging than ever before.

These facts have not gone unnoticed, and experts have attempted to define the changes in care that will be needed. A 1995 Pew Health Professions Commission report [1] contained these observations:

The system that is emerging will be integrated through delivery of primary care. This will mean that all health practitioners, generalists and specialists, must be able to understand the values and functions of coordinated, comprehensive, and continuous care and direct their practices to support such goals...The complexity and acuity of care needs in the emerging system will require the health professional to be able to work effectively as a team member in organized settings that emphasize the integration of care.

Current debate [2] continues to probe and to ask important questions regarding which strategies will best serve the needs of our citizens. Despite this debate, more physicians and other health professionals are clearly needed to care for North Carolinians now and in the future. Explorations have focused on specific components of the health care workforce, such as physicians who practice primary care and direct care workers [3]. There has been no full and objective assessment to evaluate the impact of an interdisciplinary team of individuals who provide care in an integrated manner.

Systems Errors Emerge as the Complexity of Care Changes

Medical errors and concerns about quality of care have risen to the forefront of public attention since the Institute of Medicine of the National Academies’ report To Err is Human [4] asserted in 2000 that systemic failures of health care delivery are responsible for these problems. Health care of the future must be evidence-based, standardized, reliably delivered, efficient, equitable, and patient-centered. In order for this to happen, we must have models of care that emphasize health care professionals working collaboratively and in partnership with patients, families, and communities [5].

Medicine has historically been based on the autonomous expertise, independence, and self-sufficiency of the physician, but medical knowledge has grown by quantum leaps and can no longer be understood by a single physician. Similarly, more can be done for an individual patient than any one person, or the traditional doctor-nurse pair, is able to do. Therefore medicine can no longer be an individual sport—it must be a team sport. As physician Atul Gwande said in his Harvard Medical School commencement address in 2011 [6], “Medicine no longer needs cowboys. It needs pit crews.”

The Core Competencies for Interprofessional Collaborative Practice Report (2011) [7] states that interprofessional collaborative practice is “key to the safe, high quality, accessible, patient-centered care desired by all.” The skills acquired through interprofessional team training have been associated with a significant decrease in the number of adverse safety events, especially in high-risk situations [7].

Health Professions Education Must Lead Systems Improvement

Health professions students often receive little instruction in team training or the communication skills needed to support a culture of patient safety and outcomes-based
Faculty-led experiential learning that is aligned with organizational goals for patient safety, quality improvement, and team-based care can help to achieve quality and safety goals and to improve the education and competency of clinical trainees [9]. However, traditionally trained medical educators are not equipped with the knowledge, attitudes, and skills required for teaching these competencies [8, 10]. In particular, few educators have ever participated in interprofessional education or grown comfortable with team-based care programs [10].

Using Interprofessional Education and Practice to Improve Health in North Carolina

Because the residents of Eastern North Carolina demand and deserve the very best health outcomes, East Carolina University (ECU) has implemented a multidimensional, cross-disciplinary approach to health professions education (see Table 1). Several large grants are helping to propel the curriculum forward in the areas of patient safety, quality improvement, patient safety, and interprofessional education and team-based care. A key factor for success in accomplishing the magnitude of curricular change needed is the presence of committed faculty members who understand, practice, and can teach future generations of health professionals how to create optimal care environments using effective care teams.

Contemporary models of education reform focus on the belief that health care professionals who learn together are more likely to develop the competencies needed to work together effectively to care for patients and communities [7]. A key factor for success in accomplishing the magnitude of curricular change needed is the presence of committed faculty members who understand, practice, and can teach future generations of health professionals how to create optimal care environments using effective care teams. According to a recent report on interprofessional education by Headrick and colleagues [8], “a commonly encountered limiting factor . . . was the lack of a critical mass of clinically based faculty members who were ready to teach about the improvement of care.”

### Table 1.
Selected Active Interprofessional Programs and Projects at East Carolina University (ECU)

<table>
<thead>
<tr>
<th>Educational program</th>
<th>Departments (Leaders)</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMA Accelerating Change in Medical Education</td>
<td>Brody School of Medicine at ECU (Elizabeth G. Baxley, MD, and Luan Lawson, MD, MAEd)</td>
<td>To implement an integrated, comprehensive curriculum in health care quality improvement, patient safety, and interprofessional education and team-based care.</td>
</tr>
<tr>
<td>Enhancing the Care of Women throughout the Lifespan Using Virtual Technology in Interprofessional Education*</td>
<td>ECU College of Nursing (Pamela Reis, PhD, MSN, CNM)</td>
<td>To evaluate clinical and interprofessional competencies of nurse midwifery students and third-year medical students and to examine students’ attitudes toward interprofessional teams and interprofessional education.</td>
</tr>
<tr>
<td>Integrated Behavioral Health Care Social Work Projectb</td>
<td>ECU School of Social Work; Brody School of Medicine’s Department of Family Medicine (Nancy Pierson, MSW, LCSW)</td>
<td>To address disparities and inefficiencies in the health care system.</td>
</tr>
<tr>
<td>Leadership Development Learning Module</td>
<td>ECU College of Allied Health Sciences (Emilie Walter Cellucci, PhD)</td>
<td>To make available self-paced online learning that focuses specifically on the topic of interprofessionalism in the allied health professions.</td>
</tr>
<tr>
<td>ECU medical, dental, and social work students join adult gerontology nurse practitioner and family nurse practitioner students in clinical learning experiences†</td>
<td>ECU College of Nursing (Bobby Lowery, PhD, MN, FNP-BC)</td>
<td>To promote interprofessional collaboration.</td>
</tr>
<tr>
<td>Office of Clinical Skills Assessment and Education</td>
<td>ECU Division of Health Sciences (Maria C. Clay, PhD, and Patrick A. Merricks, MBA)</td>
<td>To promote interdisciplinary and interdepartmental collaboration in health professions education by providing a variety of performance-based activities and physical examination labs in which students from multiple health sciences disciplines can learn together, and to provide interprofessional educational material for specific courses and extramurally funded projects.</td>
</tr>
<tr>
<td>Medical Simulation and Patient Safety Program, Interprofessional Clinical Simulation Program</td>
<td>Brody School of Medicine at ECU (Walter C. Robey III, MD, FACEP)</td>
<td>To provide a collaborative environment in which health professionals learn, train, work, and rehearse together in a reality-based simulated environment.</td>
</tr>
<tr>
<td>Library Liaison Program</td>
<td>William E. Laupus Health Sciences Library (Katherine Rickett, MSLS, MSEd)</td>
<td>To train students to efficiently locate evidence-based information and to facilitate participation in interdisciplinary programs.</td>
</tr>
<tr>
<td>Food Literacy Partners Program</td>
<td>Department of Public Health, Brody School of Medicine at ECU (N. Ruth Little, MPH, project director; supported by Libby Baxley, MD, and Kerry Littlewood, PhD, MSW)</td>
<td>To offer interdisciplinary community engagement opportunities for public health, medical, and social work students who are interested in providing hands-on nutrition and health education programming throughout Pitt County.</td>
</tr>
</tbody>
</table>

