The Economic Factors Related to Type 2 Diabetes in the United States and the Resulting Failure of Effective Prevention, Treatment and Cure

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ABSTRACT

Now considered an epidemic, Type 2 Diabetes costs the United States over 200 billion dollars per year in medical treatment and indirect costs (American Diabetes Association, 2008). Direct medical treatment including related excess medical costs for Type 2 Diabetes (diagnosed and undiagnosed) was estimated at almost 120 billion dollars per year in 2007 (Zhang, Dall, Mann, & Chen, 2009), a staggering 5.3% of all US healthcare dollars (Centers for Medicare and Medicaid Services, 2008). By one widely cited forecast, the cost of treating Type 2 Diabetes is expected to triple within the next 25 years (Huang, Basu, Michael, & Capretta, 2009). Given this dire prognosis, this paper will address the trillion dollar question: *What microeconomic and macroeconomic factors have conspired to block the effective prevention, assessment, treatment and cure of this disease in the United States*?

Introduction – The Problem

The cost of healthcare in the United States continues to outpace the growth of GDP. According to the Centers for Medicare and Medicaid Services, t*he health share of GDP is expected to have increased from 16.2 percent in 2008 to 17.3 percent in 2009 and will increase to nearly 20% by 2019* (Centers for Medicare and Medicaid Services, 2008). The old tradeoff between national defense and standard of living will need to be updated to three choices: Guns,

Butter or B*andaids*. Spending more of our GDP on healthcare serves to effectively lower the standard of living in the United States. As Americans spend more on healthcare, less can be spent on housing, entertainment, education, vacations, automobiles and flat panel televisions.

One of the largest increases in healthcare costs has come from the treatment of Type 2 Diabetes and related conditions such as obesity. According to the Centers for Disease Control, as of 2008, there were an estimated 24 million people in the U.S. (8% of the population) diagnosed with diabetes and another 57 million with pre-diabetes, 95% of which have Type 2. Prevalence rates doubled between 1990 and 2005 and today, on a per patient basis, the cost of treating Type 2 diabetes is more than $10,000 per year per patient with the largest amount spent on treating complications of the disease.

The failure to effectively prevent and treat Type 2 Diabetes is resulting in an economic disaster, and as the US population ages, the burden for paying for Type 2 Diabetes and its complications are shifting from the private sector to the US taxpayer through Medicare. The *Patient Protection and Affordable Care Act* and the follow on *Health Care and Education Reconciliation Act of 2010*, voted into law March of 2010 has specific provisions to increase spending on chronic disease prevention and treatment and the development of innovative therapies. It is unclear what effect these laws will have on reducing the incidence and cost of treating Type 2 Diabetes. However, the policies legislated will be discussed to help address the question – *What changes in public policy will offer hope in averting this impending Type 2 Diabetes healthcare disaster?*

Approach – Method, Organization and Expected Results

Type 2 Diabetes is one of the most preventable and curable of serious life threatening and disabling diseases – yet today prevention or cure is the exception not the rule. It is widely accepted that lifestyle changes including diet and exercise can both prevent and delay the onset of Type 2 Diabetes. A growing body of evidence suggests that following a low carbohydrate "ketogenic" diet can result in a total cure when diagnosed early. Glucose monitoring along with medications, including insulin, are used to treat symptoms and delay the progression of the disease and represent the current standard of care. Type 2 Diabetes, unlike traditional chronic illnesses, is a "lifestyle illness" caused by the interaction of an individual's genetics with their lifestyle (diet, exercise, etc). Similar to lung cancer and cigarette smoking, behavioral changes most often result in either prevention, delay of onset, or complete remission from the disease. Thus interventions successfully resulting in *beneficial* lifestyle changes will be the most effective in both the short and long run. Interventions to *change behavior* include assessment, patient education, mental health treatment and financial or other incentives that encourage behavior change.

Method - While it is clear that sufficient interventions are not being applied in preventing and curing Type 2 Diabetes, it is not clear whether such interventions are even economically or politically feasible. Such an analysis is beyond the scope of this paper. This paper explores the most fundamental principle of microeconomics, *people respond to incentives*, and evaluates the incentives as currently applied to individuals and institutions as a result of this disease and its causes. Institutions and individuals can be expected to respond to incentives reliably.

Organization – Part 1 of this paper will serve as an overview of the history and current science of Type 2 diabetes, its proposed etiology and the latest research into its prevention and cure. Part 2 will propose an economic model based on the individual and incentives and disincentives from various external sources including the food and beverage industry, healthcare and government. The final section will discuss suggestions to alter the economic factors that are creating and maintaining this epidemic through public policy changes. Innovative treatment methods based on effective incentives will be proposed.

Results – Given the immense human suffering associated with the complications of Type 2 Diabetes and the tremendous financial burden on society, there are few incentives or disincentives correctly applied to prevent and cure Type 2 Diabetes. Instead large incentives were identified that serve to maintain Type 2 Diabetes as a chronic incurable disease. Further, public policies shaped through political influence from the various institutions that benefit from the cause or chronic treatment of the disorder, have been ineffective at best and disastrous at worst. Innovative treatment strategies running counter to current economic factors will be required to counter these expensive and dangerous policies.

Part 1: History and Background of Type 2 Diabetes

There are several forms of diabetes with different causes and distinct treatment methods. They all share the same risks of serious complications such as kidney disease, blindness, amputations and nerve damage if not properly managed or treated. Type 1 is an autoimmune disease where insulin-producing cells in the pancreas are destroyed by the immune system (usually by age 20) and therefore insulin cannot be produced. Insulin serves an important function to aid in cellular glucose metabolism and to convert excess glucose, which is toxic, into fat to be stored. Without insulin, an individual will experience harmful levels of glucose upon ingesting foods or beverages containing carbohydrates. Until 1922 when Canadian doctor Frederick Banting discovered and isolated insulin and treated his first human patient, this type of diabetes was fatal. Type 1 Diabetes is treated with regular insulin injections balanced with carbohydrate intake. There is no cure for Type 1 Diabetes although much research has focused on repairing the insulin producing beta cells in the pancreas or delivering artificial insulin conveniently and accurately.

