

The State of Diabetes in North Carolina

Joseph Konen, Joyce Page

The diabetes epidemic is rapidly growing in North Carolina. In 1999, an estimated 366,000 residents were living with diagnosed diabetes. Ten years later, the prevalence of diagnosed cases had increased to approximately 659,000. Diabetes is the seventh leading cause of death in the state and decreases life expectancy by up to 15 years. If the epidemic remains unchecked in the state, annual health care costs are predicted to exceed \$17 billion by 2025. Prevention of diabetes and diabetes-related complications through treatment and disease self-management is paramount in changing this deadly and costly course and demands continued innovation in health programs and services and new partnerships among health professionals. This article reviews the diabetes burden in North Carolina and sets the stage for commentaries and sidebars in the accompanying policy forum.

The diabetes epidemic is growing. The International Diabetes Federation estimates that the number of people around the world with diabetes will grow by >50%—from 285 million to a staggering 438 million—by 2030 [1]. In North Carolina, as elsewhere, the prevalence of diabetes and associated diseases represents a burden and challenge not only for individual with the disease but also for their families, policymakers, health services systems, and communities. Preventing diabetes and diabetes-related complications through treatment and disease self-management is paramount in changing this deadly and costly course and requires continued innovation and new partnerships among stakeholders. This issue of the NCMJ is devoted to exploring the burden of diabetes in North Carolina and the public and private efforts to address this epidemic. Included are articles on the epidemiology of diabetes, innovative research programs to prevent and treat diabetes, public and private partnerships to manage diabetes through health care delivery and self-management education, use of community health workers to lead cost-effective programs that promote lifestyle changes, and thought-provoking perspectives on the need for additional research and changes in reimbursement for diabetes care.

Epidemiology and Cost of Diabetes

Diabetes defined. Diabetes is a group of diseases marked by high levels of blood glucose resulting from defects in insu-

lin production, insulin action, or both. Many forms of diabetes exist, the most common of which are type 1 diabetes, type 2 diabetes, and gestational diabetes. Type 1 diabetes results when the body loses its ability to produce insulin, a hormone that regulates the level of glucose in blood. This form of the disease, which account for approximately 5% of all diagnosed cases, is believed to be caused most often by an autoimmune reaction in which the body's immune system destroys pancreatic beta cells that make insulin. Type 2 diabetes results from a combination of resistance to the action of insulin and insufficient production of insulin relative to the body's demand. In adults, this form of diabetes is associated with older age, obesity, family history of diabetes, history of gestational diabetes, impaired glucose metabolism, physical inactivity, and race/ethnicity and accounts for approximately 90%-95% of all diagnosed cases. Type 2 diabetes is being diagnosed more frequently among children and adolescents, especially among obese individuals. Gestational diabetes, a common complication of pregnancy, can lead to perinatal complications in mothers and fetuses, macorsomia (ie, excess birth weight), and a substantial increase in the likelihood of a cesarean section. Gestational diabetes occurs in 2%-10% of pregnancies. Mothers with gestational diabetes have a 35%-60% chance of developing diabetes 10-20 years after giving birth [2]. Mothers with gestational diabetes are also at risk for developing type 2 diabetes after pregnancy. Other types of diabetes result from specific genetic conditions, surgery, medications, infections, pancreatic disease, and other illnesses. These less common types of diabetes account for 1%-5% of all diagnosed cases [3].

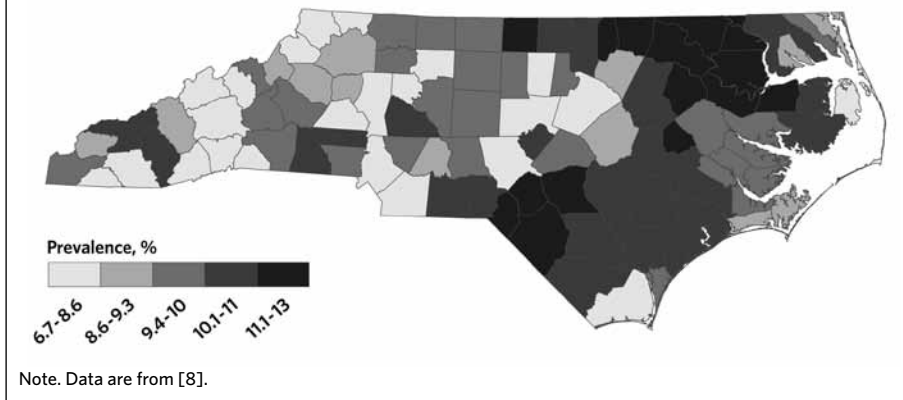
Among adults, diabetes is the leading cause of new cases of blindness, kidney failure, and nontraumatic amputation, as well as a leading contributor to heart disease, stroke, and depression. In the policy forum of this issue of the NCMJ, Mount and colleagues [4] review the relationship between dementia and diabetes among African Americans, and Dowd [5] examines the association between diabetes and hearing loss.

