

# The Diabetes, Depression, and Alcohol Triad: Potential Impact on Community Development

*Mark A Strand, Pharmacy Practice, Master of Public Health Program, North Dakota State University, Fargo, ND, USA*

*Donald Warne, MD, MPH, Director, Master of Public Health Program, North Dakota State University, Fargo, ND, USA*

---

## ABSTRACT

*Type 2 diabetes, depression and alcohol abuse exist in many populations as co-morbidities. These conditions contribute to worsened health status and lost productivity. Such diseases also contribute to high medical expenses and other societal costs. Diabetes, depression and alcohol abuse are individually associated with compromised financial status. Treating these combined conditions as a syndrome rather than as isolated disease states may result in improved quality of care, better health outcomes, and reduced costs to society. A conceptual model that could be used to address this triad is the Social Ecological Model in which intrapersonal, interpersonal, institutional and community factors as well as public policy are considered for their impact on outcomes. The triad of diabetes, depression and alcohol abuse may have common etiological factors such as social isolation and poverty, and such a holistic approach to the common determinants underlying all three conditions holds out the most hope to reduce both the prevalence of this unique disease triad and the associated costs to society.*

*Keywords:* Alcohol Abuse, Depression, Diabetes, Health Behavior, Social Determinants of Health

---

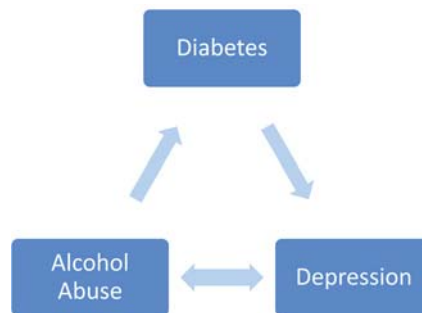
## INTRODUCTION

Type 2 diabetes, depression, and alcohol abuse exist as multiple co-morbidities (Laiterapong et al., 2011; Mark A Strand, Perry, & Wang, 2012; Tait, French, Burns, & Anstey, 2012). The co-existence of any of these pairs of diagnoses in a population of patients requires deeper ex-

ploration into the health and social determinants underlying them and the possibility of shared etiology and risk factors. These health determinants, or causes, can be intrinsic forces, such as genetics, behavior or biological mechanisms, and extrinsic forces such as social influences, including access to and coordination of health services. The triad of diabetes, depression and alcohol abuse (Figure 1) potentially shares numerous health and social determinants that need to be better understood, in particular the

DOI: 10.4018/ijssed.2014010104

Figure 1. Diabetes, depression and alcohol abuse disease triad



determinants that go beyond individual agency and include societal influences (Schmidt, Makela, Rehm, & Room, 2008).

Diabetes, depression and alcohol abuse are not the only diseases which present in a syndromic fashion and would benefit from a multidisciplinary research approach. Tuberculosis, HIV-AIDS and diabetes are common comorbid conditions. Individuals with ankylosing spondylitis frequently present with an array of inflammatory diseases of the eye, cardiovascular system and digestive system (Bremander, Petersson, Bergman, & Englund, 2011). These comorbidities have a shared biological etiology. There are other syndromic conditions which have social determinants as a shared underlying etiology, and could be approached similarly to the method being proposed in the current paper. For example, attention deficit hyperactivity disorder (ADHD) is associated with substantially elevated prevalence of learning disabilities, depression and speech problems (Larson, Russ, Kahn, & Halfon, 2011). Fibromyalgia is frequently comorbid with depression, headache, irritable bowel syndrome and chronic fatigue syndrome. These comorbid conditions tend to occur as constellations of "illness" which burden patients, but frequently defy medical description (Nettleton, O'Malley, Watt, & Duffey, 2004).

Social determinants of disease originate at the community level. Therefore understanding the determinants of the diabetes, depression and alcohol abuse triad require consideration of the community development process (Syme

& Ritterman, 2009). There are many common definitions of *community development*. This paper will use a dynamic understanding of community development, defining community development as the result of the purposive interaction of community members. This process leads to the development of the community as measured by increased welfare, health and social cohesion (Luloff and Bridger, 2003).

Good health is linked to societal economic growth through higher work productivity, demographic changes, and higher educational attainment (WHO, 2001). In the same way, poor health undermines economic growth. Type 2 diabetes, depression and alcohol abuse each result in some degree of disability for those affected by it, resulting in compromised individual welfare, lost productivity (Boles, Pelletier, & Lynch, 2004) for the individuals and high costs of health care. These factors may inhibit community development as affected individuals are compromised in their ability to perform at work, and these conditions can lead to disability or stigmatization, such as social disqualification of individuals and populations who are identified with particular health problems and increased burden of disease (Weiss, Ramakrishna, & Somma, 2006). This triad of conditions can also lead to social isolation and could possibly limit interaction with other community members, in addition to mitigating involvement in community action which is a process that is essential for community development (Karelina & DeVries, 2011).

*Table 1. Financial Costs of Diabetes, Depression, and Alcoholism in the United States (a Does not include costs of undiagnosed diabetes or depression b In dollars for most recent year for which data are available)*

Condition	Year	Cost
<b>Diabetes</b> (Diagnosed) <sup>a</sup>	2012	\$245 billion
<b>Depression</b> (Diagnosed) <sup>a</sup>	2000	\$83.1 billion
<b>Alcoholism</b> (Excessive Drinking)	2006	\$223.5 billion
<b>Total Annual Cost</b> <sup>b</sup>		<b>\$480.6 billion</b>

Understanding the epidemiology of each disease individually is the starting point in understanding their interaction and potential impact on individual welfare and community development. The epidemiology and financial burdens of diabetes, alcohol abuse and depression will be described here.

## Diabetes

In 2010, 25.6 million Americans aged 20 years or older had a diagnosis of diabetes, comprising 11.3% of all people in this age group (CDC, 2011). Diabetes rates are highest among non-Hispanic blacks, Mexican Americans, and American Indians (Cowie et al., 2010). The prevalence of diabetes in the United States is increasing among all ages at an alarming rate. From 1980 through 2010, the percentage of people with diagnosed diabetes increased by 200 percent for those aged 0–44 years, 124 percent for those aged 45–64 years, 127 percent for those aged 65–74 years, and 126 percent for those aged 75 years and older (CDC, 2013). Similar increases are currently found in most countries of the world (Danaei et al., 2011).