Type 2 Diabetes, formerly called Non-Insulin Dependent Diabetes Mellitus, is caused by the inability of the body's cells to properly utilize insulin in metabolizing glucose as an energy source. While the cause of Type 2 Diabetes has not yet been conclusively identified, it has been widely linked to obesity, diet and a sedentary lifestyle. Certain ethnic minorities (i.e. African American, Hispanic, Native American) appear to have a greater predisposition and it is believed there are genetic factors that contribute to the disease. The prevalence of Type 2 Diabetes has increased steadily over the past 50 years. In 1958 the prevalence of diabetes was only 0.93% but by 1993 it had increased to approximately 3% (National Institutes of Health, National Institute of

Diabetes and Digestive and Kidney Diseases, 1995). As of 2008 the prevalence had risen to nearly 8%.

The standard of care today begins with a recommendation of lifestyle changes (diet and exercise) (American Diabetes Association, 2010). The patient may be referred to a registered dietician or diabetes educator to help the individual plan their diet – which is calorie-reduced (following the composition of the USDA food pyramid) to promote weight loss. The job of maintaining proper glucose levels proves difficult for many and often glucose-lowering medications are initiated. The use of either glucose lowering drugs or insulin requires that the patient consume a certain minimum level of carbohydrate and time it to match the medication intake or risk hypoglycemia. On the other hand, they must not ingest too much carbohydrate or risk elevated blood sugar levels, which are harmful. In order to better manage blood sugar levels, diabetics can monitor glucose levels with blood glucose meters and adjust their diet accordingly. The patient will also be encouraged to increase their level of physical activity. The lifestyle goal is to lose 7% of their body mass index (BMI) as this number has been associated with optimum blood sugar regulation.

If lifestyle recommendations and medication prove inadequate (as for more than half of those diagnosed) the individual will, through the progression of the disease, begin to suffer from reduced pancreatic insulin production. An individual will then need to inject supplementary insulin as would a Type 1 diabetic. Poor control of blood glucose levels result in serious and potentially fatal complications such as amputations, neuropathy, blindness and kidney disease. Type 2 Diabetes is often asymptomatic in the early years so many individuals will be unaware they have the disease until complications develop. Thus regular assessment is critical for aging and at-risk populations.

The Current Science of Type 2 Diabetes Etiology and Treatment

Bariatric surgery is the most widely accepted medical "cure" for Type 2 Diabetes (American Diabetes Association, 2010), although it is not without controversy. Bariatric surgeries such as bypass, banding and stapling are becoming increasingly popular (>150,000 procedures/yr.) in spite of their high costs ($12,000-$30,000) and the substantial risk of serious complications, side effects and post operative mortality. Long-term outcomes suggest significant weight regain requiring revision surgical procedures and for a large percentage, treatment failure. Despite the risks, these procedures are recommended for the morbidly obese. Since weight loss follows surgery, it supports the argument that obesity causes Type 2 Diabetes. It can be argued, however, that the dramatically altered eating habits also results in a dramatic reduction in specific macronutrients such as carbohydrates.

Recent research suggests that obesity itself is not a direct cause of Type 2 Diabetes (25% of those diagnosed with Type 2 Diabetes are not overweight) and that reversal of insulin resistance is independent of weight loss (Gannon & Nuttall, 2006). Over the past decades dietary fat has been implicated as the major cause of America's obesity problem and ultimately the cause of Type 2 Diabetes. But this hypothesis has been recently questioned on the basis of simple historical data – overall dietary fat intake *declined* since 1977 in both absolute gram totals and as a percentage of total caloric intake while total daily caloric intake increased over 500 calories during the same period. The argument that fat alone is the cause of the current obesity epidemic has become hard to support as ecological studies have identified carbohydrate sources (Gross, Li, Ford, & Liu, 2004).

It is likely that the obesity epidemic has resulted from the increased consumption of cheap, and convenient high-caloric foods and beverages with added sugars, refined grains and

added fats and excess oils (Drewnowski A. , 2007). The most recent release of *Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010,* prepared for the Committee by the Agricultural Research Service, United States Department of Agriculture makes the recommendation to "significantly lower excessive calorie intake from added sugars, solid fats, and some refined grain products. Increase their consumption of a variety of vegetables, fruits, and fiber-rich whole grains. Avoid sugar-sweetened beverages. Consume smaller portions, especially of high-calorie foods. Choose lower-calorie options, especially when eating foods away from home. Increase their overall physical activity".

Thus it follows that an intervention promoting lifestyle modification comprising a diet very low in carbohydrates and reduced added solid fat combined with increases in physical activity may be useful in not only preventing but also treating Type 2 Diabetes.

Effective Treatment Available

The low carbohydrate "ketogenic" diet has been shown to be both safe and effective in weight loss and cholesterol/lipid improvements in many studies (Gardner, et al., 2007) (McAuley, et al., 2005) (McAuley, Smith, Taylor, McLay, Williams, & Mann, 2006) and also shown to be the most effective diet to manage type 2 diabetes. Results have shown that a ketogenic diet can result in the elimination or significant reduction in medication (Willi, Martin, Datko, & Brant, 2004) (Yancy, Foy, Chalecki, Vernon, & Westman, 2005) (Yancy, et al., 2010) (Westman, Yancy, Mavropoulos, Marquart, McDuffie, & JR, 2008) (Dashti, et al., 2007). Long-term use of the diet has been demonstrated to be safe even in high-risk populations and children (Dashti, et al., 2006) (Patel, Pyzik, Turner, Rubenstein, & Kossoff, 2010). Significant animal

research exploring the basis for this success is ongoing and has supported human studies (Al-Khalifa, Mathew, Al-Zaid, Mathew, & Dasht, 2009) (Badman, Kennedy, Adams, Pissios, & Maratos-Flier, 2009).

The ketogenic diet involves the intake reduction of non-fiber carbohydrate from a person's diet to below approximately 20 grams per day. In practical terms this suggests the elimination of all food and beverages containing sugars and starches in favor of those containing higher levels or protein and fat - such as meats, fish and non-starchy vegetables. It eliminates all breads, pastas, starchy vegetables including corn and potatoes (a legume, not vegetable), fruits and all forms of sugars other than slow metabolizing alcohols from the diet. Over a period of typically 48 hours, the body produces ketones and switches to the consumption of ketone bodies as the primary fuel source for metabolism rather than glucose. This state is called ketosis[1]. The body reverts back very quickly to glucose metabolism upon the reintroduction of higher levels of carbohydrate into the diet and the resulting insulin in the blood stream. Ketosis is diuretic and thus can result in constipation and headaches unless adequate dietary fiber and water is consumed. A positive side effect of ketosis, however, is lowered blood pressure. Due to the higher intake of protein and fat, serious negative consequences of the diet have been hypothesized (i.e. kidney and heart disease), however, to date there has been no scientific evidence linking the ketogenic diet to any serious health problems.