Electronically published January 30, 2012.

Address correspondence to Ms. Joyce Page, Diabetes Prevention and Control Branch, North Carolina Division of Public Health, 1915 Mail Service Center, Raleigh, NC 27699-1915 (joyce.page@dhhs.nc.gov).

N C Med J. 2011;72(5):373-378. ©2012 by the North Carolina Institute of Medicine and The Duke Endowment. All rights reserved. 0029-2559/2011/72505

FIGURE 1.
Age-Adjusted Prevalence of Diabetes Among North Carolina Adults in 2008, by County



Epidemiologic characteristics. The Centers for Disease Control and Prevention (CDC) estimated that, in 1999, 366,000 persons in North Carolina had diagnosed diabetes [6]. During the same year, 11.1 million persons in the United States had diagnosed diabetes [7]. Just 1 decade later, the numbers had almost doubled, with 673,000 cases of diagnosed diabetes in North Carolina and 19.7 million cases nationwide [6, 7]; Figure 1 summarizes the age-adjusted prevalence, by county, among North Carolina adults in 2009. The CDC's most recent report estimates that, in 2010, 25.8 million people in the United States had diagnosed or undiagnosed diabetes [9]. Another 79 million American adults (age, ≥ 20 years) had prediabetes, which increases their risk of developing diabetes [9]. Diabetes is the seventh leading cause of death in North Carolina and the nation and decreases life expectancy by up to 15 years [3, 10].

In 2011, the CDC published a map of the county-level diabetes prevalence in the United States (Figure 2) [11]. The map was based on data from national health surveys and shows the clustering of high diabetes rates in a so-called diabetes belt spanning 15 states, including North Carolina (Figure 3). The diabetes prevalence in the belt is 11.7%, compared with 8.5% elsewhere.

CDC researchers found that people living in the diabetes belt were more likely to be obese and to have a sedentary lifestyle, compared with people in the rest of the United States. This region also had more residents >65 years of age and a greater percentage of African Americans, 2 groups in which the risk of diabetes is particularly high. Lifestyle factors alone accounted for almost one-third of the difference in diabetes rates inside and outside the diabetes belt, but even young people with a slim waistline were more likely to have diabetes if they lived in the diabetes belt than if they lived outside it; reasons associated with this finding are not clear.

In the policy forum, Young and Potru [12] provide a closer examination of the epidemiologic characteristics of diabetes in North Carolina and discuss how meaningful use of electronic health records can facilitate collaborative efforts among North Carolina's health professionals and organiza-

tions to prevent and control the disease. Three other commentaries discuss matters relevant to specific demographic groups. Mount and colleagues [4] and Bell [13] highlight health-related inequities among African Americans and American Indians, respectively, among whom the diabetes burden is disproportionately higher than that for other racial/ethnic groups. Mattson [14] looks at the Affordable Care Act's role in expanding health care access and insurance coverage to prevent and treat diabetes in children, a group in which, as cited above, the incidence of type 2 diabetes is increasing.

Medical costs. The estimated total financial cost of diabetes in the United States in 2007 was \$174 billion, which included the costs of medical care, disability, and premature death [3]. One of every 5 health care dollars is spent on dia-