Note. AMA, American Medical Association.
*Funded with a Health Resources and Services Administration grant for interprofessional education.
†The collaborative internship program at ECU was 1 of 28 in the nation selected for the Integrated Behavioral Health Care Social Work Project.
‡Funded with a grant from the Health Resources and Services Administration.
ity improvement, team-based care, and population health. These training grants involve curricular changes that will bring health professions students together for portions of their training in more formalized and deliberate ways.

In addition, an interprofessional chapter of the Institute for Healthcare Improvement’s Open School was established at ECU in June 2012. This is a learning community of more than 170,000 health professions students worldwide who meet in local chapters to learn more about the competencies listed above and about how they can improve health care systems together. An Interprofessional Alliance for the Health Sciences has also been formed within ECU’s Division of Health Sciences, and it is strategically planning to create a model of interprofessionalism that can be used for medical practice, service, education, and research.

North Carolina needs more health care providers. The physician shortage has been well documented and has been defined in workforce projections. However, even if our medical schools continue to graduate more and more physicians and these graduates are geographically distributed in the areas of North Carolina with the greatest health disparities, we will still not meet the needs of North Carolinians if we do not intentionally change the model of health professions training. This new model must include the training and graduation of students from all of our health professions schools, such that graduates leave the educational environment knowing how to work in teams with the ability to recognize and value the skills of each team member. Only through this type of educational transformation can we realize the potential to create a healthier group of citizens who can actively participate in their own health care and who can engage with teams of health professionals working together on behalf of our communities. That is the goal of our educational programs at ECU, and we are preparing to bring about this change for a better future.

Forecasting the Future

No one can convincingly forecast all of the changes that will be needed to create a more effective health care system. However, our payment system is clearly changing; we have been transitioning from a volume-based fee schedule to a value-and-outcome–based fee schedule, and such changes are likely to continue. It has also become clear that the traditional, iterative approach to team care will need to become more efficient, so priority is being given to metrics that assess team performance rather than individual performance.

A number of questions remain unanswered: What organizational structure will promote the best practice in a clinical setting? How will we fully maximize the partnerships that will be required in the future? In what ways will the transformation of our educational practices close the communication gap between providers and patients? And in what ways should we deploy technological advances to the benefit of these initiatives?

Discovering the answers to these questions is the collective imperative of our educational institutions and health care systems throughout North Carolina and the United States. Only after we have answered these questions will we be able to enjoy a health care system that truly promotes health. NCMJ

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Acknowledgment
Potential conflicts of interest. E.G.B. and P.R.G.C. are employees of East Carolina University.

References
To address the underrepresentation of ethnic minorities in research-focused nursing doctoral programs, Winston-Salem State University (WSSU) Division of Nursing has partnered with Duke University School of Nursing to establish a Bridge to the Doctorate program. This program provides a research honors track for graduate nursing students from underrepresented minority groups who are enrolled at WSSU, with the aim of preparing them to seamlessly transition into a PhD program at Duke University.

In a landmark report titled *The Future of Nursing: Leading Change, Advancing Health* [1], the Institute of Medicine of the National Academies in 2010 illuminated the need for the nation to double the number of nurses with doctoral degrees by 2020 and emphasized the importance of fostering diversity. Doubling the pool of nurses with doctorates is essential to ensure that there will be enough faculty to convey the skills, knowledge, and experiences that future nurses will need to pursue science and discovery, to provide high-quality care, and to manage a large population of patients in an increasingly complex, diverse, and technology-driven health care system [2]. To ensure that health research questions and interventions include issues that are culturally important for minority groups, education programs must also train researchers belonging to these groups [3].

Although nursing has made great strides in recruiting underrepresented racial and ethnic minority students into research-focused doctoral programs, the total number of minority nurse scientists is less than optimal. In 2012 individuals from ethnic and racial minority groups accounted for more than a third (37%) of the US population [4], a proportion that is expected to grow. Students from minority backgrounds currently account for 27.7% of enrollment in research-focused doctoral programs for nurses, but the minority population is increasing faster than the number of minority nurse scientists and faculty members [5].