The ketogenic diet was first used medically in the 1920s to treat forms of intractable epilepsy and became largely unknown after anti-seizure medication became widely available. It resurfaced over the past few years, with multi-site clinical trials demonstrating it as a safe and effective treatment for certain forms of epilepsy. This research originated, not from the medical

[1] Ketosis should not be confused with ketoacidosis, a potentially life threatening condition those with Type 1 Diabetes can experience.

community, but from funding by the Charlie Foundation founded to promote the ketogenic diet for the treatment of epilepsy. The foundation was started by Jim Abrahams, a Hollywood producer whose son was successfully treated with the diet despite medical opposition. A made-for-television movie, starring Meryl Streep, "First Do No Harm" (1997) was based on this story.

The ketogenic diet was introduced to the American public in 1972 by Dr. Robert Atkins as a weight loss diet. Atkins, a cardiologist claimed that the diet helped treat his patients. He also made claims that the diet would be helpful in controlling blood sugar, thus treating diabetes and obesity. This successful diet was popularized with books, cookbooks and food products. Upon its success, variations of the diet such as South Beach™ and the Zone™ appeared and they have been successful in their own right. Medically managed weight loss clinics such as Lindora™ also use a low carbohydrate diet. These diets remain controversial to this day because they contradict the USDA Food Pyramid and decades of dietary recommendations from the US Government and influential health organizations such as the American Heart Association, American Diabetic Association and American Dietetic Association. Although these organizations have recently quietly retracted their strong positions against low carbohydrate diets due to overwhelming peer-reviewed research, it is still widely held by many healthcare professionals and dieticians that these diets are unsafe and ineffective. Thus with simple, relatively inexpensive dietary changes, medical care for Type 2 Diabetes and the risk of further complications can be virtually eliminated. With this information available, why is this not the standard of care for Type 2 Diabetes?

First it contradicts the current state of mainstream medical care and as such will not be recommended by primary care physicians, endocrinologists, dieticians or diabetes educators. Second, third party payers (healthcare insurance) will not reimburse for education or counseling

in support of lifestyle modification (Yale University Schools of Public Health and Medicine with the Institute for Alternative Futures, 2005). Second it requires lifestyle changes that conflict with well-entrenched, highly-marketed and convenient dietary patterns. The only likely food industry beneficiaries of the dietary change would be ranchers, poultry producers and farmers of low-starch vegetables. These farmers clearly do not have the financial and political clout of the large grain mega-corporations.

In addition to dietary lifestyle changes, managing Type 2 Diabetes and its precursor Metabolic Syndrome with exercise has also been studied and results have been positive (Lakka & Laaksonen, 2007) (Slentz, et al., 2008) (Gulve, 2008).

Part 2: Economic Model Promoting the Progression of Type 2 Diabetes

Economic factors related to food production, marketing and consumption combined with government policies in support of these factors serves to promote Type 2 Diabetes in the United States. The problem is exacerbated by reduced physical activity of the general population. Even before an official diagnosis, an individual will incur excess medical costs and once an individual has been diagnosed, healthcare services, medications and supply manufacturers fail to halt the progression of the disease. Further, as a result of certain government policies intended to serve the public good, health insurance providers will not invest in early detection and prevention services, thus they also fail to halt or prevent the progression of Type 2 Diabetes.

Economic Factors Promoting Type 2 Diabetes

The factors that service to promote Type 2 Diabetes are:

1. Comparatively lower cost, high convenience processed and restaurant foods
2. Government policies promoting the production of processed, high carbohydrate foods
3. Government policies promoting the consumption of processed, high carbohydrate foods
4. Increasing employment in low physical-activity professions

Comparatively lower cost, high convenience processed and restaurant foods

Dramatic changes in the American lifestyle over the past 40 years likely led to the promotion of Type 2 Diabetes. The increased consumption of inexpensive, calorie-dense foods and sugared beverages has been so far implicated. According to USDA data, flour and cereal product availability increased 48% from 1970 to 2000 (Drewnowski A. , 2007). Added fats and oils increased 38% and caloric sweetener consumption increased 20% over the same period. According to the USDA, previous dietary recommendations regarding reduction of consumption of identified food products have gone unheeded:

> *Substantial, high-level barriers appear to impede achievement of these goals, including certain government regulations and policies. Chief among these are land use policy and economic incentives for food manufacturers. The food supply and access to it has changed dramatically over the past 40 years, contributing to an overall increased calorie intake by many individuals. Since the 1970s, the number of fast food restaurants has increased 147 percent. The portions that are served in restaurants and the serving sizes of foods sold in packages at stores have increased as well. Moreover, the number of food items at the supermarket has increased from 10,425 in 1978 to 46,852 in 2008, and most of these contribute SoFAS[2], refined grains, and sodium to the American diet* (US Department of Agriculture, 2010)

While poverty in most nations predicts inadequate caloric intake, poverty in the United States predicts obesity and Type 2 Diabetes. It has been suggested that the relatively lower cost of energy dense foods contributes to this phenomenon (Drewnowski & Specter, 2004). Poorer individuals, it is claimed, choose low quality foods due to the cost and ultimately this is reinforced by the high palatability of its high sugar and fat content. Regardless, one question cannot be answered from this analysis - *What are the economic benefits of continuing to eating excess calories when one is obese?* If cost were the most significant factor, obesity would predict a reduction in food intake, even those considered poor in quality. While taste, convenience and availability may encourage excess calorie consumption, it may be the addictive nature of these foods themselves that trumps all other factors. Recent animal research suggest the consumption of high sugar and fat foods can result in compulsive eating behaviors similar to addiction (Epstein & Shaham, 2010) (Johnson & Kenny, 2010). Whether the food industry is

[2] Solid Fats and Added Sugars

"pushing" these low quality foods on the poor or not, certainly the economic benefit of excess consumption of low cost foods accrues to food producers, suppliers and restaurants.

Government policies promote the production of processed, high carbohydrate foods

Corn subsidies in the United States totaled $73.8 billion from 1995-2009 (Environmental Working Group, 2010) (the largest of any commodity) effectively reducing the cost for producers and consumers of corn and high fructose corn sweeteners. The apparent link between government policy and the obesity epidemic has been reviewed (Harvie & Wise, 2009). Corn sweeteners are not only used in soft drinks but are used in many processed foods. Wheat subsidies totaled $30.7 billion during the same period. Although reduced from 2009, 2010 subsidies for corn and wheat are budgeted for $2.2 billion and 1.0 billion respectively.

