# DIABETES IN RURAL AMERICA: A LITERATURE REVIEW

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## SCOPE OF PROBLEM

- Diabetes mellitus was the sixth ranking leading cause of death in 1999.[78]
- Diabetes is an "ambulatory-care-sensitive" condition.[77]

## GOALS AND OBJECTIVES

America is in the midst of a diabetes epidemic. The number of diagnosed cases has increased nearly 10-fold over the past 40 years and has nearly doubled in the past 10 years.[31, 41, 79] Approximately 17 million Americans—6 percent of the population—are diabetic, with perhaps one-third of the cases being undiagnosed.[1-3] Furthermore, a newly recognized condition called "pre-diabetes" affects another estimated 16 million Americans.[2, 3]

Approximately 17 million Americans—6 percent of the population—are diabetic, with perhaps one-third of the cases being undiagnosed.[1-3]

Diabetes imposes a costly burden on the American health care system. Total direct and indirect costs due to diabetes rose from an estimated $98 billion per year in 1997 to $132 billion in 2002.[2, 80, 137] This translates to an annual health care cost of $13,243 for each person with diabetes, compared to $2,560 for non-diabetics, for 2002.[137]

The Healthy People 2010 goal relating to diabetes is as follows:

> Through prevention programs, reduce the disease and economic burden of diabetes, and improve the quality of life for all persons who have or are at risk for diabetes.[5]

For the purposes of this literature review, the following Healthy People 2010 objectives will be addressed:

- 5-1. Increase the proportion of persons with diabetes who receive formal diabetes education.
- 5-2. Prevent new cases of diabetes.
- 5-3. Reduce the overall rate of diabetes that is clinically diagnosed.
- 5-4. Increase the proportion of adults with diabetes whose condition has been diagnosed.
- 5-5. Reduce the diabetes death rate.
- 5-6. Reduce diabetes-related deaths among persons with diabetes.
- 5-7. Reduce deaths from cardiovascular disease in persons with diabetes.

Pertinent to the discussion of diabetes are the following terms:

- *Diabetes*, more properly called diabetes mellitus, is actually a group of diseases involving the inability to produce or use insulin, and resulting in elevated plasma glucose (blood sugar) levels.[1, 25]
- *Type 1*, juvenile or insulin-dependent diabetes, involves the inability to produce insulin from the outset. It generally has an early age of onset, is probably irreversible, and accounts for 5-10 percent of all cases.
- *Type 2*, adult-onset or non-insulin dependent diabetes, is 90-95 percent of all cases. Type 2 diabetes begins with insulin resistance and high insulin levels years before diagnosis.[81] Type 2 is generally later onset, but it is becoming much more common in children.[82-85]
- *Gestational diabetes* occurs in 2-5 percent of all pregnancies in the U.S. This form of diabetes is

not necessarily permanent, but it can predispose both mother and child to type 2 diabetes.[40]

- *Other diabetes* refers here to less common forms induced by certain drugs, trauma, surgery, infections, heritable conditions, chemicals, or environmental contaminants.[55, 56, 86]

## IDENTIFIED BY PEOPLE LIVING IN RURAL AREAS AS A HIGH PRIORITY HEALTH ISSUE FOR THEM

According to the Rural Healthy People 2010 survey, diabetes was identified as the third highest ranking rural health concern.[6] In this nationwide survey of state and local rural health leaders, diabetes was ranked third among the most frequently nominated rural health priorities, after access and heart disease and stroke. There was substantial agreement on the rural priority status of diabetes relative to all other Healthy People 2010 functional areas. Diabetes ranked second, third, and fourth, respectively, among leaders of rural community health centers and clinics, rural hospitals, and state health leaders; it ranked 12th among local public health agencies—a statistically significant difference among the respondent groups. Diabetes was among the top five priorities in all four geographic regions. The South, more than the other three regions, rated diabetes as a priority—the second ranked rural priority in the South. The difference across the regions fell just short of statistical significance.[7]

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## PREVALENCE AND DISPARITIES IN RURAL AREAS

Diabetes (including gestational diabetes) prevalence increased in individual states between 1990 and 1998. In 1990, only four states had an overall prevalence of diabetes greater than 6 percent. By 1997-98, 22 states had a prevalence of at least 6 percent, and all but two states had at least a 4 percent prevalence.[49]

Diabetes impacts every area of society. It occurs across all racial/ethnic and socioeconomic groups, but it is two to five times more common in African Americans, Hispanics, Native Americans, Pacific Islanders, and Asians.[8-12] Compared with non-Hispanic whites, these groups also have an increased risk for developing complications, for hospitalization, and for death from diabetes.[31] Diabetes risk also increases with age.[31] Minority group populations are increasing at faster rates than the white population in America, and society is aging. Based on census projections of sociodemographic changes in the U.S. population, the prevalence of diabetes is expected to increase nearly two fold by 2050.[4]

> The prevalence of diabetes also varies by urbanicity and degree of rurality.