Regardless of race or ethnicity, the standard route via which American nurses enter doctoral programs is by first obtaining a bachelor of science in nursing (BSN), then a master of science in nursing (MSN), and finally a PhD; typically there are significant time gaps between each program [6]. To meet the profession's need for more nurse faculty members and researchers, an alternative pathway has recently become available with the advent of “fast-track” bachelor-to-doctoral degrees [7]. However, facilitating rapid progression from an MSN degree to a PhD remains challenging, particularly among underrepresented minority students. The median age of individuals who received nursing doctoral degrees in 1999 was 46.2 years, with a median of 15.9 years from when the student first enrolls in a graduate program to when he or she is awarded a doctorate in nursing; in comparison, the median time from first enrollment to a doctoral degree in other fields is 8.5 years [8].

The collaboration between Duke University School of Nursing (DUSON) and the MSN program at Winston-Salem State University Division of Nursing (WSSU-DON) hopes to change this situation. Together, WSSU and Duke University have established a Bridge to the Doctorate program, a research honors track designed to enable underrepresented minority students in the MSN program at WSSU-DON to seamlessly transition into a PhD program in nursing or other biomedical or behavioral disciplines at Duke University (http://wssubridge2phd.nursing.duke.edu/). Students in the program will complete their doctoral work at Duke within 6 years of beginning work on an MSN degree at WSSU.

WSSU, a constituent institution in the University of North Carolina system, is 1 of 108 historically black colleges and universities in the United States. WSSU has always had a mission of delivering high-quality education to diverse students. DUSON also has a commitment to increase diversity and inclusiveness in pedagogy, research, and the profession; the school aims to fulfill this commitment in part by broadening research questions and methodologies, particularly around the challenges of health disparities. The Bridge to the Doctorate program facilitates the education and research missions of both institutions.

**Program Aims**

Through a partnership between the DUSON and WSSU-DON faculties, the Bridge to the Doctorate program is
implementing a 17-credit-hour research honors track in the MSN program at WSSU. The track consists of early and ongoing mentored research experiences, new and existing research courses, a year-long integrated intensive mentored research experience—including an intensive 8-week summer research internship at Duke University—and multiple mentoring and enhancement experiences.

The goal is to ensure that Bridge students are positioned to be highly competitive applicants for admission into biomedical or behavioral science PhD programs in nursing or related disciplines at Duke University. After Bridge students enroll in a PhD program, faculty members continue to provide mentoring, counseling, enrichment experiences, and tutoring as needed. The Bridge to the Doctorate program also strengthens the research environment of WSSU-DON through the development of enhanced MSN research courses, monthly research seminars, an enhanced annual research symposium, and ongoing mentored faculty development.

Key Program Components

The program is innovative because Bridge students have access to a vast network of research and academic resources and social supports throughout the 2-year MSN program, to prepare them for the critical transition into a PhD program. Students progress through a rigorous research honors track working alongside faculty mentors from both institutions. Students learn the research process as they interact with and learn from interdisciplinary scientists in the field and participate in formal research seminars, team discussions with mentors, and interdisciplinary research team meetings. During the summer, students have an opportunity to experience the academic environment and culture at Duke University during an 8-week intensive immersion experience, at which time they work with mentors, PhD course faculty members, and students who are currently enrolled in DUSON’s PhD program.

The research honors track. The research honors track features early hands-on research experiences, a long-term relationship with a mentor for each student, and a number of required new-for-credit enhancement activities. Delivered concurrently with the MSN curriculum in the student’s chosen nursing specialty, the research track is organized around 4 core components essential to research training: a strong scientific knowledge base, relevant research skills, enhanced communication skills, and appropriate leadership skills [9]. Classes cover graduate research methods, statistics, writing for publication, and research thesis coursework.

The integrated intensive research practicum. The research practicum is delivered through a combination of video-conferencing and face-to-face sessions. The practicum begins with an 8-week, 40-hours-per-week intensive research experience at Duke University facilitated by the primary research mentor from Duke and supported by the WSSU-DON research mentor. During the 8-week immersion experience, students actively engage with the interdisciplinary research team of the primary mentor, learn details of the research project to which they are assigned, and develop an understanding of how a project is developed, implemented, and analyzed. The student assumes an active role in the execution of the mentor’s research and participates in planning new research, grant writing, data collection, data entry, data cleaning, and data analysis. Bridge students also participate in a wide range of educational and social activities with DUSON PhD students, and they spend 1–3 days with each of several researchers in a variety of disciplines, research centers, and institutes across the campus in order to learn about different research methods.

Mentorship. Mentors are essential to the development of research scientists and play a pivotal role in the Bridge to the Doctorate program. In 2002, Byrne and Keefe [10] reported that the focus of nursing mentorship had changed over the preceding 3 decades. Earlier, mentoring had focused on executive leadership roles, whereas the current emphasis includes mentorships for expert clinicians, advanced practice nurses, and researchers. The Bridge program includes primary nurse faculty mentors from both DUSON and WSSU-DON who are scientists with diverse backgrounds and intellectual perspectives in nursing and other biomedical and behavioral sciences. Faculty mentors work collaboratively to provide academic, scientific, emotional, and informational support and to assist students as they acquire knowledge, develop research skills, enhance communication skills, and hone leadership skills. From their unique vantage points, faculty mentors can connect students with the wide range of resources available at each institution, giving students opportunities to collaborate with expert clinicians and research scientists and to work in state-of-the-art facilities.

Mentorship in an academic environment should improve the mentee’s academic and research career, independent of intra-organizational hierarchy [11]. Primary investigators and administrators are working to develop faculty mentors and to model collegial research relationships that guide nursing mentees who are members of an ethnic minority group. The Bridge program works diligently to ensure that faculty members are actively engaged in the effective execution of the mentorship process through self-reflection, active team dialogue, and continuous evaluation.