Government policies promote the consumption of processed, high carbohydrate foods

The 2010 finance budget for the United States Department of Agriculture was $133 billion. Of that budget the virtually all was spent on various subsidies. The vast majority, 80 percent ($105 billion), was associated with mandatory programs including nutrition assistance, farm commodity programs, export and conservation promotion programs (United States Department of Agriculture, 2010). The largest of the Food Nutrition Service's nutrition assistance programs ($93 billion) include the School Lunch program ($16.9 billion) and the Supplemental Nutrition Assistance Program (SNAP)($69.1 billion), formerly called the Food Stamp Program. Despite mention by the USDA about continuing efforts to promote healthy eating and active lifestyle behaviors, no policy changes addressing this have been suggested.

> *Both FNS and the Center for Nutrition Policy and Promotion will continue efforts to promote healthy eating and active lifestyle behaviors, in part by the continued*

> *use and promotion of MyPyramid.gov and the Dietary Guidelines for Americans. Additionally, in 2010, USDA will coordinate with the Departments of Health and Human Services and Education to develop a nutrition research plan and a strategy for addressing the problem of childhood obesity.* (United States Department of Agriculture, 2010)

The USDA Food Pyramid, the visual tool providing recommendations for the American diet since 1995 was a widely adopted continuation of dietary recommendations made by the USDA for over 100 years. From its inception, the graphical representation was a standardized recommendation on what all Americans should eat each day. The information has been criticized for contributing to widespread health problems including obesity and cardiovascular disease (Marantz, Bird, & Alderman, 2008).

In 2005 the program was revamped with a new graphic and to provide a custom recommendation based on an on-line dietary calculator. A distinction has also been made between refined and whole grains (a minimum of 3 ounces of whole grains now recommended). Using the calculator on July 10, 2010 (US Department of Agriculture, 2010) suggests that a 5'11", 185 pound, 54 year old adult male is overweight. Despite this concern a meal plan of 2400 daily calories suggests 8 ounces of grain, 3 cups of vegetables (a potato is considered 1 cup), 2 cups of fruit, 3 cups of milk (including cheese) and 6.5 ounces of meat and beans. Interestingly, repeating the same calculation not including weight or height (implying average) delivered the same results. The new pyramid divides the food groups into colored triangular segments running from the base of the front side of the pyramid to the tip with only slightly differing dimensions.

Physical activity is emphasized by showing a figure running up the stairs on the left side of the pyramid. Since increased physical activity corresponds with suggestion of higher food consumption, higher physical activity ultimately benefits food suppliers and is now an important component of *dietary* recommendations.

The Federal School Lunch program ($16 billion) began in the 1946 responding to the call that the nation's children were malnourished and to "encourage the consumption of agricultural commodities and other products" (Levine, 2008). Dietary recommendations were energy dense and necessary to ensure our national security. Surplus commodities purchased by the USDA aided farmers and other food producers. Until the 1960s this welfare program served relatively few. Over the past 5 decades, however politics undoubtedly influenced by farm lobbies and other food producers resulted in dramatic program expansion. Today, about 60 percent of students get a free lunch each school day. While the politics of free school lunches have always put the interests of food producers and commercial enterprises ahead of children's health, this program has been widely criticized as contributing the obesity epidemic and, ironically, at the root of a new national security crisis (Mission Readiness: Military Leaders for Kids, 2010). This criticism has resulted in recent efforts to improve the school lunch programs:

> *While school meals must meet standards established in 1995, advances have been made in dietary guidance in the years since. At the request of the United States Department of Agriculture (USDA), the Institute of Medicine convened a committee to provide recommendations to revise standards and requirements so that school meals are more healthful. In*

this report, the committee recommends that the USDA adopt revised standards for menu planning (US Department of Agriculture, 2010).

According to the suggestions made in the report commissioned (Institute of Medicine of the National Academies, 2009), the most significant daily lunch changes recommended were:

1. Add ½–1 cup of fruit per day
2. Limit starchy vegetables and set a weekly requirement for green, orange vegetables
3. Meat reduced from 3 oz to 2.4 oz
4. Grains reduced from 3oz to 2.8 oz with half to be "whole-grain rich"
5. Milk should now contain 1% fat or less[3].

Breakfast recommendations added 1-2 meats or meat alternatives (in addition to grain rather than as an alternative to grains) and raised fruit from ½ cup to 1 cup. Ultimately, except for limiting starchy vegetables, these recommendations do not seem to alter previous dietary recommendations significantly.

Food Stamp Program

The SNAP food stamp program represents the largest food subsidy program with an annual budget of $69 billion (2010). This program provides those that qualify (approximately 10% of the entire US population) with plastic debit cards to purchase allowable food products. There has been ongoing debate regarding the nutritional and health impact of use of this program. According to the USDA, participation predicts the consumption of higher amounts of meat, added sugars and total fat (Food and Rural Economics Division, Economic Research Service, 2000). Recent research suggests an association between increases in body mass index (BMI) and SNAP program participation (Zagorsky & Smith, 2009) for females and suggests possible changes to encourage the consumption of healthier foods purchased under the program.

[3] Also suggested for breakfasts

Food Manufacturing Industry

The food manufacturing industry (NAICS 311) processes agricultural and livestock products into various foods for consumption by animals and humans. Processed foods include processed meat, processed seafood, dairy products, grain and fruit and vegetable preserving, animal food, grain milling, tortilla and bakery manufacturing and sweets and confectionary. This industry is one of the largest manufacturing sectors in the US, accounting for more than 10 percent of all manufacturing shipments. With a value of $538 billion in 2006, the processed food industry has experienced a 27% growth since 1997 (U.S. Department of Commerce, 2008). The US imports and exports about $35 billion of these products per year. According to the Department of Commerce Bureau of Economic Analysis corporate profits for the entire food manufacturing industries including beverage and tobacco total $33.7 billion in 2008.