FIGURE 2.
Prevalence of Diagnosed Diabetes Among US Adults in 2007, by County

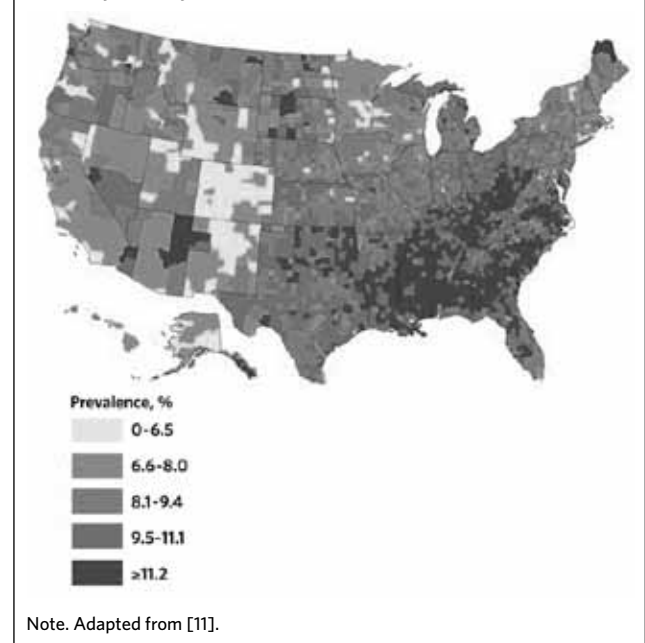
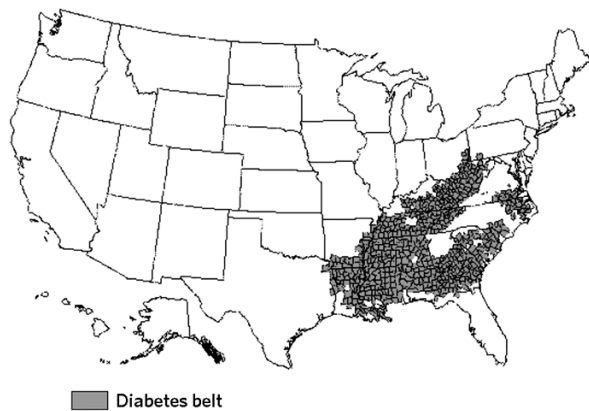


FIGURE 3.
Diabetes Belt



Note. Adapted from [11].

betes care, and 1 of every 10 health care dollars spent is for circumstances attributable to diabetes [15]. After adjustment for age and other demographic factors, annual health care expenditures among people with diabetes are 2.3-fold higher than those for people without diabetes.

North Carolina spent approximately \$5.3 billion on excess medical costs and lost productivity attributable to diabetes [16]. From July 2007 to June 2008, the North Carolina Medicaid program spent around \$525 million for diabetes-related medical care and prescription drugs for adults [17]. If the epidemic remains unchecked in the state, annual costs are predicted to exceed \$17 billion by 2025 [18]. In her contribution to the policy forum, Reese [19] reviews innovative lifestyle interventions, as well as initiatives involving insurers and health professionals, that can reduce diabetes-associated costs in the state.

Diabetes Prevention

Although there appears to be little that people can do to avoid getting type 1 diabetes, there are clear risk factors for type 2 diabetes that are amenable to prevention efforts. Studies, some of which are summarized below, have shown that lifestyle modifications such as dietary changes, increased physical activity, weight reduction, and antistress techniques, supported by a continuing education program, can reduce the incidence of diabetes and, among persons with diabetes, the need for treatment of the disease and its complications.

Diabetes Prevention Program (DPP). The DPP was a major clinical research study involving 3,234 participants who were overweight and had prediabetes at the time of enrollment [20]. Participants were randomized to receive a lifestyle intervention involving exercise and modifications of behavior and diet; to receive metformin; or to receive placebo. Forty-five percent of participants were from a minority group (ie, African American, Alaska Native, American Indian, Asian American, Hispanic/Latino, and Pacific Islander) associ-