Mentorship by student peers at WSSU-DON and by PhD students at Duke University is another important component of the program. Since the program began in summer 2013, Bridge students with clinical expertise from prior nursing experience have emerged as mentors for peers who have just completed their undergraduate education. Although peer mentoring is not a new model on college campuses [12], it usually occurs as a planned activity rather than emerging spontaneously. According to Noone [13], ethnic minority students may be more comfortable in learning environments where collaboration is emphasized over competition. Peer mentoring thus supports the success of the entire Bridge cohort.
The WSSU-Duke partnership is supportive of faculty mentors and their mentees. This partnership has strengthened the research environment, peer mentoring, collaboration, and clinical and research scholarship. These early advances in mentoring of ethnic minority students as they train to become nurse researchers are critically important if we are to address the complex relationships that exist among individual, interpersonal, institutional, social, and political factors that influence health outcomes.

Student research. Research guided by the primary mentors is the final component of the Bridge program. Students develop their research thesis during the first year of the program and continue to work on their research during the 8-week immersion experience and throughout the last year of their MSN coursework. Students receive institutional review board approval for their research, analyze the data, prepare their thesis, submit an abstract for presentation at a national research conference, and submit a manuscript for publication. The dissemination of their scholarship is essential to Bridge students’ development as they transition into their PhD programs, and this research will position them well for admission to such programs.

Significance of the Program

Few members of underrepresented minorities hold doctorates or are enrolled in PhD programs in nursing or related biomedical and behavioral science programs [14, 15]. This number is not likely to increase much without significant intervention, and the Bridge to the Doctorate initiative is currently funding only 2 other nursing programs in the nation—one at the University of California, Los Angeles and one at the University of Illinois at Chicago [16]. Despite the distance between Duke University and WSSU, the 2 schools are taking a leadership role in addressing the serious disparity in nurses’ access to doctoral education and providing an innovative model that other institutions can emulate. This collaborative partnership not only expands both institutions’ capacity but also enriches the cultural and academic milieu by creating a pipeline through which underrepresented minorities are primed for transition to PhD programs in nursing and related scientific disciplines. This program also has the potential to influence the research agenda by broadening research questions and methodologies, particularly around the challenges of health disparities.

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Acknowledgments

The Bridge to the Doctorate program is funded by a grant from the National Institute of General Medical Sciences of the National Institutes of Health (Grant Number: IR25GM102739-01; Project Title: MSN Nursing Program Partnership for Bridges to the Doctorate). We would like to thank Julie Cusatis (program coordinator, Winston-Salem State University–Duke Nursing Bridge to the Doctorate) and Terry Valiga (professor and director, Institute for Educational Excellence, Duke University School of Nursing) for editorial assistance.

Potential conflicts of interest. D.H.B. and D.L.P. are employees of Duke University School of Nursing. J.C.-N. and E.O.O. are employees of Winston-Salem State University.

References

A Postprofessional Distance-Education Program in Neurodiagnostics and Sleep Science

Auburne Overton

Sleep medicine is a quickly growing field of allied health and preventive medicine. The University of North Carolina has proven innovative and timely in offering a neurodiagnostics and sleep science bachelor’s degree program for the sleep medicine profession.

The Department of Kinesiology in the College of Health and Human Services at the University of North Carolina (UNC) at Charlotte, in collaboration with the Departments of Allied Health Sciences and Neurology in the School of Medicine at UNC-Chapel Hill, has developed a postprofessional baccalaureate-degree program in neurodiagnostics and sleep science (NDSS). Offering a bachelor of science (BS) degree to sleep technologists and electroneurodiagnostic technologists who are already registered and practicing in their respective fields, this program can increase students’ professional knowledge and expand their opportunities for career advancement. This program is the first of its type in the nation, and it is working to set the national standard for future BS degrees in NDSS. Since the program’s first class enrolled in the fall semester of 2011, students have been motivated and qualified practitioners who want to become institutional, educational, and health care leaders. To help students meet these goals, the NDSS program provides a broad foundation in sleep science and teaches critical thinking and problem solving skills.

To assess the demand for a new baccalaureate-degree program in NDSS, a survey was conducted in 2008 of students enrolled in the 5 accredited community college programs in North Carolina that offer a concentration in polysomnography and/or electroneurodiagnostic technology; 82% of respondents indicated that they were interested in pursuing a BS degree in NDSS. To further study the expressed interest in this type of program, a survey was conducted of the students at each of the 33 polysomnography and electroneurodiagnostic technology programs in the United States that have been accredited by the Commission on Accreditation of Allied Health Education Programs; 65% of these respondents said that they were interested in pursuing a BS degree in NDSS.

The NDSS program at UNC-Charlotte is offered via distance-learning delivery methods. Due to the nature of their work, sleep technologists are inherently technologically savvy and adapt readily to the distance-learning format. This method also works well for sleep technologists because of their varied work schedules. Offering courses online allows all students to access the same information, regardless of their work and life schedules, which facilitates participation and engagement in the courses. Offering the courses via distance learning also makes the program available to students regardless of their physical location. Thanks to the distance-learning delivery model, students are able to participate in all of the program’s educational experiences through various means of online collaboration. There are also internship and capstone requirements that students must fulfill at various times throughout their program of study. Students can either develop relationships with professionals in their own geographic locale, or they can travel to Chapel Hill for a short period of time to complete these requirements.

The need for technologists with higher levels of education has arisen as the roles and responsibilities of technologists have expanded; sleep technologists are now dealing with different patient populations, and they are expected not only to be knowledgeable about technical subjects but also to be capable of managing resources and finances. In particular, health care reform and the increased emphasis on preventive health care have been major contributing factors in emphasizing the importance of sleep medicine, as treatment of sleep disorders is a preventive cost-savings measure. Patients with undiagnosed sleep disorders have at least twice the utilization of care and double the healthcare costs of those whose sleep disorders have been treated [1-3], and at least one quarter of all Americans can benefit from evaluation of obstructive sleep apnea and other sleep disorders [4].