The ten largest companies in this sector are household names - Kraft Foods, Tyson Foods, PepsiCo, Nestle, Anheuser-Busch, General Mills, Dean Foods, Smithfield Foods, ConAgra Foods, and Cadbury Schweppes. This industry employs nearly 1.5 million workers in the United States. Of the $6,111 in annual food spending per person in 2006, $2694 was spend on food away from home (restaurants and fast food) with the remaining $3,417 spent on food for prepared and consumed at home. The largest individual segment of at home food is an "other food" category which includes sugar, sweets, fats and oils, miscellaneous foods, nonalcoholic beverages, and prepared food. At $1212 per person annually, this segment alone represents approximately $372 billion in annual sales. It is expected that the market for prepared foods such as snack foods and frozen foods will continue to grow as a result of dual income earners and those looking for convenience. It is also expected to grow as a result of the aging US population.

Food Away from Home

Americans have been eating out more often each year. According to the National Restaurant Association (NRA), 2010 sales for food and beverage is forecast to be $580 billion for all outside eating establishments and take out food sources (National Restaurant Association, 2010), or about 4% of the US gross domestic product. According to the NRA, the overall economic impact of the restaurant industry will exceed $1.5 trillion in 2010. Today, half of the American food expenditures are spent eating food prepared away from the home - up from only 25% in 1955. The NRA claims there are 945,000 establishments and the industry employs 12.7 million workers, one of the largest private sector employers.

According to the NRA, 40% of adults surveyed agreed that purchasing meals away from home makes them more productive in their day-to-day life and 59% say there are more restaurants they enjoy going to now than there were two years ago. Further, 78% adults agree that going out to a restaurant give them a greater opportunity to socialize and a better use of their leisure time than cooking and cleaning up. Twenty nine percent say purchasing take out food is essential to the way they live and 65% say their favorite restaurant foods provide flavor and taste sensations that can't be easily duplicated at home.

Increasing Employment in Low Physical-activity Professions and the Sedentary Lifestyle

The sedentary lifestyle of the average American has been blamed for much of the obesity and Type 2 Diabetes epidemics. There is sufficient evidence that over the past 50 years, the number of Americans living a relatively sedentary lifestyle has increased (Brownson, Boehmer, & Luke, 2005) however recent evidence suggests that physical activity related to leisure time has actually risen significantly for adults between 1988 and 2008 (Centers for Disease Control and Prevention, 2010). Given insignificant changes in work and commute related physical activity,

differences in total adult calorie expenditure during this period did not change while Type 2 diabetes prevalence has more than doubled. This suggests that physical activity alone cannot account for the increases in the prevalence of the disease. On a practical level, except during leisure time, adults have little opportunity to increase physical activity. Continued technological advancements and the increased use of automobile transportation are not likely to afford individuals the opportunity to increase physical activity significantly at work or during commutes. Expecting leisure time energy expenditure to mediate excess dietary intake of 500 calories is not reasonable for the typical American.

Economic Factors That Fail to Prevent or Halt the Progression of Type 2 Diabetes

The following health insurance and healthcare providers do not have adequate incentive to halt or prevent the progression of Type 2 Diabetes:

1. Healthcare services including physicians, hospitals, pharmacists, pharmacies, registered dieticians and educators.
2. Pharmaceutical and Diabetes Supply Manufacturers.
3. Health insurance reimbursement policies.
4. Government healthcare (Medicare) and reimbursement policies.

Health Care Services

Healthcare expenditures in the US totaled $2.5 trillion dollars in 2009 (Centers for Medicare and Medicaid Services, 2008). This represents approximately 17% of the entire Gross Domestic Product of the United States. The chronic disease Diabetes resulted in estimated excess annual medical costs of $116 billion in 2007 and this number is expected to triple by 2025, with

more than 90% due to Type 2 Diabetes (American Diabetes Association, 2008)[4]. The excess expenditures for treating diabetes results from primary care outpatient visits, hospital inpatient and outpatient care, medication, supplies and home health. The economic factors affecting Type 2 Diabetes come from various sources – health care delivery services, health insurance carriers (including Medicare), pharmaceutical and medical devices manufacturers and policies of the US Government.

Service Costs

The following table of diabetes treatment illustrates the estimated annual cost and the percentage of all service of that type in the United States.

Service	**Cost $ (millions)**	**% of US Service of that type**
Hospital Services		
Hospital Inpatient	58,344	14%
Emergency Room	3,870	5%
Hospital Outpatient	2,985	4%
Total		
Nursing Residential	7,486	10%
Physician Office Visit	9,897	6%
Total of above services	82,582	

Table 1- Medical service costs attributable to Type 2 Diabetes.

It is estimated that 14% of all hospital inpatient services are provided to diabetics, 10% of all residential nursing and 6% of all physician office visits are directly associated with diabetes.

[4] Type 2 Diabetes represents between 90% and 95% of all cases of diabetes in the United States. The incidence of Type 2 Diabetes has been growing rapidly (8%) while the incidence of Type 1 Diabetes has remained fairly constant at less than 1% of the US population. The economic cost analysis conducted by the American Diabetes Association in 2007 did not distinguish between types. As the overall costs were likely underestimated by at least 10%, the numbers presented are not likely to overestimate the medical costs attributable to Type 2.

Medicine and Diabetes Supply Manufacturers

The cost of medicines used to treat diabetes or its complications each year are shown below ($ millions) (American Diabetes Association, 2008):

Insulin	$ 3,733
Diabetic supplies	1,783
Oral agents	8,586
Retail prescriptions	12,692
Other equipment and supplies	890
Total cost per year (2007 est.)	$ 26,883

This amounts to approximately $27 billion per year to treat diabetes. Since Type 2 Diabetes represents approximately 90% of all diabetes cases, $24.2 billion of medicines and supplies can be attributed to Type 2 Diabetes each year.

As of January 2010, the pharmaceutical industry was developing 211 new drugs to treat Type 2 Diabetes and its complications (Pharmaceutical Research and Manufacturers of America, 2010). These diverse drugs operate on a wide range of functions. Some help to increase insulin production, others lower blood glucose levels or improve glucose transport and metabolism. Many more reduce or treat symptoms of the various serious complications of diabetes such as neuropathy, retinal damage, circulatory problems and resulting amputations. As diabetes is considered a chronic condition, none of these drugs are being touted as a cure. The high cost of developing these new medications would not make economic sense for a one time cure. In addition to medicines, diabetics often require a host of supplies such as glucose monitors and testing strips. These are considered important in maintaining proper blood sugar levels (Kulkarni, 2006). As listed above, this represents nearly a $2 billion market.