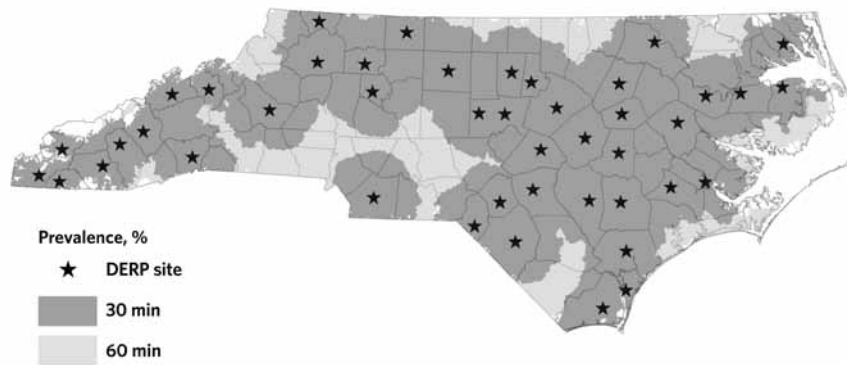
ated with an increased risk of developing diabetes. The DPP study showed that people at risk for developing diabetes can prevent or delay disease onset by losing a modest amount of weight through diet and exercise. Participants in the lifestyle intervention group reduced their risk of developing diabetes by 58%. Participants who received metformin also had a reduced risk of developing diabetes, but the decrease was less than that observed in the lifestyle intervention group. Interventions in the DPP study emphasized the role of healthful dietary choices, increased physical activity, improved coping skills, and group support in helping participants lose 5%-7% of their body weight. Results from the study led the CDC to design the National Diabetes Prevention Program to bring evidence-based lifestyle interventions for preventing type 2 diabetes to communities [21]. The inaugural partners of the National Diabetes Prevention Program were the YMCA and UnitedHealth Group.

North Carolina activities. North Carolinians have benefitted from several successful prevention-related activities. Findings from a recently published research study at Wake Forest University (Winston-Salem, NC) are described by Katula and colleagues [22] in the policy forum. The study evaluated the Healthy Living Partnerships to Prevent Diabetes (HELP PD), a translational intervention based on the DPP but with modifications to improve logistical feasibility, cost, and sustainability. Twelve months after enrollment, values of several key risk factors were significantly lower among participants in the HELP PD intervention, compared with participants who received enhanced usual care. Paul and colleagues [23] complement the commentary by Mattson [14] with a discussion of the ENERGIZE! program, an intensive community-based program developed at WakeMed Health and Hospitals (Raleigh, NC) to educate overweight children with prediabetes or metabolic syndrome, as well as their families, about healthy eating, physical activity, and behavior change. A total of 535 children in Wake County have completed the program, and significant improvements in several diabetes-related risk factors have been observed between baseline and 6-month and 12-month follow-up visits. Bachar [24] adds to the discussion by Bell [13] by reviewing lessons from Cherokee Choices, a program based in Cherokee, North Carolina, that focuses on biological and environmental risk factors for diabetes among members of the Eastern Band of Cherokee Indians. The program, whose main components include elementary school mentoring, worksite wellness for adults, and church-based health promotion, corroborated the importance of factors such as community involvement and feedback, one-on-one support, and interagency collaboration in diabetes prevention efforts.

Diabetes Care Through Education

Although significant progress has been seen in recent years with regard to clinical interventions that can control hemoglobin A_{1c} and cholesterol levels in persons with dia-

FIGURE 4.
Driving Time to Nearest North Carolina Diabetes Education Recognition Program (DERP) Site



Note. Driving times were derived by Paige Bennett (Heart Disease and Stroke Prevention Branch, North Carolina Division of Public Health), using the Network Analysis Tool of ArcGIS 9.3.1. Driving distances were estimated using the North Carolina Department of Transportation's Integrated Statewide Road Network, version II (available at: <http://www.lib.ncsu.edu/gis/ncdot.html>).

betes, <60% of all adults aged ≥ 40 years with diagnosed diabetes have their blood sugar level, cholesterol level, or blood pressure under optimal control [25]. Effective management of diabetes requires more than medicine. People with diabetes need education and steady support. Primary care physicians are the first line of defense against this epidemic, but face-to-face interactions with clinicians are just the start. Today, self-management education is such a critical part of diabetes care that medical treatment without it is considered inadequate.