The prevalence of diabetes also varies by urbanicity and degree of rurality. In 1995, the self-reported 3.6 percent prevalence of diabetes in non-metropolitan statistical areas (MSAs) of the U.S. was higher than in central cities (3.19 percent) and all MSAs (3.24 percent).[13] These figures are undoubtedly underestimates because of the recent upsurge in cases nationwide and the large number of undiagnosed cases.[87]

The prevalence of diabetes may vary significantly in different rural regions of the country. It is generally more common in the Southeast and Southwest.[12, 14-16] Rates are also very high in Hawaii and Puerto Rico, and somewhat higher in Alaska.[21, 88, 89] Regional differences may reflect racial/ethnic, socioeconomic, age, and lifestyle factors.

An important rural population group is migrant farm workers. Estimates on their total number have ranged from 750,000 to 5 million. Migrant workers are often not counted in national health surveys because of their transient employment and location, and no national prevalence data are available.[90] Nevertheless, in two published studies on migrant health clinics, diabetes rose in rank from the sixth

most frequent diagnosis or reason for physician visits in 1980 to first place in 1986-1987.[17, 18]

The issue of rural-urban disparities for diabetes is quite complex; however, the prevalence appears to be higher in developed rural areas and lower in undeveloped ones.[19-21] As the differences between rural and urban lifestyles disappear, higher rural prevalences may reflect differences in socioeconomic, racial/ethnic, or age status, more so than rurality *per se*. Rural residents from undeveloped areas typically develop diabetes at higher rates after moving to cities.[91]

As the differences between rural and urban lifestyles disappear, rural-urban disparities may reflect socioeconomic or racial/ethnic differences. This was true for Hawaii; only 3 percent of the geographic variation in diabetes prevalence was due to rural residence, and 35 percent was explained by differences in racial/ethnic proportions.[92]

## IMPACT OF THE CONDITION ON MORTALITY

Diabetes was the sixth leading cause of death in the U.S. for the year 2000, accounting for a preliminary 68,662 deaths in 2000.[23] Death rates for diabetics are two times higher than for non-diabetics, and higher for both genders and for all ages and races.[24] Diabetics are two to four times more likely to die from heart disease; those with pre-diabetes are twice as likely to die from heart disease.[3, 25] Diabetes is the leading cause of deaths from kidney disease.[26]

In the Harvard Nurses Study, women with type 2 diabetes at enrollment were over three times more likely to die than those without diabetes during the 20-year follow-up period. The risk of death from all causes associated with pre-existing diabetes and coronary heart disease (CHD) was additive. Diabetes elevated the risk of dying from CHD nearly 7½ fold over the 20-year period, and the presence of both conditions at the outset elevated the risk of dying from CHD nearly 18 fold.[93]

If one also considers deaths from diabetes as an underlying cause, the toll is much higher. In 2000, deaths from complications of diabetes—heart disease, cerebrovascular disease, diabetes, infections, kidney disease, and hypertension—totaled 1,098,857, or 45.7 percent of the total deaths in the U.S.[23] Diabetes may not be a factor in all these deaths but could be involved in most of them, for it is severely under-reported as an underlying cause of death.[24] Once these considerations are taken into account, diabetes is undoubtedly a major killer of Americans.

Death rates from diabetes are not uniform throughout the country, and regional differences in mortality from diabetes can be highly significant. Highest age-adjusted diabetes mortality rates are generally in the Southeast and Southwest.[27] Racial/ethnic differences account for much larger differences in mortality from diabetes in the U.S. than rural-urban differences.[28, 29]

## IMPACT OF THE CONDITION ON MORBIDITY

From the latest estimates of 17 million diabetics and 16 million with pre-diabetes,[1-3] diabetes affects 11.5 percent of the 287 million Americans. This does not include the unknown but substantial number of persons in earlier stages of the disease. Over 760,000 people were diagnosed with diabetes each year during the 1990s.[31] The risk of type 2 diabetes increases with age for the first seven decades, and it is slightly more common in women.[4, 31] It is not uncommon for 25-50 percent of elderly people in the high-risk racial/ethnic groups to be diabetic.