The constant development of new diagnostic and treatment technologies has also produced change in this field, and it will likely continue to do so. The role of nighttime technologists is changing, as these technologists are expected to perform more specialized clinical testing—including seizure
monitoring, dental device titration, and servoventilation. Daytime technologists are also seeing their job descriptions change with the inclusion of additional duties, such as providing more patient and community education, providing patient follow-up, monitoring patients for treatment compliance, teaching patients to use durable medical equipment (eg, continuous positive airway pressure [CPAP] machines), marketing, and other leadership and management duties.

The rapid growth in home sleep testing is another potential concern for sleep technologists. While home sleep testing is not necessarily less accurate than a full polysomnogram, home sleep tests are not continuously monitored and examined by trained professionals and do not collect the same amount and types of physiological data. Thus many comorbidities and sleep-related complications may be omitted from a patient’s treatment plan if a lab-based, attended polysomnogram is not performed.

In a survey by the journal Sleep Review, 50% of sleep labs reported that they currently offer home sleep testing to Medicare patients, and 64% reported that they offer it to patients with private insurance [5]. Many technologists fear that this trend will become a threat to their livelihood, as more patients seek to have home sleep testing rather than being tested and treated in traditional sleep labs. However, there are still patients with comorbidities and/or severe complications who need to undergo fully attended sleep studies. In fact, despite the availability of more cost-effective home sleep testing, the vast majority of sleep studies performed over the past 4 years have been facility-based, attended sleep studies (Figure 1) [6]. This creates further need for technologists with the experience and education to treat these sicker patients.

As the trend toward home sleep testing continues to evolve, many technologists may find that they are required to obtain higher educational degrees, such as the BS degree offered at UNC-Charlotte, in order to stay viable in the job market and to lead their profession during this time of change. A sleep medicine workforce with higher levels of education will better serve the needs of our patients through their knowledge and their experience in helping patients navigate complicated sleep disorders and associated comorbidities. These individuals are also poised to serve as leaders of their profession, to move sleep medicine forward as a new foundation in preventative medicine, and to provide innovative diagnosis and treatment for large sections of the population.

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Acknowledgments
Potential conflicts of interest. A.O. is an employee of the University of North Carolina at Charlotte and chair of the Committee on Accreditation of Polysomnographic Technology Education Programs.

References
What do these busy people have in common?

They all got tested for colorectal cancer.
If they have time, so do you.

Screening saves lives. Screening tests help find precancerous polyps so they can be removed before they turn into cancer.

If you’re over 50, take time to see your doctor and get screened.
Running the Numbers

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

The Maldistribution of Health Care Providers in Rural and Underserved Areas in North Carolina

Throughout the ongoing implementation of the Patient Protection and Affordable Care Act of 2010, policy makers have questioned whether North Carolina will have an adequate supply of health workers to meet the increasing demand generated by expanded health insurance coverage. Some organizations have suggested that the state will face a shortage of health professionals, particularly primary care providers [1, 2]. However, more nuanced scrutiny of the data suggests that the critical concern is not an overall shortage of providers, but rather a maldistribution of health professionals relative to population health needs.

Our analysis draws on data from the North Carolina Health Professions Data System, which contains information about the education, employment, and geographic characteristics of health professionals in the state. Data are compiled from annual licensure files from the North Carolina Medical Board and the North Carolina Board of Nursing. In this report, we include data for all licensed physicians actively practicing in North Carolina, except for those who are currently in training or are employed by the federal government. Due to space limitations, we concentrate on the physician workforce in 3 specialties that are facing shortages—primary care, general surgery, and psychiatry [3]. Because numerous studies have suggested that a more flexible deployment of health care workers in new models of care could alleviate workforce shortfalls [4, 5], we also include data on licensed nurse practitioners (NPs) and physician assistants (PAs) actively practicing in the state.

While we cannot perfectly forecast the number of physicians who will be needed in the future, benchmarking the relative supply of physicians in various geographic areas and different health care markets can be useful [6]. Along with the use of national measures of underservice, such as health professional shortage area (HPSA) designations, benchmarks provide a relative indicator of supply and can help to identify areas of the state that lag behind the average. Lagging counties are often rural and are often contiguous with other counties that face persistent health professional shortages. Shortfalls in the supply of health professionals in rural areas are a concern because rural populations tend to be in poorer health relative to metropolitan populations, with higher rates of obesity as well as higher rates of mortality from chronic diseases such as diabetes and chronic obstructive pulmonary disease [7]. Rural populations are also more likely to encounter barriers to accessing health care—such as longer driving distances and limited access to transportation [8].

To identify underserved areas in North Carolina, we designated certain counties as persistent primary care health professional shortage areas (PHPSAs). PHPSAs are counties that have met federal HPSA criteria in 6 of the last 7 lists released by the Health Resources and Services Administration [9]. If an area has less than 1 primary care physician for every 3,500 people, it meets HPSA criteria. In whole-county HPSAs, the entire county qualifies as a HPSA based on the physician-to-population ratio; in part-county HPSAs, a group or geographic area within the county meets the HPSA designation status, even though the county as a whole does not.

Figure 1 shows the counties in North Carolina that qualified as whole-county or part-county

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0029-2559/2014/75119
PHPSAs in 2010. Stars denote nonmetropolitan counties, based on the February 2013 Office of Management and Budget designations for metropolitan and micropolitan [10].