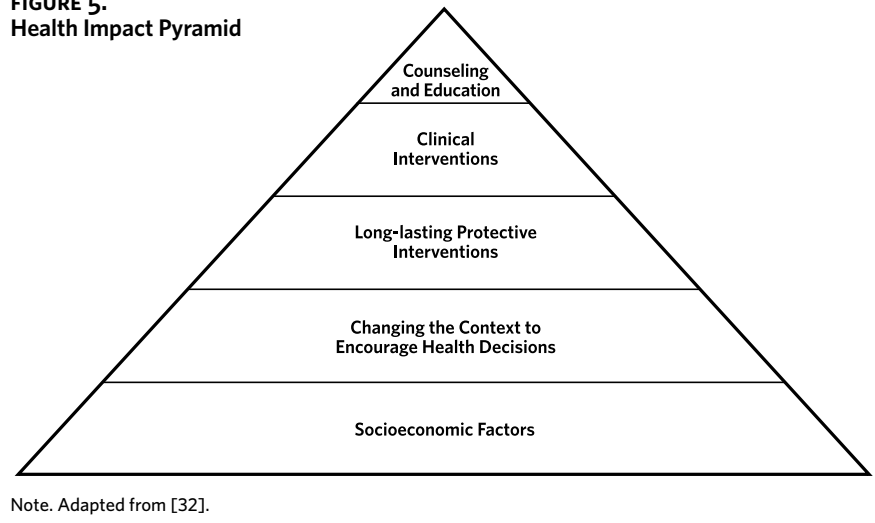
Several commentaries in the policy forum describe diabetes-related educational programs and services in place around North Carolina. Rinker and colleagues [26] discuss the North Carolina Diabetes Education Recognition Program (NCDERP), created in 2006 to provide diabetes self-management education and thereby empower people with diabetes to take charge of their care. Although there are 42 NCDERP sites throughout the state, thousands of persons are more than a 30-minute drive from a program, and individuals in several counties with the highest prevalence must drive for >60 minutes to reach a program (Figure 4) [27]. Lengthy driving times are most common in eastern North Carolina, where health disparities and economic disadvantages are prominent. Unfortunately, problems with Medicare reimbursement may threaten this valuable program.

Two policy forum contributions highlight the delivery of self-management education in team-based settings to underserved populations in the state. In rural eastern North Carolina, the ECARE-DIABETES program places diabetes educators along primary care professionals to deliver diabetes-associated primary care and education during the same visit. Same-day delivery of integrated care has a number of advantages, including the elimination of transportation-related barriers that can keep patients from following up on referrals to off-site educators. Bray and colleagues [28] review ECARE-DIABETES and assert the need for changes in

Centers for Medicare and Medicaid Services policy, which currently prohibits billing for primary care services and self-management education provided on the same day. The contribution from Sale [29] looks at the Diabetes Center, an American Diabetes Association-accredited program in western North Carolina. The center is part of the Health Education Center at Mission Hospital (Asheville, NC) and features a multidisciplinary team of health care professionals who work together to provide self-management education and a comprehensive array of additional diabetes-related services.

Three articles in this issue discuss programs in which community health workers help people with diabetes take better care of themselves. In the HELP PD intervention, reviewed by Katula and colleagues [22], community health workers with well-controlled type 2 diabetes conduct group sessions that educate attendees about weight loss, physical activity, nutrition. Page and Weisner [30] describe a successful partnership between the Division of Public Health and the Division of Aging and Adult Services in the North Carolina Department of Health and Human Services. The divisions collaborated to adopt an evidence-based self-management curriculum, Living Healthy in NC, that uses peer-to-peer learning to help persons manage diabetes and other diseases. Living Healthy in NC is based on Stanford University's Chronic Disease Self-Management Program and has been implemented throughout the state through the efforts of numerous partners. Finally, Bryant and Rocha-Goldberg [31] describe the work of El Centro Hispano, a grassroots organization with the mission of improving the quality of life among Latinos in and around Durham, Chapel Hill, and Carrboro, North Carolina. Since 2002, El Centro Hispano has offered diabetes education programs conducted by community health workers, referred to as promotores. During the first 6 months of 2011 alone, promotores provided diabetes education to 825 Latino adults.

FIGURE 5.
Health Impact Pyramid



North Carolina's Diabetes Strategic Plan

The North Carolina diabetes strategic plan for 2011-2015 reflects the most current thinking on how to prevent and manage diabetes at a population level, including policy changes needed in health care system and community settings. Strategies are to be implemented from 2011 to 2015 through the joint efforts of the North Carolina Diabetes Advisory Council, the Diabetes Prevention and Control Branch of the North Carolina Department of Health and Human Services, and numerous public and private collaborative partners. Strategies are grounded in evidence-based and best practices and were developed in accordance with the Health Impact Pyramid, created by Thomas Freiden, director of the CDC (Figure 5) [32]. The pyramid is a 5-tiered framework for developing public health strategies that reflects the impact of different public health interventions. Interventions on the lower levels tend to be more effective because they reach broader segments of society and require less individual effort [32]. The plan also reflects efforts to increase awareness among health care professionals about community resources, such as diabetes self-management education provided by local health departments, that are available for their patients. Another focus of the plan involves shifting away from addressing diabetes as an independent condition to addressing diabetes in conjunction with its comorbidities. For example, QuitlineNC (available at: <http://www.quitlinenc.com/>) is being promoted to reduce the risk of heart disease among diabetics who currently smoke.