Current treatment methods obviously are failing to either prevent or halt the progression of the Type 2 Diabetes (Sheehan, 2010). As of 2007, physician and hospital visits related to Type

2 Diabetes represented a $70+ billion per year industry. Since little or no funds are provided for prevention, it is not surprising that with little incentive the disease has not been adequately prevented. Although a leg amputation will be covered under both private medical insurance as well as Medicare, neither will pay for intensive lifestyle modification counseling when an individual is first diagnosed. While an annual visit to a dietician or a diabetes educator is now commonly covered, this is obviously inadequate to deal with the psychological problems obstructing lasting lifestyle change and medication compliance.

Health Insurance Reimbursement Policies

Despite evidence suggesting methods of prevention or treatment/disease management with lifestyle modification alone, health insurance providers generally do not pay for these expenses (Yale University Schools of Public Health and Medicine with the Institute for Alternative Futures, 2005). As a result almost no healthcare funds are being expended for prevention or lifestyle treatment today. While this may be surprising given the large economic cost of not preventing or properly treating Type 2 Diabetes, there is a clear economic explanation. Over half of the costs associated with failure to treat diabetes result after age 65. This has created a huge burden on the Medicare system with one quarter of all Medicare dollars spent treating diabetes in 2000 (McKinlay, 2000). This shifts the cost burden to the Medicare system and ultimately to the American taxpayer. Oral medications and insulin, when properly used will delay the onset of the serious medical costs past age 65.

Employers, facing ever increasing health insurance costs and may indirect costs (i.e. sick time, loss of productivity) have been seeking alternatives bypassing the healthcare system altogether to reduce their costs associated to lifestyle illnesses such as Type 2 Diabetes. The fast growing Wellness Industry is now providing relatively low cost dietary and fitness counseling

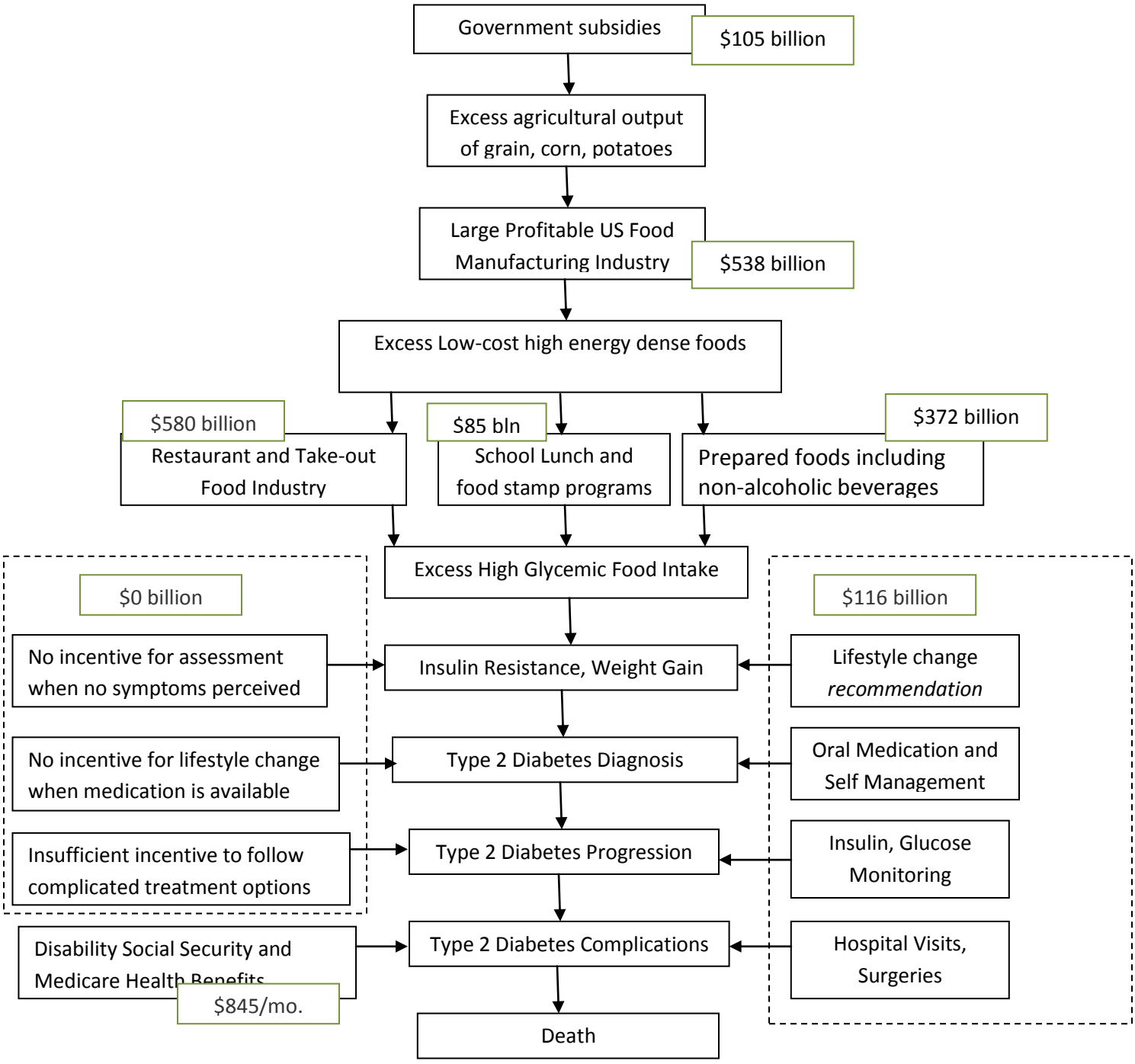
via telephone or internet to help employees lose weight and remain compliant on their medication. They also provide on-site health screening and fitness programs. This suggests that the health insurance and healthcare industry does not have adequate financial incentives to lower costs through prevention. Interestingly, though, some wellness firms have been recently acquired by large health insurance and healthcare providers.

Government healthcare (Medicare) and reimbursement policies

After age 65, Americans are provided health care insurance through Medicare for the rest of their lives. Further, individuals under age 65 diagnosed with diabetes and complications such as neuropathy or retinopathy qualify for Social Security disability benefits, a direct economic benefit to the individual. This can result in payments as high as $845 per month (California) for individuals or $1400 per month for couples. In addition to federal benefits, an individual may also qualify for additional state or employer sponsored disability insurance benefits. Once an individual qualifies for Social Security disability benefits for two years they automatically receive Medicare healthcare coverage, thus relieving the private sector from the most expensive portion of Diabetes health care costs. In some states (i.e. California) health care coverage benefits in the state sponsored program (i.e. Medi-Cal) accrue immediately upon eligibility for federal disability. Thus even for the 50% of those diagnosed with Type Diabetes younger than age 65, Medicare and the American taxpayer shoulder the largest portion of healthcare costs. Because the public sector pays for all medical care after age 65 or when an individual at any age has diabetes with complications, it is logical that private health insurance firms would limit their investment in early or preventative care that would not bring a commensurate reduction in future claim payments.