Diabetes is a costly disease, and it can be devastating to the family financial profile. About a fifth of diabetes patients spend 10 percent or more of their family income on health care, and about one in nine spend 20 percent (Sarpong, Bernard, & Miller, 2012). Even at that, averages hide the fact that this percentage is much higher the lower one's income is (Dinca-Panaitescu et al., 2012). In 2007, the total costs of diagnosed diabetes in the United States was \$174 billion,

of which \$116 billion was for direct medical costs and \$58 billion was for indirect costs (disability, work loss, premature mortality) (CDC, 2011). As of 2012 total cost of diabetes had risen to \$245 billion (Table 1) (CDC, 2013). These indirect costs of diabetes represent a significant financial burden for diabetic patients, who already deal with lost work productivity and lost income. Their ability to participate in community development processes is also compromised, resulting in loss to the individual and the community of which they are a part. For example, individuals with insulin-dependent diabetes are significantly inconvenienced when it comes to travelling, for they are required to tote along a large supply of insulin and medical devices used to deliver the insulin and test their blood glucose levels. Inconvenience, and even stigma, is associated with injecting oneself with insulin when taking meals with others. Finally, as presented above, diabetic patients lose a significant amount of work time, thus finding it difficult to be able to fully participate in activities. Surely those coping well with the disease are able to actively participate in community development activities, but as will be presented below, as the number of comorbid conditions mount, the barriers to community participation likewise increase.

## Depression

With the publication of the Global Burden of Disease report in 1996, the prevalence and extent of mental illness suffered globally was finally exposed (Murray & Lopez, 1996). Since the

release of this report, greater attention has been paid to mental illness as an under-diagnosed and poorly managed medical condition on a global scale. However, the population burden of depression is not declining, which requires explanation.

Depression is one of the most burdensome psychiatric conditions and is experienced by large numbers of people. The age-adjusted prevalence of major depression is 8.3 percent among all populations, with the lowest rate of 1.1 percent among Asian Americans and the highest rate of 27.8 percent among American Indians/Native Alaskans (Li, Ford, & Strine, 2008). Prevalence of major depressive disorder was significantly higher in Whites than in African Americans and Mexican Americans (Riolo, Nguyen, Greden, & King, 2005).

Depression is among the leading causes of health-related lost labor time, making it a costly disease both in terms of cost of treatment and lost productivity (Stewart, Ricci, Chee, Hahn, & Morganstein, 2003). Workers with depression reported significantly more total health-related lost productive time than those without depression (5.6 hr/wk vs 1.5 hr/wk). More than 80 percent of the lost productive time costs are explained by reduced performance while at work, and yet less than 30 percent of individuals with depression reported use of antidepressants in the previous 12 months. This highlights the extant problem of inadequate treatment for those diagnosed with depression--a problem in need of explanation. The number of psychiatrists being trained in the United States is declining (Faulkner et al., 2011). Cost-cutting measures by health care organizations have also slowed the growth of depression treatment (Marcus Sc, 2010). Most importantly, patients with depression remain a stigmatized population.

Perceived stigma of a disease, such as diabetes or alcoholism, contributes to worsening of depression symptoms. Being treated in a stigmatizing way by others creates a fear of rejection, which intensifies the social isolation one is experiencing. It is the community or social group who reinforces, or defies, the stigmatization process, and can help the patient overcome

perceived stigma (Mickelson & Williams, 2008). In fact, the social constraints associated with stigmatization contribute to lower adherence to essential diabetes self-care activities such as general diet and exercise (Braitman et al., 2008). Just at the time when one is most in need of social support, it is least available.

The financial cost of depression in the United States was estimated to be \$83.1 billion in 2000 (Table 1) (Greenberg et al., 2003). Of the 2000 total costs, \$26.1 billion (31 percent) were direct medical costs, \$5.4 billion (7 percent) were suicide-related mortality costs, and \$51.5 billion (62 percent) were workplace costs (Greenberg et al., 2003). Depression is a highly prevalent health burden, and as will be described later, is a common co-morbidity of both diabetes and alcohol abuse.

## Alcohol Abuse

Prevalence of lifetime and 12-month alcohol abuse has been reported to be 17.8 percent and 4.7 percent, respectively, in the United States (Hasin, Stinson, Ogburn, & Grant, 2007). From a lifetime prevalence perspective, a recent study found that about 42 percent of men and about 19 percent of women reported a history of either alcohol abuse or alcoholism at some point in their lives.

Alcohol abuse and the morbidity associated with it follows a reverse economic gradient, particularly among men (Schmidt et al., 2008), so that heavy episodic drinking patterns are more common in impoverished than in affluent populations (Anderson, Chisholm, & Fuhr, 2009). The relationship between alcohol abuse and poverty is clear, even though the direction of causality is not.

Excessive alcohol consumption is responsible for an average of 79,000 deaths and 2.3 million years of potential life lost in the United States each year (Bouchery, Harwood, Sacks, Simon, & Brewer). The estimated total economic cost of excessive drinking was \$223.5 billion in 2006 (Bouchery et al.) (See Table 1). Of the total cost, 72.2 percent came from lost productivity, 11.0 percent from increased

healthcare costs and 9.4 percent from criminal justice costs.

Alcohol is associated with excess mortality from liver cancer, upper digestive cancer, liver disease, and pancreatic disease (Mathurin & Deltenre, 2009; Rehm et al., 2003). The putative relationship between alcohol abuse and impaired glucose tolerance will be described later.

The prevalence of diabetes, depression, and alcohol abuse as individual conditions has been described above. Table 1 summarizes the financial costs in the United States of each of these conditions individually, using the most recent data available. Although it is medically convenient to diagnose and treat these three conditions as individual diseases, it is the contention of the authors that for many populations these three conditions occur simultaneously as a syndrome. Each of the pairs of dual co-morbidity will be described presently.

### **Diabetes and Depression Comorbidity**

Diabetes is associated with high rates of disability and impaired quality of life (Laiterapong et al., 2011), including depression. In a qualitative study of diabetic patients, 61 percent reported that diabetes contributed to their depression symptoms (Tanenbaum et al., 2013), and diabetes was mentioned more often at higher levels of depression severity ( $r=0.38$ ,  $p=0.001$ ). Major depression is highly prevalent among people with diabetes, as high as 13.3 percent among type 2 diabetics on insulin (Li et al., 2008). Furthermore, depression among people with diabetes is related to worsened health outcomes and quality of life (Goldney, Phillips, Fisher, & Wilson, 2004).