Once it develops, diabetes is a chronic, lifelong disease with no cure and rather ineffective, costly treatment. According to the National Hospital Discharge Survey, diabetes is the sixth leading cause of hospitalization in the U.S. for men at least 45 years old, and it is seventh overall for women of comparable ages.[30] In 1996, diabetes was listed as a discharge diagnosis in 3.8 million cases.[31]

Hospitalizations are only a small part of the total picture of morbidity from diabetes, however. There were 64 million office visits to physicians and 1.2 million emergency room visits made by diabetics in 1996.[31] In 1997, total work-loss days from diabetes totaled 14 million; disability days were nearly 88

million, and 74,927 workers with diabetes were permanently disabled.[80]

## CONTRIBUTOR TO MANY OTHER HEALTH PROBLEMS

Diabetes itself is only part of the picture of morbidity and mortality in diabetics. Diabetes has serious complications that affect the direct cost of health care and also indirect costs such as days lost from work, premature death, and quality of life. Many of these complications are chronic, life-long conditions requiring intensive, ongoing, and expensive treatment. The duration of the disease is a major factor for development of complications.[36-38]

Virtually every system in the body can develop complications from diabetes:[25, 26, 32-35]

- cardiovascular disease;
- abnormal blood lipid profiles;
- hypertension;
- stroke;
- blindness;
- end-stage renal disease requiring kidney dialysis or transplants;
- impotence;
- peripheral neuropathy (numbness or pain in the extremities);
- gangrene and amputation of lower limbs;
- periodontal disease;
- more frequent infections, including pneumonia and influenza; and
- psychological effects—depression, social stigma, and discrimination.

Gestational diabetes is a major risk to both mother and infant[1, 25, 39, 40] and is associated with the following conditions and outcomes:

- pre-eclampsia (life-threatening high blood pressure) in pregnant women,
- complications of pregnancy,
- macrosomia (large birth weight),
- neonatal complications,
- infant mortality,
- birth defects, and
- increased risk for developing type 2 diabetes in mother and child.

It is not unusual for some diabetics to have more than one serious complication.[94] However, many of the complications of diabetes can be prevented.[25]

## BARRIERS

In the face of a steadily increasing prevalence of diabetes, the American health care system has failed to prevent, detect, and manage diabetes adequately.[31, 57, 58] This is especially true in rural and low-income areas.[59-61] Rural diabetics on Medicare are less likely to visit a physician than their urban counterparts, and fewer of them have insurance coverage for medications.[57, 62-64] Rural residents tend to rely on home health care in lieu of office visits.[64] Diabetes was the sixth leading cause of death in the U.S. for the year 2000, accounting for a preliminary 68,662 deaths in 2000.[23] Death rates for diabetics are two times higher than for non-diabetics, and higher for both genders and for all ages and races.[24] Diabetics are two to four times more likely to die from heart disease; those with pre-diabetes are twice as likely to die from heart disease.[3, 25] Diabetes is the leading cause of deaths from kidney disease.[26] Rural residence is a significant risk factor for never receiving an ophthalmic examination,[65] which can detect early signs of diabetic retinopathy. When rural residents do see a doctor, they are more likely to see a generalist than a specialist for treatment of diabetes.[62] Rural patients with a history of

Rural diabetics on Medicare are less likely to visit a physician than their urban counterparts.[57, 62-64]

gestational diabetes are at high risk for developing type 2 diabetes, yet only 30 percent have adequate follow-up by their physicians.[95]

Irrespective of location, diagnosis often comes too late to prevent development of irreversible complications, sometimes more than 10 years after onset of the disease.[50] Rushed physicians who see more patients are much less likely to order recommended screening tests to detect early stages of diabetes complications.[96]

Quality of care for diabetes among Medicare beneficiaries, measured by frequency of receiving core medical tests, is actually better in large rural communities than in all other locations, including urban ones, but it is worst in remote rural areas.[62] One study finds that among diabetics on Medicare, significantly fewer rural diabetics than urban ones receive adequate posthospital home health care.[66]