The following figure summarizes the various factors associated with the initiation and progression of Type 2 Diabetes as described in this section.

Figure 1 - Proposed Economic Model of Initiation and Progression of Type 2 Diabetes in the United States.



Part 3 – Conclusion: Changing the Economics of Type 2 Diabetes through Public Policy

The economic factors that have been implicated in the cause and failure to treat Type 2 Diabetes are driven by industry segments and specific government policies totaling over $1.7 trillion per year. The food production and manufacturing industries and the health insurance and healthcare industries are powerful economic and political forces. Changes will be required to alter their incentives if Type 2 Diabetes is going to be adequately prevented and treated. As important as the change in industry incentives, individual incentives must also be changed to force individuals to take responsibility for their health and well being. The following economic incentives, through public policy change and based on the model presented on the previous page, are proposed to change consumer and industry behavior to prevent and successfully treat Type 2 Diabetes:

Proposed Food Industry Incentive Changes

1. Eliminate government subsidies on corn, potatoes and wheat.
2. Establish government subsidies for high quality vegetables and small locally grown produce.

Proposed Healthcare Incentive Changes

1. Provide Federal grants to fund the development of evidence-based lifestyle modification treatment methods. Require treatment programs be evaluated on objective criteria of positive health outcomes. Programs shown effective will be approved for medical reimbursement.

2. Provide grants to allow licensed mental health professionals to train and become certified in effective lifestyle modification treatment methods at no charge to them.
3. Require by law that approved lifestyle modification treatment programs are a fully covered medical expense. Health insurance companies and Medicare will be required to cover these treatments at parity with direct medical care.
4. Medicare authorized to bill back previous health insurance providers for a percentage of costs associated with Type 2 Diabetes treatment if diagnosed before Medicare eligible.

Proposed Individual Incentive Changes

1. Medicare requires all Americans at 55 years of age take a healthcare screening for Type 2 Diabetes and other chronic conditions. If diabetes detected, the individual will be offered a chance to participate in a lifestyle modification treatment program at no cost. If they fail to participate, are unsuccessful or fail to submit to testing, they will have Chronic Illness Surcharge deducted from their paycheck, effectively doubling the Medicare tax for these individuals.
2. Add a tax on all sugar sweetened non-alcoholic beverages. No tax will be charged for beverages with less than 10 calories per 12 ounces.
3. Waive co-payment for medications and supplies for treating Type 2 Diabetes and other chronic lifestyle health conditions only after completion of an annual intensive lifestyle modification treatment program.
4. Reduce disability benefits for lifestyle illnesses by 25-50%. Provide Medicare coverage only after 5 years when disability based on a lifestyle illness.

References

Al-Khalifa, A., Mathew, T. C., Al-Zaid, N. S., Mathew, E., & Dasht, H. M. (2009). Therapeutic role of low-carbohydrate ketogenic diet in diabetes. *Nutrition* , 1177-1185.

American Diabetes Association. (2010). American Diabetes Standards of Medical Care in Diabetes. *Diabetes Care* , S11-S61.

American Diabetes Association. (2008). Economic Costs of Diabetes in the U.S. in 2007. *Diabetes Care* , 596-615.

Badman, M., Kennedy, A., Adams, A., Pissios, P., & Maratos-Flier, E. (2009). A Very Low Carbohydrate Ketogenic Diet Improves Glucose Tolerance in ob/ob Mice Independent of Weight Loss. *American Journal of Physiology, Endocrinolology and Metabolism* .

Brownson, R., Boehmer, T., & Luke, D. (2005). Declining Rates of Physical Activity in the United States: What are the Contributors? *Annual Review of Public Health 2005* , 421–43.

Centers for Disease Control and Prevention. (2010, 7 1). *1988–2008 No Leisure-Time Physical Activity Trend Chart.* Retrieved 7 9, 2010, from Centers of Disease Control and Prevention: http://www.cdc.gov/nccdphp/dnpa/physical/stats/leisure_time.htm

Centers for Medicare and Medicaid Services. (2008). National Health Expenditures 2008 Highlights. *retrieved from: http://www.cms.gov/NationalHealthExpendData/downloads/highlights.pdf on 6/16/2010* .

Dashti, H. M., Al-Zaid, N. S., Mathew, T. C., Al-Mousawi, M., Talib, H., Asfar, S. K., et al. (2006). Long term effects of ketogenic diet in obese subjects with high cholesterol level. *Molecular and Cellular Biochemistry* , 1-9.

Dashti, H., Mathew, T., Khadada, M., Al-Mousawi, M., Talib, H., Asfar, S., et al. (2007). Beneficial effects of ketogenic diet in obese diabetic subjects. *Mollecular Cell Biochemistry* , 249-256.

Drewnowski, A. (2007). The Real Contribution of Added Sugars and Fats to Obesity. *Epidemiologic Reviews* , 160-171.

Drewnowski, A., & Specter, S. (2004). Poverty and obesity: the role of energy density and energy costs. *American Journal of Clinical Nutrition* , 6-16.

Environmental Working Group. (2010, 7 9). *Farm Subsidy Database*. Retrieved July 9, 2010, from farm.ewg.org: http://farm.ewg.org/region.php?fips=00000&progcode=total

Epstein, D., & Shaham, Y. (2010). Cheesecake-eating rats and the question of food addiction. *Nature Neuroscience* , 529-531.

Food and Rural Economics Division, Economic Research Service. (2000). *The Effect on Dietary Quality of Participation in the Food Stamp and WIC.* Washington DC: USDA.

Gannon, M., & Nuttall, F. (2006). Control of blood glucose in type 2 diabetes without weight loss by modification of diet composition. *Nutrition & Metabolism* , 1-8.

Gardner, C. D., Kiazand, A., Alhassan, S., Kim, S., Stafford, R. S., Balise, R. R., et al. (2007). Comparison of the Atkins, Zone, Ornish, and LEARN diets for change in weight and related risk factors among overweight premenopausal women: the A TO Z Weight Loss Study: a randomized trial. *Journal of the American Medical Association* , 969-977.