Diabetes can lead to the development or worsening of depressive symptoms due to the rigors and stressfulness of managing diabetes (Katon Wj & et al., 2004). Diabetes can also cause complications (heart disease, kidney failure, blindness, pain, etc.) that may worsen symptoms of depression (De Groot, Anderson, Freedland, Clouse, & Lustman, 2001). Likewise, depression can lead to poor lifestyle

decisions, such as poor diet, less exercise, smoking and weight gain, which worsen diabetes outcomes (Knol et al., 2006). Depression also affects one's ability to perform activities of daily living and think clearly, which can compromise one's ability to manage his or her condition (Rustad, Musselman, & Nemeroff, 2011). More research is needed to clarify the pathways that link diabetes and depression.

Primary care providers, such as family physicians, provide the vast majority of care for patients with diabetes and depression, with assistance from the medical specialties of endocrinology and psychiatry, respectively. Unfortunately, an overly reductionist approach to medical care frequently results in treating diabetes and depression as isolated diseases in the same individual, without necessarily addressing them as a linked syndrome. Busy providers may find it difficult to manage multiple co-morbidities simultaneously, but for the sake of improved outcomes, it is imperative that new models of care be designed for individuals affected by this disease triad, and other syndromic illnesses. Information derived from research into the social determinants of disease could be more adroitly applied to models of patient care (Braveman, Egerter, & Williams, 2011).

### **Alcohol and Diabetes Comorbidity**

The health risks of alcohol consumption (Kvaavik, Batty, Ursin, Huxley, & Gale, 2010), especially binge drinking (Sofia Malyutina et al., 2002; Bagnardi, 2008; S et al.) and/or strong liquor consumption (Schuckit, 2009) are well substantiated, including the risks for metabolic disorders, such as diabetes (Strand et al., 2012). Zaridze et al. (2009) found a dose-response relationship between death due to pancreatic disease in Russian men who consumed three or more half-liter bottles of vodka per week, with a relative risk of 6.69. Kristiansen et al (Kristiansen, Grønabæk, Becker, & Tolstrup, 2008) report that high alcohol intake was associated with a higher risk of pancreatitis and in a dose-response manner. However, as with cardiovascular disease, the influence of alcohol

intake on the risk of developing type 2 diabetes appears to have a U-shaped curve (Alromaihi, Zielke, & Bhan, 2012), being potentially beneficial at low, but extremely harmful at high, intake levels respectively.

Heavy drinkers have been shown to have higher rates of diabetes and higher mean blood glucose levels than occasional drinkers or non-drinkers (Jin et al., 2011; M. A. Strand, Perry, Wang, Liu, & Lynn, 2012). While at low levels, alcohol increases insulin sensitivity temporarily (Avogaro, Watanabe, & Dall'Arche, 2004), explaining the benefits found. But at higher levels of intake, alcohol generates cellular oxidative stress (Dembele, Nguyen, Hernandez, & Nyomba, 2009) and compromises pancreatic beta cell function (Shin, Lee, Yang, & Kim, 2002). Alcohol consumption in patients with type 2 diabetes can result in hypoglycemia as the liver stops releasing stored glucose into the bloodstream (Alromaihi et al., 2012). This combination creates added risk for confusion or even loss of consciousness due to hypoglycemia. This partially explains the mechanism through which alcohol abuse contributes to the difficulty in appropriately managing diabetes.

However, the causal relationship appears to be from alcohol to diabetes, where alcohol abuse leads to worsening diabetes, not the other way around. For example, it has been shown that individuals are likely to give up drinking after being diagnosed with diabetes or to reduce their alcohol intake in an attempt to improve quality of life and reduce severity of the disease (Kahn, 1999; Liang & Chikritzhs, 2010). However, in some individuals with diabetes, it is conceivable that worsened depression as a result of a diabetes diagnosis could lead to worsened depression and secondarily increased alcohol intake.

### **Alcohol and Depression Comorbidity**

Depression is common among individuals struggling with alcoholism (Tait et al., 2012; Hsieh et al.). For some, this depression is episodic and will subside after successfully overcoming their

alcohol dependence. For others, their depression is the underlying condition and retreat to alcohol is a form of self-medication to improve mood and energy level. Self-medication with alcohol has been seen with numerous mood disorders, including dysthymia, major depressive disorder, and bipolar disorder (Bolton, Robinson, & Sareen, 2009). While directionality or causality between alcohol abuse and depression is difficult to determine, the paired relationship contributes to intensified burden of disease for individuals who present with both conditions.

### **Diabetes, Depression, and Alcohol Triad**

Evidence for diabetes, depression and alcohol occurring as co-morbidities among many populations suggests the possibility that they actually exist as a triad (Tann, Yabiku, Okamoto, & Yanow, 2007). While biological mechanisms for these multiple co-morbidities exist, the social determinants underlying this triad are even more intriguing. A conceptual model for exploring the etiology of this triad will be introduced presently.

### **CONCEPTUAL MODEL**

Figure 1 brings together the above evidence to show the interrelationships between these three conditions. One should take note of the arrows to see that the relationship is not a continuous or multidirectional cycle. Alcohol abuse contributes to the development or worsening of diabetes and depression. Diabetes contributes to depression but not directly to alcohol abuse; in fact, diabetics tend to reduce alcohol intake upon diagnosis of diabetes. Depression contributes to alcohol abuse, and can lead to worsening of diabetes symptoms due to compromised self-care, but no physiological mechanism is known that would cause depression to result in diabetes. The role of alcohol abuse in worsening the disease burden of diabetes and depression is evident. Furthermore, the strong relationship between alcohol abuse and financial difficulties, and the modifiable nature of alcohol abuse make it a

Figure 2. The social-ecological model



key entry point to break the cycle of diabetes, alcohol and depression.

It is possible that the social and environmental conditions that predispose some populations to higher rates of diabetes, depression, and alcohol abuse could be similar and synergistic. One conceptual model that could guide exploration into this triad is the Social Ecological Model.

### The Social Ecological Model

The social ecological model (Sallis & Owen, 1997; Stokols, 1996) provides an evidence-based framework to analyze health behaviors from five levels of influence (See Figure 2).