## KNOWN CAUSES OF THE CONDITION OR PROBLEM SO EFFECTIVE INTERVENTIONS OR SOLUTIONS CAN BE IDENTIFIED

### Demographic, Socioeconomic, Lifestyle, and Environmental Factors

There are several explanations for the dramatic increase in diabetes. The risk of type 2 diabetes increases with age, and the American population is getting steadily older. Yet only 30 percent of the increased prevalence in diabetes is due to aging of the population.[79]

Diabetes, like other chronic diseases, is associated with lower socioeconomic status (SES).[46-49] It is also more common in people exposed to certain environmental chemicals—notably arsenic, dioxins, trichloroethylene, and benzene.[54-56] Exposures to other environmental toxicants may be important but have not been fully investigated. Environmentally induced diabetes may be closely linked with socioeconomic status, because people in the lower SES strata tend to have higher exposures to environmental contaminants.[97]

Type 2 diabetes is closely linked with obesity, and its rise parallels the steadily increasing girth in the American population.[41] The typical American diet, laden with fat and sugars, along with a sedentary lifestyle, are major factors contributing to the increase in obesity and diabetes. This relationship between lifestyle and diabetes is dramatically illustrated in various immigrant groups, who typically develop diabetes as they become Americanized.[98-101] Obesity and lack of leisure activity are more common in rural than in urban areas.[30]

The quality of one's diet, as well as its quantity, also contributes to the risk of developing type 2 diabetes. While the total contribution of carbohydrates to the typical American diet is very much the same as it was in 1900, the consumption of simple sugars, mainly in the form of soft drinks, has risen dramatically since that time to over 19 ounces per day per person.[102] Consumption of dairy products protects against the development of insulin resistance syndrome, a precursor of type 2 diabetes.[103] This may be because people who are drinking more milk consume less soft drinks.

Overall, the best efforts in public health have not been effective in reducing high-risk behaviors in Americans. There has been no improvement in food preferences or physical inactivity, according to the CDC's Behavioral Risk Factor Surveillance System.[49]

### Racial/Ethnic and Genetic Factors, and Pathophysiology

As previously mentioned, type 2 diabetes occurs more frequently in minority groups, those of lower socioeconomic status, and women.[9, 11, 12] The rural-urban disparity may be much higher for African Americans; in 1994, prevalence rates were 5.34 percent for non-MSA residents versus 3.61 percent in MSAs—a 48 percent difference.[22]

Type 2 diabetes clearly has a genetic component, for it tends to occur in families. There is a high concordance between identical twins.[42, 43] Having a family history is a clearly established risk factor.[44, 45]

Type 2 diabetes develops slowly over a period of many years before the blood sugar becomes elevated. Early signs include high serum insulin levels, low blood sugar after a large meal, a peculiar pigmentation pattern of the skin called acanthosis nigricans, and modest elevations of fasting blood sugar.[104-107] Some of these signs are already evident in at-risk children.[108]

The exact cause in individual cases of type 1 diabetes is often unclear; stress, trauma, infection, and genetics may all play a role.[1, 25] Gestational diabetes is associated with excessive weight gain during pregnancy, but it is undoubtedly due to underlying predisposing conditions.[109] Drug or chemically induced diabetes can sometimes, but not always, be traced to a specific exposure.

### Clinical Diagnosis

Unfortunately, many people in the pre-clinical stages of diabetes have not been diagnosed.[2, 3] By the time blood glucose becomes elevated to the clinical definition of diabetes, irreversible complications may have already taken place.[50-52] Thus, the clinical diagnosis based on elevated blood glucose may be too late to prevent reversible changes.

However, several important risk factors for type 2 diabetes can be easily identified years before the development of the disease, and these should be incorporated into routine surveillance of at-risk populations. Among these are obesity; sedentary lifestyle; android ("apple") body type, characterized by a high waist-to-hip ratio; age; family history of diabetes; giving birth to a macrosomic infant (weighing more than nine pounds); and a peculiar pigmentation pattern of the skin called acanthosis nigricans (AN).[44, 45, 104, 110, 111]

Possibly less well known, AN is probably the most visible indicator for the layman. It appears as dark, thick, velvety patches on the back of the neck, armpits, elbows and knuckles, knees, and groin. For reasons not fully understood, the presence of AN correlates with high blood insulin levels, a precursor of type 2 diabetes, even more so than obesity.[53] AN is often mistaken for dirt, and mothers may fuss at their children for not washing properly. It has been seen in children as young as four years of age.[108] As with diabetes itself, persons of color are more likely to develop AN.[112, 113]

