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Abstract

I examine whether individuals respond to monetary incentives to detect latent medical conditions. The effect is identified by an amendment to Title 38 that deemed diabetes associated with Agent Orange exposure a compensable disability under the VA's Disability Compensation program. Since a diagnosis is a requisite for benefit eligibility, and nearly one-third of diabetics remain undiagnosed, the advent of disability insurance may have encouraged the detection of diabetes among the previously undiagnosed population. Evidence from the National Health Interview Survey suggests that the policy increased the prevalence of diabetes by 2.7 percentage points among veterans.

JEL Codes: H0, I12
Keywords: Human capital investment, health, diabetes, Vietnam veterans, Agent Orange

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I. Introduction

The early detection and treatment of certain medical conditions and diseases substantially reduces the risk of morbidity and mortality. For example, Bunker, Frazier, and Mosteller (1994) conclude that screening for and treatment of hypertension (i.e. high blood pressure) increases life expectancy by five to six months; and periodic testing for cervical cancer increases life expectancy by 10 to 15 years. Based on current medical evidence, medical screening is now an integral component of public health policy. In a report to the Secretary of Health and Human Services titled *Guide to Preventative Services*, the U.S. Preventative Services Task Force (2002) recommends proactive screening for nine medical conditions and diseases.[1] These recommendations are based in part on whether the benefits of detection and subsequent treatment outweigh the potential complications of screening.

Despite the potential health benefits of early detection, the direct and indirect costs of medical screening may discourage many individuals from seeking medical consultation and consequently knowing their health status. Indeed, health policies designed to increase medical screening rates generally involve reducing the direct costs borne by the individual. But even when the cost of medical consultation is negligible, many health diseases and conditions remain undiagnosed. For example, despite the near zero costs of determining one's HIV status - testing is potentially free, timely, and anonymous - Glynn and Rhodes (2005) report that in 2003 approximately 24%-27% of individuals infected with HIV are undiagnosed. If the detection and

[1] The U.S. Preventative Services Task Force recommends - with caveats - screening for breast cancer, chlamydial infection, colorectal cancer, osteoporosis, lipid disorders, diabetes, obesity, and cervical cancer.

treatment of latent medical conditions is a prescribed policy goal, then understanding the motives for detecting latent conditions has important policy implications.

In this study, I consider whether individuals respond to monetary incentives to determine their diabetes status by exploiting a policy change to the Department of Veterans Affairs (VA) Disability Compensation (DC) program. The DC program compensates veterans for disabilities either acquired or aggravated during military service. Many Vietnam veterans causally associated their diabetes with Agent Orange exposure, an herbicide used extensively during the Vietnam War. However, veterans seeking compensation for diabetes faced two difficulties when establishing service-connectedness. First, there was little to no medical evidence that dioxin exposure is associated with the onset or aggravation of diabetes. And second, applicants would have to provide documentation that they were exposed to Agent Orange during military service. Therefore, many veterans seeking DC benefits for diabetes were presumably denied.

This changed in 2001 when the Department of Veterans Affairs deemed diabetes mellitus a *presumptively service-connected disability*. This amendment to US Code Title 38 (AT38), eliminated the two difficulties to establish service-connectedness. First, the National Academy of Sciences, commissioned by the VA, concluded there was limited or suggestive evidence of an association between exposure to dioxin, a chemical contained in Agent Orange, and the onset of diabetes. This opened up the possibility that diabetes was indeed service-connected. And second, the VA would *presume* exposure to dioxin based on dates and location of service, so Vietnam veterans would not have to prove direct exposure to dioxin. Because of the extensive use of Agent Orange in Vietnam, presumably all diabetic Vietnam veterans became eligible for DC benefits after the policy was implemented.

The change to DC eligibility criteria had a measurable impact on DC rolls and expenditures. Duggan, Rosenheck, and Singleton (2008) conclude that approximately 7 percent of Vietnam veterans alive in 2006 were either newly eligible for or enjoyed an increase in DC benefits, increasing DC expenditures by an estimated $2.85 billion in fiscal year 2007 and total expenditures in net present value by $50 billion. The effect of the policy on DC rolls was so evident that by the end of fiscal year 2005, 20.8% of the .916 million Vietnam beneficiaries were receiving compensation for diabetes, compared to (at most) 6.2% of the .750 million Vietnam Era beneficiaries just four years earlier.[2]

Because a diabetes diagnosis is a requisite for DC benefit eligibility, the change to the DC program's medical eligibility criteria may encourage the detection of diabetes among the previously undiagnosed population. This is a plausible behavioral response since nearly one-third of adult diabetics in the US remained undiagnosed (CDC, 2003). If disability insurance positively impacts the incidence of diabetes diagnosis, then the prevalence of diagnosed diabetes should rise in tandem with the increase in DC rolls and expenditures due to the policy change. If disability insurance has no detection effects, there should be no differential increase in diabetes prevalence among those affected by the policy.