- **Intrapersonal Factors:** Individual characteristics that influence behavior, such as biology, knowledge, beliefs, and personality traits.
- **Interpersonal Factors:** Interpersonal processes, and primary groups including family, friends, peers, that provide social identity, support, and role definition.
- **Institutional Factors:** Rules, regulations, policies, and informal structures, which may constrain or promote recommended behaviors.
- **Community Factors:** Social networks and norms, or standards, which exist as formal

or informal influences among individuals, groups, and organizations.

- **Public Policy:** Local, state, federal policies and laws that regulate or support healthy actions and practices for disease prevention, early detection, control, and management.

The Social Ecological Model is the ideal theoretical perspective to identify the underlying causes of this disease triad and in designing appropriate interventions to address it at population and individual levels. A research program based on this model will be proposed in the Proposed Research Questions section to follow. But first the issue of social support will be used to explain the relationship between the Social Ecological Model and the conceptual model for this disease triad. Lack of social support has been shown to contribute to depression (Grav, 2012), compromised diabetes management (Schjøtz, Bøgelund, Almdal, Jensen, & Willaing, 2012) and alcohol abuse (Bacharach, Bamberger, Doveh, & Cohen, 2007). In fact, evidence from many countries has shown that individuals without adequate social support have higher rates of virtually every disease that has been studied, independently of other disease risk factors (Berkman & Kawachi, 2000). Therefore, lack of social support is a significant determinant of the disease triad. Furthermore, social support is a broad concept that could be described by each of the factors of the Social

Ecological Model. Well validated instruments such as the Multidimensional Scale of Perceived Social Support could be used to assess social support in an individual or group of people, and this could be used to identify individuals at elevated risk for one or more of these three disease states. Furthermore, increasing social support could potentially be used as a treatment modality for individuals affected by the diabetes, depression, and alcohol syndrome.

As defined previously, community development results from the interactions of community members in such a way as to improve welfare, health and social cohesion. Addressing the problem of social support holds the potential of lessening the burden of disease from each of the components of this triad, and contributing to an essential element of community development, the interaction of community members leading to increased social cohesion.

Population health is dependent on healthy community processes as described in the definition for community development used in this paper (Syme & Ritterman, 2009). In other words, conflicts in the community, or lack of empowerment of community members will contribute to poor population health (Laverack, 2006). Likewise, individuals who are members of such communities will experience compounded disease burden when they do develop disease because the community resources essential to their care are lacking. The disease triad of diabetes, depression and alcohol abuse are more common among poorer sectors of society. Affected individuals experience the double burden of compromised ability to contribute to the community, and increasing distance from the resources of the community by which to cope with disease or pursue recovery.

It is important to understand that while overall economic improvement in a community holds out the possibility of increased resources available for improved welfare, it does not ensure it. For if such economic improvement comes at the expense of social equality, it is equally likely to result in worsened health outcomes for those who are not benefitting from the improved economic status (Avendano &

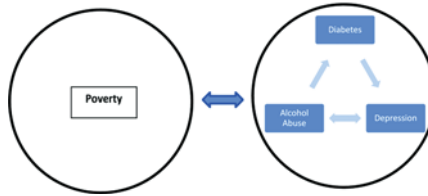
Glymour, 2008). Take for example the recent economic downturn in the United States. While the income increases among the wealthiest and even the middle class may have slowed, only among the lowest income populations have net incomes decreased. This income inequality is a greater contributor to worsened health outcomes than absolute poverty (Kawachi & Kennedy, 1999; Marchman Andersen, Dalton, Lynch, Johansen, & Holtug, 2013). The mechanism of action is considered to be the decline of social cohesion that results from inequality (Kawachi & Kennedy, 1999). In developed countries, poverty and income inequality are also correlated with higher rates of diabetes (Dinca-Panaitescu et al., 2012), depression (Dinca-Panaitescu et al., 2012; Mickelson & Williams, 2008), and alcohol abuse (Anderson et al., 2009). While the role of poverty as a contributor to the disease triad cannot be overstated, processes mediating this relationship need to be elucidated in order to develop appropriate interventions.

The association between low income and diabetes incidence cannot be explained by age, sex, health behaviors or psychological distress (Dinca-Panaitescu et al., 2012). Perhaps poverty and inequity in community development are both causative factors in the development of this triad among individuals. Furthermore, the reduced productivity among individuals with these conditions could result in a bi-directional perpetuation of poverty and the triad (Figure 3). The role of social programs, designed to support such individuals, will be considered later.

The medical system currently does not address the triad as a syndrome. Rather, the medical care system addresses diabetes and outpatient depression management, and the behavioral health system addresses major depression and alcohol treatment. In the non-holistic model shown in Figure 4, separate providers, provider systems, case managers, payers, enrollment criteria, and information technology systems exist. This system, or multitude of systems, is poorly coordinated, and potentially has a significant impact on increasing the financial and social costs of the triad to society. Perhaps the health care system needs to move from the one-disease,



Figure 3. A putative relationship between poverty and the disease triad



reductionist approach to care, to a holistic focus that includes assessment of social determinants of health. Additionally, the health care system needs to examine its role in advocacy to promote health equity and to reduce health disparities that are based in social determinants of health such as social isolation and poverty.

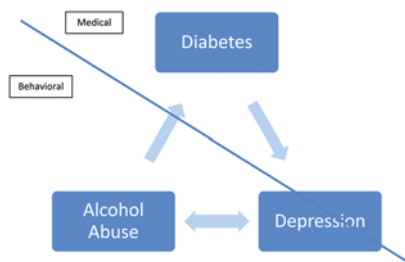
### Policy Implications

While typically considered outside the realm of health care, policy development that improves the living conditions of the population is vital to effectively address the health issues facing modern society, including the disease triad. The history of public health and medicine has revealed that public health interventions, including improving community environments through policy development, can have a much larger impact on the health of a population than medical care alone (Prevention, 1999). Social, economic, and ecological environments need to be addressed with the same commitment as improvements in sanitation were in the previous century. The approach to environmental health needs to include promoting positive

impact on non-communicable, chronic disease in much the same manner as public health efforts addressed infectious diseases in previous decades. This approach would result in savings to society through reduced healthcare expenses, increased individual productivity and enhanced community development. As will be proposed shortly, numerous research opportunities exist in addressing the impact of the triad of diabetes, depression, and alcohol abuse on community development. The full impact of the diabetes, depression, and alcohol abuse triad in economic and social outcomes is not fully understood. Perhaps negative synergies exist that further exacerbate health care costs among individuals and populations that experience higher rates of the triad. Perhaps poorly coordinated medical and behavioral health care have an associated cost to society, and perhaps under-diagnosing or not recognizing the interconnectedness of diabetes, depression, and alcohol abuse are adding to the societal cost.