Final Thoughts

The epidemic of diabetes is devastating, but we are hopeful. There is an astounding body of knowledge on the prevention of diabetes, the prevention or delay of complications, and the management of the disease. New medication and lifestyle interventions continuously become available, and techniques such as islet cell transplantation may one day

be curative for significant numbers of persons afflicted with diabetes. In addition, new and powerful partnerships are being formed between public health workers, health care providers, and researchers, to ensure effective delivery of treatment by professionals and effective self-management by patients.

Despite the wealth of knowledge about the causes, prevention and treatment of diabetes, today there is still no cure. An effective response to the epidemic of diabetes will depend on improving access to health care; health education, promotion, and communication; community mobilization; and implementation of strategic plans. Together, these tools and efforts can lead to significant reductions in diabetes and its consequences. **NCMJ**

Joseph Konen, MD, MSPH chair, North Carolina Diabetes Advisory Council, Raleigh, North Carolina.

Joyce Page, MSPH, MPH director, Diabetes Programs in Communities, Diabetes Prevention and Control Branch, Division of Public Health, North Carolina Department of Health and Human Services, Raleigh, North Carolina.

Acknowledgments

Potential conflicts of interest. J.K. and J.P. have no relevant conflicts of interest.

References

1. Centers for Disease Control and Prevention (CDC). Number of Americans with diabetes projected to double or triple by 2050 [press release]. CDC Web site. <http://www.cdc.gov/media/pressrel/2010/r101022.html>. Released October 22, 2010. Accessed September 26, 2011.
2. Centers for Disease Control and Prevention (CDC). 2011 National Diabetes Fact Sheet. CDC Web site. http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf. Accessed January 9, 2012.
3. National Diabetes Information Clearinghouse (NDIC). National diabetes statistics, 2011. <http://diabetes.niddk.nih.gov/DM/PUBS/statistics/>. NDIC Web site. Accessed September 26, 2011.
4. Mount DL, Hairston KG, Charles SM. Diabetes and adverse mental health among African Americans. *N C Med J.* 2011;72(5):400-401 (in this issue).
5. Dowd KR. Could hearing loss be the link between diabetes and depression? *N C Med J.* 2011;72(5):402-404 (in this issue).
6. Centers for Disease Control and Prevention (CDC). North Carolina