## PROPOSED SOLUTIONS OR INTERVENTIONS THAT ARE FEASIBLE IN RURAL COMMUNITIES

Regardless of the type of diabetes, the risks of morbidity, mortality, and complications are related to the degree of control of blood sugar levels.[67, 70] Unfortunately, such control is not maintained in many diabetics, especially as they get older. Traditional treatments of diet, exercise, oral pharmaceuticals, and insulin therapy tend to be progressively more ineffective with duration of the disease.[114]

Psychosocial factors such as social impact and complexity of the diet regimen, along with age, history of smoking, and presence of renal disease, may be more important in determining survival than traditional clinical measures.[115] These considerations are important to take into account when planning effective prevention, interventions, and treatments for diabetes.

The solutions to controlling the epidemic of diabetes are not high-tech. Because diabetes cannot be cured or adequately treated by present methods, the Diabetes Prevention Program Research Group has recommended **prevention** as the preferable approach.[67]

There are three types of prevention, each staged to the development of diabetes:

- *Primary prevention* refers to delay or prevention of the onset of the disease in those at risk. Early stages of type 2 diabetes can be reversed by exercise and modest weight loss.[68, 69] Onset of type 2 diabetes can be prevented or delayed by similar means.[67] Methods of preventing type 1 and gestational diabetes are not well understood. Chemical- or drug-induced diabetes can be prevented by avoiding or minimizing exposure to the diabetogenic agent. There is much

controversy about gestational diabetes, especially as to whether or not universal screening of all pregnancies prevents adverse outcomes.[109]

- *Secondary prevention* means prevention complications in those already diagnosed with diabetes. Complications can be prevented or delayed by effective control of blood glucose.[70-72]
- *Tertiary prevention* aims at preventing worsening of complications once they have developed. Up to 90 percent of diabetes-related blindness can be prevented with appropriate screening and regular eye care, including annual fundoscopic (dilated) eye examinations.[26] Over half of diabetics' lower limb amputations are preventable with patient education and care.[25, 26]

All types of prevention have a place in management of diabetes from a medical and public health perspective, but primary prevention is ultimately the most cost effective and the most desirable from an ethical standpoint. The latest HHS recommendations are aimed at intervention at the pre-diabetes stage.[2, 3]

Based on strict review of published studies, the HHS Task Force on Community Preventive Services has recommended four types of interventions for reducing morbidity and mortality from diabetes. These are case and disease management by health care providers, community-based self-management education programs for adults with type 2 diabetes, and home-based programs for children and adolescents with type 1.[73]

Successful treatment of diabetes is complex. It involves patient education and monitoring of nutrition, exercise, motivation, and lifestyle, which physicians as a rule are not trained to provide. It also requires a large component of self-management, which is likely to be more successful if the provider-patient relationship and level of patient satisfaction are positive.

The American health care system, based on a model of providing acute care, has not been especially effective in the treatment and management of diabetes and other chronic diseases. A new model for diabetes care is needed, one that takes all these elements into account and is based on a chronic rather than acute disease model.[75, 76]

An intriguing new model of health care has shown promise for routine maintenance of diabetic patients after diagnosis. Using a "cluster visit" or "shared medical appointment" structure, groups of patients meet periodically with non-physician health professionals such as nurses, psychologists, diabetes educators, and dietitians.[116] The cluster visit model has also been combined with case management in a rural area.[117] This model is attractive in two respects: it may be more cost effective than a typical managed-care setting, and it can be used in rural areas not served by a physician. It could also provide a mechanism for social support in addition to health care.

Most published studies with a community component address only one component of diabetes education, prevention, detection, and care. Some of the more comprehensive programs are found in rural health networks, such as PennCARE. This HCFA (now CMS) coordinated care demonstration project uses a hybrid case and disease management approach.[118]

Early detection of diabetic retinopathy has been successful with mobile eye clinics, Polaroid or digital retinal photography with telemetry for remote diagnosis, and training of primary care physicians or optometrists in using the technologies.[119-125]

On-line access using a customized software program is effective for diabetes education and for providing social support to rural women in remote areas.[126]

The Kentucky Diabetes Control Program is based on a pyrimidal model to train paraprofessional subspecialists through centralized resource centers and regional diabetes teaching teams, as a way of reaching primary care providers and patients cost effectively.[127] This program did not depend on networking of providers, but a non-profit program in Utah conducted by *HealthInsight*, based on combining providers from rural and urban areas for their mutual benefit. The organizers followed up

with attendees to monitor progress toward goals set in the workshop.[128]