The disease triad is more common among poor populations, many of whom qualify for public programs such as disability assistance,

Figure 4. Separation of medical and behavioral care in the diabetes, depression, and alcohol abuse triad



Temporary Assistance for Needy Families, unemployment benefits, Medicaid and food stamps. These programs could be better integrated with the medical system treating these patients. Program offices could serve as a naturally occurring gatekeeper for screenings. Case managers with these agencies could implement screenings for depression (Patient Health Questionnaire-9), alcohol abuse (Simple Screening Instrument for Substance Abuse) and diabetes control (hemoglobin A1C). After identifying individuals with the disease triad they could also coordinate appropriate holistic care for them. As is being argued in this paper, such an approach assumes the integration of public health with the medical system in a way that better serves vulnerable populations and populations presenting with complex and burdensome conditions. As described above, the three diseases of this triad prevail disproportionately among American Indian and Alaska Native individuals and military veterans, many of whom rely on the Indian Health Service and Veteran Affairs healthcare systems, respectively. Therefore these healthcare systems can serve as potential points of entry for interventions aimed at the disease triad.

The diabetes, depression and alcohol triad also create opportunities for occupational health to intervene, for most employers will have employees with this triad. Policies to protect such individuals from discrimination, guided by a therapeutic focus rather than a punitive focus, could be implemented. Employing individuals with training in public health, who are competent in both behavioral and health sciences, could strengthen their capacity to improve the welfare of such employees, and improve work productivity through worksite wellness programming.

### **Proposed Research Questions**

According to the Agency for Healthcare Research and Quality, 99 percent of medical research dollars in the United States are spent on new drugs and new devices (Clancy, 2006). This leaves little research money available to

fund research into complex questions such as the social and ecological determinants of the disease triad of diabetes, depression and alcohol abuse. But in order to enhance the healthy development of communities, and elicit the involvement of all members of the community, individuals suffering from the burden of this disease triad need to be provided holistic, cost-effective and appropriate health services. In order to do that, the etiology of this disease triad needs to be better understood.

Several assumptions underlie the research needs introduced in Table 2. First, diabetes, depression and alcohol share a common set of social determinants. Second, populations with this disease triad experience economic burdens and social isolation which contributes to worsened health outcomes. Finally, populations with high rates of this disease triad face significant barriers to participating in the community development process and impediments to improved welfare. Therefore a multidisciplinary approach is recommended to guide the design of a research program. As mentioned in the introduction, other disease syndromes exist, and could be investigated in a similar manner to the proposal to follow.

Table 2 introduces two ways to approach a research agenda for understanding the diabetes, depression and alcohol abuse triad. The first method proposed is a multidisciplinary approach, where each discipline defines one of the factors, and designs a research question using that definition. As a first step in this direction, each of the factors in the Social Ecological Model needs to be given an operational definition (Table 2, column 2). Using this operational definition, possible research questions for each of the factors are proposed to begin to better understand the diabetes, depression and alcohol abuse triad (Table 2, column 3). Areas of commonality between the disease states then become a means through which to intervene in reducing the prevalence or gravity of the disease.

A second method would be to focus on one factor considered to be a crucial determinant of the disease triad. As described previously, social support could be chosen as that one crucial deter-

Table 2. A research proposal based on the five factors of the Social Ecological Model

Factor	Sample operational definitions for exploring the disease triad.	Multidisciplinary research questions to accompany the sample definitions.	Sample research agenda addressing "social support" across all factors.
Intrapersonal Factors	Individual characteristics that influence behavior, such as biology, knowledge, beliefs, and personality traits.	Using the Health Belief Model, Do individuals with any pairs of these diseases or the disease triad demonstrate health perceptions significantly different from health individuals or individuals with only one of these diseases?	Compare social support and individual motivation to behavior change among individuals with the disease triad.
Interpersonal Factors	Social support levels as a measure of healthy interpersonal relationships.	Can the provision of social support improve coping mechanisms and reduce adverse health outcomes of individuals with one or more of these three disease states?	Assess perceived level of social support (Multidimensional Scale of Perceived Social Support) among individuals with the disease triad, using individuals with other disease states as a control group.
Institutional Factors	Worksite policies after a bout of disease.	Do employers practice sick leave and recovery practices in a way that are discriminatory to individuals with the disease triad, or in any way unsupportive?	Investigate organizational culture to determine the extent to which management supports employees struggling with the disease triad.
Community Factors	Stigmatization of individuals with disease.	What social norms are in place to reduce stigmatization of individuals with diabetes, depression or alcoholism, or any combination of these three conditions?	Explore whether community organizations can serve as a proxy for social support through programming and informal practices.
Public Policy	Policies of third-party payers (insurance, Medicaid, Medicare).	Do third-party payers discriminate against individuals with these disease states? Are they willing to accept high short-term expenditures with a view to reduced costs long-term?	Identify employment policies that are least discriminatory to individuals with the disease triad.

minant. The final column in Table 2 shows how each of the five factors of the Social Ecological Model could be used to analyze social support, thus allowing for a more rigorous investigation of one variable from multiple perspectives. It is recommended that multidisciplinary research teams come together to address one or more of the factors in the Social Ecological Model.

It is evident that effective research paradigms constructed along these lines will rely on the expertise of medical and behavioral experts, as well as economists and public policy experts. In this way progress can be made in elucidating the pathways mediating the disease triad and the social constructs considered to be

contributing to it. This will also aid in the design of the necessary holistic care that individuals and populations afflicted by this disease triad need if they are to experience improved health and resume active participation in community development.

## CONCLUSION

Type 2 diabetes, depression and alcohol abuse are found as multiple co-morbidities among many vulnerable populations. These populations are themselves frequently poor, and live in communities experiencing developmental stagnation or decline. Attempts to catalyze com-

munity development in such communities are threatened by low productivity of its members and their poor health status.