Gross, L., Li, L., Ford, E., & Liu, S. (2004). Increased consumption of refined carbohydrates and the epidemic of type 2 diabetes in the United States: an ecologic assessment. *American Journal of Clinical Nutrition* , 774-779.

Gulve, A. E. (2008). Exercise and Glycemic Control in Diabetes: Benefits, Challenges, and Adjustments to Pharmacotherapy. *Physical Therapy* , 1297-1321.

Harvie, A., & Wise, T. (2009). *Sweetening the Pot: Implicit Subsidies to Corn Sweeteners and the U.S. Obesity Epidemic.* Boston: Global Development and Environment Institute Tufts University.

Huang, E., Basu, A., Michael, O., & Capretta, J. (2009). Projecting the Future Diabetes Population Size and Related Costs. *Diabetes Care* , 2225-2229.

Institute of Medicine of the National Academies. (2009). *School Meals: Building Blocks for Healthy Children.* Washington DC: National Academies of Science.

Johnson, P., & Kenny, P. (2010). Dopamine D2 receptors in addiction-like reward dysfunction and compulsive eating in obese rats. *Nature Neuroscience* , 635–641.

Kulkarni, K. (2006, December 21). The Role of Blood Glucose Monitoring in Diabetes. Salt Lake City, Utah, US.

Lakka, T., & Laaksonen, D. (2007). Physical activity in prevention and treatment of the metabolic syndrome. *Applied Physiology, Nutrition and Metabolism* , 76-88.

Levine, S. (2008). S*chool Lunch Politics: The Surprising History of America's Favorite Welfare Program (Politics and Society in Twentieth Century America).* Princeton, NJ: Princeton University Press.

Marantz, P., Bird, E., & Alderman, M. (2008). A Call for Higher Standards of Evidence for Dietary Guidelines. *American Journal of Preventive Medicine* , 234–240.

McAuley, K. A., Smith, K. J., Taylor, R. W., McLay, R. T., Williams, S. M., & Mann, J. I. (2006). Long-term effects of popular dietary approaches on weight loss and features of insulin resistance. *International Journal of Obesity* , 342-349.

McAuley, K., Hopkins, C., Smith, K., McLay, R., Williams, S., Taylor, R., et al. (2005). Comparison of high-fat and high-protein diets with a high-carbohydrate diet in insulin-resistant obese women. *Diabetologia* , 8-16.

McKinlay, M. (2000). US Public Health and the 21st Century: Diabetes Mellitus. *The Lancet* , 757-761.

Mission Readiness: Military Leaders for Kids. (2010). *Too Fat to Fight.* Washington DC: Mission Readiness.

National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. (1995). *Diabetes in America, Second Edition (1995)* . Washington D.C.

National Restaurant Association. (2010, July). *2010 Restaurant Industry Factbook.* Retrieved July 9, 2010, from National Restaurant Association Web Site: http://www.restaurant.org/pdfs/research/2010Forecast_PFB.pdf

Patel, A., Pyzik, P. L., Turner, Z., Rubenstein, J. E., & Kossoff, E. H. (2010). Long-term outcomes of children treated with the ketogenic diet in the past. *Epilepsia* .

Pharmaceutical Research and Manufacturers of America. (2010, January). *Medicines in Development for Diabetes 2010.* Retrieved June 14, 2010, from www.pharm.org: http://www.phrma.org/sites/phrma.org/files/attachments/Diabetes_2010.pdf

Sheehan, J. (2010). Bad Medicine: There Is a Lot Wrong with Diabetes Care in the United States. *Culture, Medicince and Psychiatry* , 2–12.

Slentz, C. A., Tanner, C. J., Bateman, L. A., Durheim, M. T., Huffman, K. M., Houmard, J. A., et al. (2008). Effects of Exercise Training Intensity on Pancreatic β-Cell Function. *Diabetes Care* .

U.S. Department of Commerce. (2008). *U.S. Department of Commerce Industry Report, Food Manufacturing NAICS 311.* Washington D.C.: U.S. Department of Commerce.

United States Department of Agriculture. (2010). *USDA Budget Summary and Performance Plan FY 2010.* Washington DC: USDA.

US Department of Agriculture. (2010, April 9). *My Pyramid Plan*. Retrieved July 10, 2010, from MyPyramid.Gov: http://www.mypyramid.gov/mypyramid/index.aspx

US Department of Agriculture. (2010, May 8). *Nutrient Standard Menu Planning*. Retrieved July 10, 2010, from Healthy Meals Resource System: http://healthymeals.nal.usda.gov/nal_display/index.php?info_center=14&tax_level=1&tax_subject=234

US Department of Agriculture. (2010). *Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans.* Washington D.C.: US Department of Agriculture.

Westman, E., Yancy, W. J., Mavropoulos, J., Marquart, M., McDuffie, & JR. (2008). The effect of a low-carbohydrate, ketogenic diet versus a lowglycemic index diet on glycemic control in type 2 diabetes mellitus. . *Nutrition and Metabolism* , 36.

Willi, S. M., Martin, K., Datko, F. M., & Brant, B. P. (2004). Treatment of type 2 diabetes in childhood using a very-low-calorie diet. *Diabetes Care* , 348-353.

Yale University Schools of Public Health and Medicine with the Institute for Alternative Futures. (2005). *Barriers to Chronic Disease Care in the United States of America: The Case of Diabetes and its Consequences.*

Yancy, W. J., Westman, E., McDuffie, J., Grambow, S., Jeffreys, A., Bolton, J., et al. (2010). A randomized trial of a low-carbohydrate diet vs orlistat plus a low-fat diet for weight loss. *Archives of Internal Medicine* , 136-145.

Yancy, W. S., Foy, M., Chalecki, A. M., Vernon, M. C., & Westman, E. C. (2005). A low-carbohydrate, ketogenic diet to treat type 2 diabetes. *Nutrition and Metabolism* , 1-7.

Zagorsky, J., & Smith, P. (2009). Does the U.S. Food Stamp Program contribute to adult weight gain? *Economics & Human Biology* , 246-258.

Zhang, Y., Dall, T. M., Mann, S. E., & Chen, Y. (2009). The Economic Costs of Undiagnosed Diabetes. *POPULATION HEALTH MANAGEMENT* , 95-101.