Many published diabetes education programs have not been culturally sensitive. One exception is the Texas Rio Grande Valley Diabetes Education Study, which has used Mexican-American diabetes educators and a Spanish-language curriculum at an appropriate educational level. This study used the local county Extension office as a neutral meeting place.[129]

Of 82 published adult diabetes education programs, most of them (51 percent) were conducted at clinics, followed by hospital settings (22 percent). Very few were done in the patient's home (1.2 percent) or in a private physician's office (2.4 percent). These programs were not necessarily based in rural areas, and only 34 out of the 82 programs (41 percent) had follow-up of 24 weeks or longer.[74] However, the question of whether or not diabetes education has any lasting effect on clinical outcomes remains largely unanswered.

Many effective rural diabetes prevention programs can be developed and implemented at the local level in the absence of local health care providers. Exercise may be one of the most important ways to improve diabetes risk factors, even more so than weight loss.[130, 131] Self-reported level of exercise was the only significant predictor of quality of life for diabetics.[132] Rural communities and organizations can sponsor exercise programs, with or without the participation of health care providers.

Parents can work with school administrators to provide healthier meals and snacks in the schools, and to develop alternatives to selling soft drinks and high-fat snacks from vending machines in the school corridors. States can tax soft drinks and fast foods and provide incentives to schools to stop selling them, as seen in legislation introduced in California.[133]

Social service agencies and grocery stores can provide information on nutrition and healthy lifestyles to families using social assistance or food stamps. Pharmacies and grocery stores can distribute information on diabetes risk factors and prevention. The cost of educational materials can be underwritten by companies that market and distribute fresh, whole foods, as well as by the parent grocery and pharmacy companies. Even grocery store checkers can be trained to provide information on preventing diabetes to customers.

In addition to prevention, early detection may be critical for preventing development of complications. Community-based screenings and health fairs may be the most cost effective way to identify persons at risk, based on a simple questionnaire and fasting or random blood glucose values from glucometer readings.[2]

Many pharmacies are located closer to rural markets than physicians and can potentially provide some services traditionally performed by health care providers.[134] With some training, pharmacists could do diabetes education, screening, and routine follow-ups. Diabetes education has been successfully conducted at a rural pharmacy.[135] Pharmacists and grocers could sell individual blood glucose tests. Individuals with a preliminary diagnosis could be referred to health care providers, and those found to be at risk could be provided with literature and on-site counseling or community-based classes on healthy lifestyles.

For those who have been diagnosed with diabetes, regular follow-up is essential. Routine office visits need not be performed by a physician, however.[116, 117] Using existing resources in different ways, rather than restructuring the rural health care system, may be the most effective means to provide better health services to rural diabetics.[134]

## COMMUNITY MODELS KNOWN TO WORK

Diabetes is a major public health problem, and successful models for practice reflect the importance given to preventing diabetes and its complications in rural populations. Of the 68 rural awardees in the Models that Work program funded by the Health Resources and Services Administration's Bureau of Primary Health Care, 11 have programs in diabetes education, screening, prevention, or treatment.[136]

See the Models for Practice section in Volume 1 for a catalog of models.

## SUMMARY AND CONCLUSIONS

America is in the midst of an epidemic of diabetes, which, if unchecked, will produce an intolerable burden on our health care system and quality of life over the next generation. The prevalence of diabetes is somewhat higher in rural than in urban areas, but racial/ethnic, socioeconomic, and lifestyle factors appear to be stronger risk factors for diabetes than rural residence *per se*. Rural diabetics tend to be diagnosed later and receive substandard health care compared to their urban counterparts.

However, type 2 diabetes, the predominant form, can largely be prevented by the simple means of modest weight loss, healthy eating, and exercise. The American public health and health care systems have been largely ineffective in dealing with prevention and treatment of diabetes. Rural areas are especially disadvantaged because of the lack of nearby health care providers who are knowledgeable about diabetes and less access to insurance coverage.

New cost-effective approaches need to be developed around a chronic disease model, using the existing health care and public health infrastructure, and based upon preventive and routine patient care clustered at the community level by allied health professionals. These approaches may also be useful in solving the related problems of access to health care and prevention and management of other chronic diseases.

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