It is the contention of the authors that poverty, financial crises, and social isolation are a necessary but not sufficient condition leading to the development of the disease triad. Physiologically and psychologically, alcohol abuse is a significant contributor to both worsening diabetes and depression in populations experiencing this syndrome. From there the cycle begins, and is very difficult to ameliorate. Therefore, initiatives to address inequality and poverty at multiple levels are an essential, but insufficient, part of the process of addressing the disease triad. Also needed are just and accessible health care services that diagnose and treat the disease triad holistically.

The exact mechanism at work in individuals and communities to create conditions hospitable to the disease triad are not at all clear. It is the hope of the authors that this paper will heighten awareness of the burden of disease created in many populations by the presence of the co-morbidities of diabetes, depression and alcohol abuse, and that community development can occur in places previously considered beyond hope.

## REFERENCES

- Alromaihi, D., Zielke, J., & Bhan, A. (2012). Challenges of type 2 diabetes in patients with alcohol dependence. *Clinical Diabetes*, 30(3), 120–122. doi:10.2337/diaclin.30.3.120
- Anderson, P., Chisholm, D., & Fuhr, D. C. (2009). Effectiveness and cost-effectiveness of policies and programmes to reduce the harm caused by alcohol. 373, 2234–2246.
- Avendano, M., & Glymour, M. (2008). Stroke disparities in older Americans: Is wealth a more powerful indicator of risk than income and education? *Stroke*, 39, 1533–1540. doi:10.1161/STROKEAHA.107.490383 PMID:18436891
- Avogaro, A., R. M., Watanabe, R., & Dall'Arche, A. (2004). Acute alcohol consumption improves insulin action without affecting insulin secretion in type 2 diabetic subjects. *Diabetes Care*, 27(6), 1369–1374. doi:10.2337/diacare.27.6.1369 PMID:15161790
- Bacharach, S., Bamberger, P., Doveh, E., & Cohen, A. (2007). Retirement, social support and drinking behavior: A cohort analysis of males with a baseline history of problem drinking. *Journal of Drug Issues*, 37, 717–736. doi:10.1177/002204260703700303 PMID:18612374
- Bagnardi, V., Zatonski, W., Scotti, L., La Vecchia, C., & Corrao, G. (2008). Does drinking pattern modify the effect of alcohol on the risk of coronary heart disease? Evidence from a Meta-analysis. *Journal of Epidemiology and Community Health*, 62, 615–619. doi:10.1136/jech.2007.065607 PMID:18559444
- Berkman, L. F., & Kawachi, I. O. (2000). *Social epidemiology*. Oxford University Press.
- Boles, M., Pelletier, B., & Lynch, W. (2004). The relationship between health risks and work productivity. *Journal of Occupational and Environmental Medicine*, 46(7). doi:10.1097/01.jom.0000131830.45744.97 PMID:15247814
- Bolton, J. M., Robinson, J., & Sareen, J. (2009). *Self-medication of mood disorders with alcohol and drugs*. National Epidemiologic Survey on Alcohol and Related Conditions.
- Bouchery, E. E., Harwood, H. J., Sacks, J. J., Simon, C. J., & Brewer, R. D. (2006). Economic costs of excessive alcohol consumption in the U.S. 41(5), 516–524.
- Braitman, A. L., Derlega, V. J., Henson, J. M., Robinett, I., Saadeh, G. M., & Janda, L. J. et al. (2008). Social constraints in talking about diabetes to significant others and diabetes self-care: A social-cognitive processing perspective. *Journal of Social and Clinical Psychology*, 27(9), 949–969. doi:10.1521/jsep.2008.27.9.949
- Braveman, P., Egerter, S., & Williams, D. R. (2011). The social determinants of health: Coming of age. *Annual Review of Public Health*, 32, 381–398. doi:10.1146/annurev-publhealth-031210-101218 PMID:21091195
- Bremander, A., Petersson, I., Bergman, S., & Englund, M. (2011). Population-based estimates of common comorbidities and cardiovascular disease in ankylosing spondylitis. *Arthritis Care and Research*, 63(4), 550–556. doi:10.1002/acr.20408 PMID:21452267