- percentage of adults with diagnosed diabetes, 1994-2009. CDC Website. http://apps.nccd.cdc.gov/ddtstrs/Index.aspx?stateId=37&state=North_Carolina&cat=prevalence&Data=data&view=TO&trend=prevalence&id=1. Accessed September 26, 2011.
7. Centers for Disease Control and Prevention (CDC). Number (in millions) of civilian, noninstitutionalized persons with diagnosed diabetes, United States, 1980-2009. CDC Web site. <http://www.cdc.gov/diabetes/statistics/prev/national/figpersons.htm>. Modified March 29, 2011. Accessed October 27, 2011.
 8. Centers for Disease Control and Prevention (CDC). County level estimates of diagnosed diabetes—state maps: North Carolina. CDC Web site. http://apps.nccd.cdc.gov/DDT_STRS2/CountyPrevalenceData.aspx?mode=DBT. Accessed January 9, 2012.
 9. Centers for Disease Control and Prevention (CDC). 2011 National Diabetes Fact Sheet. Atlanta, GA: CDC; 2011. http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf. Accessed September 26, 2011.
 10. Diabetes Prevention and Control Branch, North Carolina Division of Public Health. The Burden of Diabetes in North Carolina 2010. Raleigh, NC: North Carolina Department of Health and Human Services; 2010. http://www.ncdiabetes.org/library/_pdf/Diabetes%20burden%20in%20North%20Carolina%202010%20Fact%20Sheet%20WEB.pdf. Accessed September 26, 2011.
 11. Centers for Disease Control and Prevention (CDC). CDC identifies diabetes belt. CDC Web site. http://www.cdc.gov/diabetes/news/docs/diabetes_belt.htm. Accessed May 24, 2011.
 12. Young LA, Potru P. Diabetes in North Carolina: descriptive epidemiology and meaningful use of electronic health records. *N C Med J*. 2011;72(5):383-386 (in this issue).
 13. Bell RA. Barriers to diabetes prevention and control among American Indians. *N C Med J*. 2011;72(5):393-396 (in this issue).
 14. Mattson GL. How does the Affordable Care Act support children at risk for or with diabetes? *N C Med J*. 2011;72(5):379-382 (in this issue).
 15. Fradkin J, Rodgers GP. The economic imperative to conquer diabetes. *Diabetes Care*. 2008;31(3):624-625. <http://care.diabetesjournals.org/content/31/3/624.full>. Accessed September 13, 2011.
 16. American Diabetes Association (ADA). The estimated prevalence and cost of diabetes in North Carolina. ADA Web site. <http://www.diabetesarchive.net/advocacy-and-legalresources/cost-of-diabetes-results.jsp?state=North+Carolina&district=3713&DistName=Congressional+District+13>. Accessed October 24, 2011.
 17. Buescher PA, Whitmire JT, Pullen-Smith B. Medical care costs for diabetes associated with health disparities among adult enrolled in Medicaid in North Carolina. *N C Med J*. 2010;71(4):319-324.
 18. Institute for Alternative Futures (IAF). Diabetes 2025 forecasts, 2011. IAF Web site. <http://altfutures.org>. Updated 2011. Accessed July 31, 2011.
 19. Reese AB. Innovative approaches to reduce diabetes costs. *N C Med J*. 2011;72(5):409-412 (in this issue).
 20. Knowler WC, Barrett-Connor E, Fowler SC, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346:393-403.
 21. Centers for Disease Control and Prevention (CDC). National Diabetes Prevention Program. CDC Web site. http://www.cdc.gov/diabetes/projects/prevention_program.htm. Accessed September 9, 2011.
 22. Katula JA, Blackwell CS, Rosenberger EL, Goff DC Jr. Translating diabetes prevention programs: implications for dissemination and policy. *N C Med J*. 2011;72(5):405-408 (in this issue).
 23. Paul JH, Piehl MD, Lagarde WH. ENERGIZE! A community-based lifestyle intervention targeting at-risk, overweight children. *N C Med J*. 2011;72(5):381 (in this issue).
 24. Bachar J. Cherokee Choices: a diabetes prevention program in Cherokee, North Carolina. *N C Med J*. 2011;72(5):394-395 (in this issue).
 25. Agency for Healthcare Research and Quality (AHRQ), US Department of Health and Human Services. Chapter 2: effectiveness. In: *National Healthcare Quality Report, 2008*. AHRQ Web site. <http://www.ahrq.gov/qual/nhqr08/Chap2.htm>. Accessed September 9, 2011.
 26. Rinker J, Edwards LE, Widener D. Facilitating self-management of diabetes through education: the North Carolina case. *N C Med J*. 2011;72(5):387-389 (in this issue).
 27. Diabetes Prevention and Control Branch (DPCB), North Carolina Division of Public Health. North Carolina Diabetes Education Recognition Program. DPCB Website. <http://www.ncdiabetes.org/programs/ADA.aspx>. Accessed January 9, 2012.
 28. Bray P, Cummings DM, Thompson DK. Use of integrated care delivery to improve the quality of diabetes management among African Americans. *N C Med J*. 2011;72(5):390-392 (in this issue).
 29. Sale B. Hospital-based self-management of diabetes. *N C Med J*. 2011;72(5):388 (in this issue).
 30. Page J, Weisner S. Peer-to-peer learning in the self-management of chronic disease. *N C Med J*. 2011;72(5):398 (in this issue).
 31. Bryant CT, Rocha-Goldberg P. Community-based prevention and control of diabetes among North Carolina Latinos. *N C Med J*. 2011;72(5):397-399 (in this issue).
 32. Frieden TR. A framework for public health action: the health impact pyramid. *Am J Public Health*. 2010;100(4):590-595.

Information and Support
Within Your Reach

1-800-367-2229

NC Family Health Resource Line

NC Child Care Health and Safety Resource Center

Services in English and Spanish
Monday – Friday, 8 am – 5 pm (closed on holidays)
TTY for the hearing impaired: 1-800-976-1922