Concerns about a national shortage of primary care physicians have been raised in both the academic literature [11-14] and in the popular press [15, 16]. Between 1991 and 2010, however, North Carolina’s primary care physician workforce grew at a rate of 42%, compared with a growth rate of only 35% for the state’s physician workforce as a whole. Although the overall supply of primary care
FIGURE 3. Primary Care Physicians, General Surgeons, and Psychiatrists in North Carolina in 2011, Based on Primary Practice Location

Map A. Number of Primary Care Physicians per 10,000 Population

- 11.29 to 23.72 (7 counties)
- 7.78 to 11.28 (18 counties)
- 4.27 to 7.77 (47 counties)
- 0.47 to 4.26 (27 counties)
- None (1 county)

Note. The state as a whole had 7,520 primary care physicians (7.78 per 10,000 population). Primary care physicians included those who listed their primary area of practice as family practice, general practice, internal medicine, obstetrics and gynecology, or pediatrics. Stars denote the state’s 54 nonmetropolitan counties.

Map B. Number of General Surgeons per 10,000 Population

- 1.35 to 3.76 (7 counties)
- 0.78 to 1.34 (16 counties)
- 0.36 to 0.77 (38 counties)
- 0.01 to 0.37 (15 counties)
- None (24 counties)

Note. The state as a whole had 759 general surgeons (0.78 per 10,000 population). General surgeons included physicians who listed their primary area of practice as general surgery, abdominal surgery, trauma surgery, vascular surgery, surgical critical care, surgical oncology, bariatric surgery, or transplant surgery. Stars denote the state’s 54 nonmetropolitan counties.

Map C. Number of Psychiatrists per 10,000 Population

- 2.58 to 9.58 (5 counties)
- 1.02 to 2.57 (9 counties)
- 0.60 to 1.19 (21 counties)
- 0.01 to 0.59 (38 counties)
- None (27 counties)

Note. The state as a whole had 1,164 psychiatrists (1.20 per 10,000 population). Psychiatrists included physicians who listed their primary area of practice as psychiatry, child psychiatry, psychosomatic medicine, addiction/chemical dependency, medicine/psychiatry, forensic psychiatry, addiction psychiatry, alcohol/drug abuse, psychiatry/geriatric, or hypnosis. Stars denote the state’s 54 nonmetropolitan counties.

Sources of data: North Carolina Health Professions Data System, Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, with data derived from the North Carolina Medical Board, 2011. Data on physicians include active, in-state, nonfederal, non-resident-in-training MDs and DOs licensed in North Carolina as of October 31, 2011. Population data are from the US Census Bureau, 2013. Nonmetropolitan counties, whose designation is based on Core Based Statistical Area (CBSA) information from the February 2013 update, are counties that have micropolitan areas (an urban core with a population of more than 10,000 but less than 50,000) or are outside of CBSAs [10].
Physician Assistants (PAs) and Nurse Practitioners (NPs) in North Carolina, by Persistent Primary Care Health Professional Shortage Area (PHPSA) Status, 1979–2011

Sources of data: Practitioner data are from the North Carolina Health Professions Data System, 1979 to 2010; North Carolina Office of State Planning. Figures include all licensed, active, in-state PAs and NPs. North Carolina population data are smoothed figures based on the 1980, 1990, 2000, and 2010 US Censuses. Health Professional Shortage Areas (HPSAs) are from the Area Resource File of the Health Resources and Services Administration (HRSA). Persistent HPSAs are those designated as HPSAs by HRSA during at least 6 of the most recent 7 designation periods (from 2002 through 2010). HPSA designations are not available for 2006 and 2007.

Physicians grew steadily from 1991 to 2010, supply has remained stagnant in the state’s most underserved areas. Figure 2 shows that the gap between well-supplied and underserved counties is increasing. Between 1979 and 2010, the number of primary care physicians per capita increased in non-PHPSA counties and in those designated as part-county PHPSAs, but it remained stagnant in whole-county PHPSAs. In 2011, just 18% (n = 1,327) of primary care physicians had a primary practice location in a rural county, even though 2010 census estimates indicated that 45% of North Carolinians lived in a rural county [17].

Figure 3 shows the distribution of primary care physicians, psychiatrists, and general surgeons in North Carolina by primary practice location in 2011. Not surprisingly, physicians who practice in these specialties are most concentrated in counties with academic health centers, while PHPSA counties face a shortage of all of these professionals. These data may underestimate coverage, because 27% (n = 2,026) of primary care physicians, 35% (n = 264) of general surgeons, and 41% (n = 473) of psychiatrists practice in more than one location, but due to limitations in how the data are collected, we are unable to estimate the percentage of time that these primary care physicians, general surgeons, and psychiatrists spend in secondary or tertiary practice locations.

General surgeons are often omitted from many discussions about workforce shortages, but they play a critical role in providing residents of rural areas with acute care and trauma services and treatment for other urgent medical conditions [18]. General surgeons are also a necessary referral resource for the management of critical care, obstetric, endoscopic, and pre- and postsurgical care issues. From a health systems perspective, general surgeons in rural areas also provide an important revenue stream for small hospitals, which can face difficulties remaining open if they are unable to provide surgical services [18-21]. In 2011, 83% (n = 630) of the state’s general surgeons had a primary practice location in a metropolitan area, and only 17% (n = 129) were practicing primarily in a rural area. Only 1 general surgeon had a primary practice location in a whole-county PHPSA (in Washington County), and 17 counties did not
have any general surgery coverage. Addressing the maldistribution of general surgeons is of critical importance in ensuring that rural citizens have access to surgical care for urgent conditions such as appendectomies and trauma.

Prior studies have suggested that many North Carolinians who need mental health services have not been able to receive such care [22]. Mental health resources and services are overburdened in rural areas of the state [23]. In 2011, 27 counties maintained services only as psychiatrists’ secondary or tertiary practice locations, and 13 counties had no psychiatrist coverage at all. Just 13% (n = 149) of the state’s psychiatrist workforce has a primary practice location in a rural county, and only 5 psychiatrists have a primary practice location in a whole-county HPSA. Rural counties with a shortage of psychiatrists often rely on primary care professionals for provision of mental health services, but these same counties also lag behind in terms of their supply of primary care providers [24].