- CDC. (2011). *National diabetes fact sheet*. Atlanta, GA: National Center for Chronic Disease Prevention and Health Promotion.
- CDC. (2013). *Percentage of civilian, noninstitutionalized population with diagnosed diabetes, by age, United States, 1980–2010*. Retrieved February 20, 2013, from <http://www.cdc.gov/diabetes/statistics/prev/national/figbyage.htm>
- Clancy, C. (2006). The 1.6 trillion dollars question: if we're spending so much on healthcare, why so little improvement in quality? [J]. United States.]. *MedGenMed : Medscape General Medicine*, 8, 58. PMID:16926797
- Cowie, C. C., Rust, K. F., Byrd-Holt, D. D., Gregg, E. W., Ford, E. S., & Geiss, L. S. et al. (2010). Prevalence of diabetes and high risk for diabetes using A1C criteria in the U.S. population in 1988-2006. *Diabetes Care*, 33, 562–568. doi:10.2337/dc09-1524 PMID:20067953
- Danaei, G., Finucane, M. M., Lu, Y., Singh, G. M., Cowan, M. J., & Paciorek, C. J. et al. (2011). National, regional, and global trends in fasting plasma glucose and diabetes prevalence since 1980: systematic analysis of health examination surveys and epidemiological studies with 370 country-years and 2.7 million participants [J]. Elsevier Ltd.]. *Lancet*, 378, 31–40. doi:10.1016/S0140-6736(11)60679-X PMID:21705069
- De Groot, M., Anderson, R., Freedland, K. E., Clouse, R. E., & Lustman, P. J. (2001). Association of depression and diabetes complications: A meta-analysis. *Psychosomatic Medicine*, 63, 619–630. doi:10.1097/00006842-200107000-00015 PMID:11485116
- Dembele, K., K. H., Nguyen, K., Hernandez, T., & Nyomba, B. (2009). Effects of ethanol on pancreatic beta-cell death: Interaction with glucose and fatty acids. *Cell Biology and Toxicology*, 25(2), 141–152. doi:10.1007/s10565-008-9067-9 PMID:18330713
- Dinca-Panaitescu, M., Dinca-Panaitescu, S., Raphael, D., Bryant, T., Pilkington, B., & Daiski, I. (2012). The dynamics of the relationship between diabetes incidence and low income: Longitudinal results from Canada's National Population Health Survey. *Maturitas*, 72(3), 229–235. doi:10.1016/j.maturitas.2012.03.017 PMID:22551632
- Faulkner, L. R., Juul, D., Andrade, N. N., Brooks, B. A., Colenda, C. C., & Guynn, R. W. et al. (2011). Recent trends in american board of psychiatry and neurology psychiatric subspecialties. *Academic Psychiatry*, 35, 35–39. doi:10.1176/appi.ap.35.1.35 PMID:21209405
- Goldney, R., Phillips, P., Fisher, L., & Wilson, D. (2004). Diabetes, depression, and quality of life. *Diabetes Care*, 27, 1066–1070. doi:10.2337/diabetes.27.5.1066 PMID:15111522
- Grav, S. H., Ove Romild, Ulla Stordal, Eystein. (2012). Association between social support and depression in the general population: the HUNT study, a cross-sectional survey. *Journal of Clinical Nursing*, 21, 111–120. doi:10.1111/j.1365-2702.2011.03868.x PMID:22017561
- Greenberg, P. E., Kessler, R. C., Birnbaum, H. G., Leong, S. A., Lowe, S. W., Berglund, P. A., & Corey-Lisle, P. K. (2003). The economic burden of depression in the United States: How did it change between 1990 and 2000? *The Journal of Clinical Psychiatry*, 64, 1465–1475. doi:10.4088/JCP.v64n1211 PMID:14728109
- Hasin, D., Stinson, F., Ogburn, E., & Grant, B. (2007). Prevalence, correlates, disability, and comorbidity of dsm-iv alcohol abuse and dependence in the united states: Results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry*, 64(7), 830–842. doi:10.1001/archpsyc.64.7.830 PMID:17606817
- Hsieh, M. H., Tang, C.-H., Hung, S.-T., Lee, I. H., Lin, Y.-J., & Yang, Y. K. (n.d.). Comorbid prevalence of alcohol dependence, substance abuse, and external cause of injury in patients with bipolar disorder in a nationwide representative sample in Taiwan. *14*, 677–679.
- Jin, L., Huang, Y., Bi, Y., Zhao, L., Xu, M., & Xu, Y. et al. (2011). Association between alcohol consumption and metabolic syndrome in 19,215 middle-aged and elderly Chinese. *Diabetes Research and Clinical Practice*, 92, 386–392. doi:10.1016/j.diabres.2011.02.033 PMID:21458874
- Kahn, M. E. (1999). Diabetic risk taking: The role of information, education and medication. *Journal of Risk and Uncertainty*, 18(2), 147–164. doi:10.1023/A:1007838613940
- Karelina, K., & DeVries, A. C. (2011). Modeling social influences on human health. *Psychosomatic Medicine*, 73(1), 67–74. doi:10.1097/PSY.0b013e3182002116 PMID:21097660
- Katon Wj, V. K. M. L. E. B. et al. (2004). The pathways study: A randomized trial of collaborative care in patients with diabetes and depression. *Archives of General Psychiatry*, 61(10), 1042–1049. doi:10.1001/archpsyc.61.10.1042 PMID:15466678

- Kawachi, I., & Kennedy, B. P. (1999). Income inequality and health: Pathways and mechanisms. *Health Services Research, 34*, 215–227. PMID:10199670
- Knol, M., Twisk, J., Beekman, A., Heine, R., Snock, F., & Pouver, F. (2006). Depression as a risk factor for the onset of type 2 diabetes mellitus. A meta-analysis. *Diabetologia, 49*, 837–845. doi:10.1007/s00125-006-0159-x PMID:16520921
- Kristiansen, L., Grønbaek, M., Becker, U., & Tolstrup, J. S. (2008). Risk of pancreatitis according to alcohol drinking habits: A population-based cohort study. *American Journal of Epidemiology, 168*, 932–937. doi:10.1093/aje/kwn222 PMID:18779386
- Kvaavik, E., Batty, D., Ursin, G., Huxley, R., & Gale, C. R. (2010). Influence of individual and combined health behaviors on total and cause-specific mortality in men and women: The United Kingdom health and lifestyle survey. *Archives of Internal Medicine, 170*(8), 711–718. doi:10.1001/archinternmed.2010.76 PMID:20421558
- Laiteerapong, N., Karter, A. J., Liu, J. Y., Moffet, H. H., Sudore, R., & Schillinger, D. et al. (2011). Correlates of quality of life in older adults with diabetes: the diabetes & aging study. *Diabetes Care, 34*(8), 1749–1753. doi:10.2337/dc10-2424 PMID:21636795
- Larson, K., Russ, S. A., Kahn, R. S., & Halfon, N. (2011). Patterns of comorbidity, functioning, and service use for US children with ADHD. *Pediatrics, 127*(3), 462–470. doi:10.1542/peds.2010-0165 PMID:21300675
- Laverack, G. (2006). Improving health outcomes through community empowerment: A review of the literature. *Journal of Health, Population, and Nutrition, 24*(1), 113–120. PMID:16796158
- Li, C., Ford, E. S., & Strine, T. W. (2008). Prevalence of depression among U.S. adults with diabetes: Findings from the 2006 behavioral risk factor surveillance system. *Diabetes Care, 31*, 105–107. doi:10.2337/dc07-1154 PMID:17934145
- Liang, W., & Chikritzhs, T. (2010). Reduction in alcohol consumption and health status. *Addiction (Abingdon, England), 106*, 75–81. doi:10.1111/j.1360-0443.2010.03164.x PMID:21054616
- Malyutina, S., Bobak, M., Kurilovitch, S., Gafarov, V., Simonova, G., Nikitin, Y., & Marmot, M. (2002). Relation between heavy and binge drinking and all-cause and cardiovascular mortality in Novosibirsk, Russia: A prospective cohort study. *The Lancet, 360*(9344), 1448–1454. doi: http://dx.doi.org/10.1016/S0140-6736(02)11470-X
- Marchman Andersen, M., Dalton, S. O., Lynch, J., Johansen, C., & Holtug, N. (2013). Social inequality in health, responsibility and egalitarian justice. *Journal of Public Health, 35*(1), 4–8. doi:10.1093/pubmed/fdt012 PMID:23436200
- Marcus Sc, O. M. (2010). National trends in the treatment for depression from 1998 to 2007. *Archives of General Psychiatry, 67*(12), 1265–1273. doi:10.1001/archgenpsychiatry.2010.151 PMID:21135326
- Mathurin, P., & Deltenre, P. (2009). Effect of binge drinking on the liver: an alarming public health issue? *Gut, 58*, 613–617. doi:10.1136/gut.2007.145573 PMID:19174416
- Mickelson, K. D., & Williams, S. L. (2008). Perceived Stigma of Poverty and Depression: Examination of Interpersonal and Intrapersonal Mediators. *Journal of Social and Clinical Psychology, 27*(9), 903–930. doi:10.1521/jscp.2008.27.9.903
- Murray, C. J. L., & Lopez, A. (Eds.). (1996). *The global burden of disease*. Geneva, Switzerland: World Health Organization.
- Nettleton, S., O'Malley, L., Watt, I., & Duffey, P. (2004). Enigmatic illness: Narratives of patients who live with medically unexplained symptoms. *Social Theory & Health, 2*(1), 47–66. doi:10.1057/palgrave.sth.8700013
- Prevention, C. f. D. C. a. (1999). Ten great public health achievements: United States, 1900-1999. *Morbidity and Mortality Weekly Report, 48*(12), 241-243.
- Rehm, J., Room, R., Graham, K., Monteiro, M., Gmel, G., & Sempos, C. (2003). The relationship of average volume of alcohol consumption and patterns of drinking to burden of disease. *Addiction (Abingdon, England), 98*, 1209–1228. doi:10.1046/j.1360-0443.2003.00467.x PMID:12930209
- Riolo, S. A., Nguyen, T. A., Greden, J. F., & King, C. A. (2005). Prevalence of depression by race/ethnicity: Findings from the national health and nutrition examination survey III. *95*, 998–1000.
- Rustad, J. K., Musselman, D. L., & Nemeroff, C. B. (2011). The relationship of depression and diabetes: Pathophysiological and treatment implications. *Psychoneuroendocrinology, 36*(9), 1276–1286. doi:10.1016/j.psyneuen.2011.03.005 PMID:21474250
- Sallis, J. F., & Owen, N. (1997). Ecological models. In K. Glanz, F. M. Lewis, & B. K. Rimer (Eds.), *Health behavior and health education: Theory, research, and practice* (2nd ed., pp. 403–424). San Francisco, CA: Jossey-Bass Publishers.

- Sarpong, E. M., Bernard, D. M., & Miller, G. E. (2012). Changes in pharmaceutical treatment of diabetes and family financial burdens. *Medical Care Research and Review*, 69(4), 474-491. doi:10.1177/1077558712442570 PMID:22513449
- Schiøtz, M. L., Bøgelund, M., Almdal, T., Jensen, B. B., & Willaing, I. (2012). Social support and self-management behaviour among patients with Type 2 diabetes. *Diabetic Medicine*, 29(5), 654-661. doi:10.1111/j.1464-5491.2011.03485.x PMID:21992512
- Schmidt, L., Makela, P., Rehm, J., & Room, R. (2008). Alcohol and social determinants of health. In E. Blas, & A. Sivasankara (Eds.), *Priority public health conditions: From learning to action on social determinants of health*. Geneva, Switzerland: World Health Organization.
- Schuckit, M. A. (2009). Alcohol-use disorders. *Lancet*, 373, 492-501. doi:10.1016/S0140-6736(09)60009-X PMID:19168210
- Shin, J. S., Lee, J. J., Yang, J. W., & Kim, C. W. (2002). Ethanol decreases basal insulin secretion from HIT-T15 cells. *Life Sciences*, 70(17), 1989-1997. doi:10.1016/S0024-3205(02)01484-4 PMID:12148691
- Stewart, W. F., Ricci, J. A., Chee, E., Hahn, S. R., & Morganstein, D. (2003). Cost of lost productive work time among U.S. workers with depression. *Journal of the American Medical Association*, 289, 3135-3144. doi:10.1001/jama.289.23.3135 PMID:12813119
- Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion*, 10(4), 282-298. doi:10.4278/0890-1171-10.4.282 PMID:10159709
- Strand, M. A., Perry, J., Wang, P., Liu, S., & Lynn, H. (2012). Risk factors for metabolic syndrome in a cohort study in a North China urban middle-aged population. *Asia Pac J Public Health*. doi:10.10539512438609 [pii]
- Strand, M. A., Perry, J. L., & Wang, P. (2012). The association of metabolic syndrome with alcohol consumption among urban Chinese. *Journal of World Health and Population*, 13(4), 5-14. doi:10.12927/whp.2012.22907 PMID:23089724
- Syme, S. L., & Ritterman, M. L. (2009). The importance of community development for health and well-being. *Community Development Investment Review*, 5(3), 1-13.
- Tait, R. J., French, D. J., Burns, R., & Anstey, K. J. (2012). Alcohol use and depression from middle age to the oldest old: gender is more important than age. *International Psychogeriatrics*, 24, 1275-1283. doi:10.1017/S1041610212000087 PMID:22340862
- Tanenbaum, M. L., Ritholz, M. D., Binko, D. H., Baek, R. N., Erica Shreck, M. S., & Gonzalez, J. S. (2013). Probing for depression and finding diabetes: A mixed-methods analysis of depression interviews with adults treated for type 2 diabetes. *Journal of Affective Disorders*. doi:10.1016/j.jad.2013.01.029 PMID:23453278
- Tann, S. S., Yabiku, S. T., Okamoto, S. K., & Yanow, J. (2007). TRIADD: The risk for alcohol abuse, depression, and diabetes multimorbidity in the American Indian and Alaska Native population. *American Indian and Alaska Native Mental Health Research*, 14(1), 1-23. doi:10.5820/aian.1401.2007.5 PMID:17602410
- Weiss, M. G., Ramakrishna, J., & Somma, D. (2006). Health-related stigma: Rethinking concepts and interventions 1. *Psychology Health and Medicine*, 11(3), 277-287. doi:10.1080/13548500600595053 PMID:17130065
- WHO. (2001). *Macroeconomics and health: Investing in health for economic development*. Geneva, Switzerland: World Health Organization Commission on Macroeconomics and Health.
- Zaridze, D., Brennan, P., Boreham, J., Boroda, A., Karpov, R., & Lazarev, A. et al. (2009). Alcohol and cause-specific mortality in Russia: a retrospective case-control study of 48 557 adult deaths. *Lancet*, 373, 2201-2214. doi:10.1016/S0140-6736(09)61034-5 PMID:19560602