PAs and NPs also play a critical role in the provision of health services for North Carolinians. Between 1990 and 2010, North Carolina’s NP workforce had a cumulative rate of growth of 383%, and its PA workforce had a cumulative growth rate of 214%; in comparison, the cumulative growth rate of North Carolina’s physicians was only 35%. The majority of growth in these professions occurred in non-PHPSA counties and in those with a part-county PHPSA designation (Figure 4). National data indicate that NPs and PAs are increasingly subspecializing [25, 26]. Thus, the question of whether NPs and PAs can ameliorate workforce shortfalls by substituting or supplementing the care historically provided by physicians likely varies by specialty, geography, and employment setting.

Prior research has documented the state’s maldistribution of primary care providers, general surgeons, and psychiatrists [27]. Our analysis shows that this maldistribution has persisted. Several initiatives are under way to diffuse the education of health professionals to underserved areas of the state, with the goal of then retaining those providers in areas where population health needs are greatest. Routine monitoring of the North Carolina health professional workforce and continued benchmarking will allow policymakers to determine the success of these training initiatives, as well as that of loan repayment and other rurally focused policies and programs. NCMJ

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Acknowledgments
The authors would like to thank Katie Gaul, research associate at the Cecil G. Sheps Center for Health Services Research, for her cartographic expertise.

Potential conflicts of interest. J.C.S. and E.P.F. have no relevant conflicts of interest.

References
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Spotlight on the Safety Net

A Community Collaboration

Creation of a Family Medicine Residency Track in Care of the Underserved: A Collaboration Between the University of North Carolina Department of Family Medicine and Piedmont Health Services

North Carolina faces many challenges in training and retaining a highly skilled primary care workforce. Recent projections from the Robert Graham Center indicate that the state needs to add 1,885 primary care physicians by 2030 just to continue to meet current levels of demand [1]. The North Carolina Institute of Medicine has called for new innovative training models to retain homegrown medical students and to attract well-trained providers from out of state to practice in underserved settings in North Carolina [2].

In response to this need, the Department of Family Medicine at the University of North Carolina (UNC) School of Medicine entered into a partnership with Piedmont Health Services (PHS) in 2010; the goals of this partnership are to improve access to care in rural Caswell County and to increase the number of family medicine physicians practicing in medically underserved settings in North Carolina. A key element of this initiative was the creation of a residency track that will train 2 residents per year to work in underserved settings, thus creating a training pipeline for PHS and other safety-net providers across the state. Operationally, the underserved track allows residents to provide direct patient care in their continuity clinics at PHS’s Prospect Hill Community Health Center in Caswell County. PHS providers supervise the residents, and revenue from resident encounters will be used to support the residents’ salaries once the program is fully implemented.

Workforce studies have demonstrated that family medicine residents who train in community health centers are 4 times more likely to choose that practice setting after graduation [3]. This research has guided our development of a teaching health center. The Teaching Health Center Graduate Medical Education (THCGME) program is a Health Resources and Services Administration (HRSA) initiative that provides graduate medical education (GME) funds directly to community health centers that sponsor their own residency programs. Congress has only authorized this program through 2015. The UNC-PHS collaboration does not meet the criteria for this funding because the residency program is sponsored by UNC rather than by PHS, but our collaboration has nonetheless incorporated key principles from the teaching health center model. Specifically, residents who want to have a career working with underserved populations are given an opportunity to train at a well-established and efficiently run federally qualified health center (FQHC) where they are supervised by clinician-educators who are culturally competent in working with the medically underserved.

PHS receives significant benefits from this partnership. PHS operates 7 FQHCs in a 4-county area but has a limited pool of qualified primary care providers, so PHS was looking for innovative ways to staff its centers. The residents’ total clinic time counts as a 0.6 full-time-equivalent provider, so their presence immediately increased access to health care. In addition, we are confident that some of the graduates of the underserved residency track will remain with the organization after graduation, which will improve PHS staffing levels over the long term.

The keys to the success of the partnership are that PHS and UNC’s Department of Family Medicine have a long history of successful col-
laboration and trust, and they share similar missions. UNC’s Department of Family Medicine has also implemented a faculty development program for PHS clinician-educators, and residents are engaged in quality improvement projects as part of their training, which will improve quality of care not just at Prospect Hill but across PHS. Lastly, UNC’s standing in the community has served to draw patients to the Prospect Hill site.

PHS recently built a new health center at Prospect Hill that was designed to meet the requirements to be certified as a new family medicine center for the underserved track. Starting in 2011, 2 residents were recruited from an expanded first-year class to join the underserved track, and we have phased in the program by having those 2 residents begin working as continuity providers at PHS in their second year. Because of high demand and interest in the underserved track, we created a separate match number within our residency program in our third year of the collaboration; this assures highly interested applicants that if they match in the track, then they will have their continuity practice at Prospect Hill.

A unique component of the UNC-PHS collaboration is that we have been able to launch the underserved track without additional GME funds from our sponsoring institution or from the THCGME program. We have successfully worked to engage local funders, and their donations along with a grant from HRSA covered our start-up costs and 4 years of salaries for the 6 new positions in the underserved track.

This program yields both short-term and long-term benefits for the local community in Caswell County. Serving as a training site for a prestigious university program is a source of pride and has increased access to high-quality, cost-effective care. Studies have also shown significant economic benefits for communities that improve access to primary care [4]. In the long term, the expanded residency program increases the likelihood that well-trained, culturally competent family physicians will continue to practice in the community. We plan to expand this model across other PHS sites and across the state to help meet workforce needs.

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Acknowledgments

Financial and in-kind support was received from the University of North Carolina Department of Family Medicine, Piedmont Health Services, the Blue Cross and Blue Shield of North Carolina Foundation, the Health Resources and Services Administration, and The Duke Endowment.

Potential conflicts of interest. E.A. is an employee of the University of North Carolina Department of Family Medicine, and A.D. is an employee of Piedmont Health Services.

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Philanthropy Profile

The Mentor's Role in Training Health Professionals: The Family Medicine Interest and Scholars Program

Primary care is a central element of the transformation of the health care system as envisioned in the Patient Protection and Affordable Care Act of 2010. Simply put, communities with better access to primary care have better outcomes at a lower cost [1, 2]. But how do we ensure that there will be an adequate supply of primary care physicians, or that the people who train to work in primary care stay in primary care? At the Blue Cross and Blue Shield of North Carolina (BCBSNC) Foundation, we recognize that supporting visionary leaders and fostering leadership succession are critical to success in all of our work. In the case of primary care education, this means exposing medical students who are considering a career in primary care to exceptional leaders in that field.

Four years ago, the North Carolina Academy of Family Physicians Foundation established the Family Medicine Interest and Scholars Program, in which mentors give medical students early clinical exposure to primary care and encourage their interest in this career path. The program’s goal is to increase the number of North Carolina–trained medical students who match into in-state family medicine residency programs and begin practicing in North Carolina. Supported by a grant from the BCBSNC Foundation, the program has for the past 3 years supported medical students at 4 medical schools—the University of North Carolina at Chapel Hill, Duke University, Wake Forest University, and East Carolina University; the program has also served Campbell University School of Osteopathic Medicine since the school opened in August 2013. To date, the program has provided mentoring and leadership opportunities for more than 50 medical students. It has also bolstered student membership in the North Carolina Academy of Family Physicians (increasing it by almost 500%) and has provided financial support for each campus’s Family Medicine Interest Group. As a result, more students who enter medical school with an interest in family medicine have the support to maintain that commitment throughout their years on campus.

The signature component of the Family Medicine Interest and Scholars Program is a formal mentorship that pairs first-year students interested in family medicine with a preceptor, beginning in the summer after the student’s first year of medical school. This mentoring relationship is developed over an initial 4-week period of clinical immersion and then continues for 3 consecutive years, during which time the student-mentor dyads meet at conferences, continue to share clinical experiences, and check in regularly via e-mail and by phone. During this time, the preceptors offer guidance, introduce students to the team-based model of care that often characterizes family medicine, and provide opportunities for students to strengthen their clinical skills. The relationship fast-tracks primary care training and also provides students with insight.

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0029-2559/2014/75122
into the day-to-day life of family physicians. The support that mentors provide includes not just supervision of students as they are exposed to common (and uncommon) medical procedures, but also personal contact—for example, a student might be invited to join his or her mentor on the mountain bike trails of Henderson County. Many of the program scholars report that what they learn about a family physician’s lifestyle, particularly in rural areas, is just as important in influencing their commitment to family medicine as what they learn about the work of a family physician.

Mentors not only expose students to the real-world experience of the modern family physician but also serve as a touchstone over the course of a student’s medical school career and beyond. Sadly, as medical school rotations accelerate over the course of a student’s career, students increasingly encounter discouraging messages about primary care. In fact, one of the most disappointing revelations for the organizers of the Family Medicine Interest and Scholars Program has been learning that negative messages about primary care still permeate the student experience. For example, one student in the program responded to a survey with the following statement:

I’ve interacted with quite a few individuals who seem to think that people who practice primary care are less intelligent/capable/driven… It is difficult to hear other students and a few faculty members downplay the impact of family doctors.

Through the program, mentors serve as an antidote to these attitudes and remind students about what drew them to medicine in the first place—the opportunity to connect with patients. Scholars who ultimately commit to primary care explain their choice by citing both their own experience in taking histories and their observations of their mentor—his or her approach to team-based care, deep commitment to patients, and engagement with the community.

A second component of the Family Medicine Interest and Scholars Program is support for each school’s Family Medicine Interest Group. This funding can be used to support student travel to conferences and to bring national speakers to campus. The schools report that attendance at events organized by the Family Medicine Interest Group has increased as a result of these new resources. The ability to immerse themselves in family medicine on campus also increases students’ long-term engagement with the North Carolina Academy of Family Physicians and provides other opportunities in family medicine. Some schools have even used the occasion of a visit by a national speaker as an opportunity to engage with the larger provider community, elevating the status of primary care at the regional level.

Early data on the outcomes of this project have changed the way the North Carolina Academy of Family Physicians approaches its membership. The organization has increased educational opportunities that support mentoring at its annual meeting, and it has developed more formal criteria for mentors, who are selected for their commitment to the specialty, their ability to teach, and their innovative approaches to primary care. Many of the 45 mentors who have served in this capacity have regarded their role as a calling and an opportunity to give back to a field they have found rewarding.

Finally, the Family Medicine Interest and Scholars Program offers financial incentives to participants who enter a family medicine residency after medical school. The money is delivered in 2 installments—the first when the scholar matches with a family medicine residency program, and the second when the scholar commits to practice in North Carolina following residency.

While all aspects of the Family Medicine Interest and Scholars Program play an important role, the most valuable program component is the relationship between preceptors and the next generation of family physicians. The true promise of primary care is realized not only when students learn how to conduct a physical exam, but also when they learn how to advocate for their most vulnerable patients, how to educate their peers, and how to navigate the local system of care and all its associated politics. As one of the program’s scholars explained, a primary care physician needs to be “both excellent and humble”—and that is a skill that has to be taught outside the classroom. NCMJ

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Acknowledgment Potential conflicts of interest. K.E. is an employee of the Blue Cross and Blue Shield of North Carolina Foundation.

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NCMJ vol. 75, no. 1
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