[2] There were 46,395 *total* compensated diabetes cases on the rolls at the end of fiscal year 2001; and 190,199 compensated cases among Vietnam Era beneficiaries at the end of fiscal year 2005. There were 749,554 and 916,220 Vietnam Era beneficiaries receiving disability compensation at the end of fiscal years 2001 and 2005, respectively (VBA Reports). The figures cited are calculated assuming that all cases in 2001 were among Vietnam Era veterans, a conservative assumption, and that each beneficiary can have at most one diabetes case.

Numerous studies examine the effect of disability insurance on labor supply (Autor and Duggan, 2003; Duggan, Rosenheck, and Singleton, 2008; Black, Daniel, and Sanders, 2002; Bound, 1989; Borsch-Supan, 2000; Chen and Van der Klaauw, 2007; Gruber, 2000; Parsons, 1980), yet few studies examine detection effects of disability insurance. Empirically identifying detection effects is complicated since benefit eligibility rules are generally applied universally, so it is difficult to disentangle detection effects due to disability benefits from other health trends. In this study, the policy only affected Vietnam veterans, so an attempt is made to disentangle the effects of disability benefits from other plausible factors.

But even in cases in which an adequate comparison group is available, the advent of disability insurance may change *de facto* medical standards for diagnosis. Kubik (1999) examines legislative changes to Supplemental Security Income and concludes that SSI benefits encouraged the detection and treatment of mental health conditions among children. And Cullen (2003) finds that an increase in supplemental revenue to schools to accommodate students with disabilities increases the percent of students defined as disabled. However, in both cases, it is difficult to determine whether the rise in prevalence is a result of increased detection or vague medical standards. In this study, I examine the effect of disability insurance on the diagnosis and treatment of diabetes, which are arguably less subjective than many other measures of health status.

The analysis also contributes to the discussion of the causal pathways responsible for the socioeconomic status and health gradient; in particular, differential values of life. The value of life hypothesis states that patient individuals value future returns relative to immediate returns more so than less patient individuals; so patient individuals may invest more in human capital, including both education and health (Grossman, 1972). Time preferences, however, are difficult to quantify for empirical analysis. In this study, I surmount this difficulty by examining a policy that effectively shifted the returns of health investment from the future (i.e. marginal declines in mortality and morbidity later) to the present (i.e. disability benefits effective immediately).

To estimate the impact of AT38 on the prevalence of diabetes among the veteran population, I use data from the National Health Interview Survey. Survey years 1997 through 2006 are chosen to adequately span before and after AT38 was implemented, which occurred in 2001. Only males born between 1944 and 1950 are considered in the analysis sample since a significant proportion of Vietnam veterans are male and born during these years.

Using nonveterans as a comparison group, the results indicate that the prevalence of diabetes increased by 2.7 percentage points among veterans after AT38 was implemented relative average changes in diabetes prevalence over the same time period. However, only half of veterans in the NHIS sample actually served in the Vietnam theater, so AT38 may have increased diabetes prevalence by as much as 5.4 percentage points among those affected by the policy. It is unlikely that differential exposure to Agent Orange is driving the empirical result because, according to a publication by the Institute of Medicine, the increased risk of diabetes onset from herbicide exposure is small. Auxiliary analysis suggests that a significant proportion of the rise in diabetes is due to new diagnoses and that the likelihood of diabetes treatment also increased after the policy was implemented.

A straightforward calculation suggests that total increase in DC benefit expenditures due to AT38 is substantially greater than the estimated value of increased life expectancy among newly diagnosed diabetics. However, at the individual level, the value of increased life expectancy exceeds the net present value of DC benefits. Therefore, to be an effective policy instrument, monetary incentives to encourage the detection of latent medical conditions should be targeted to those who are least likely to be diagnosed.

II. VA Disability Compensation

A. Program Rules

DC benefits are awarded to veterans with disabilities deemed to be service-connected, defined as a disease or injury either aggravated or acquired during active military service (which includes wartime and peacetime service).[3] At the initial application level, applications are vetted through a three-member Rating Board, composed of one medical doctor and two nonmedical personnel. The Board evaluates the disability and its service-relatedness by verifying the timing and etiology of the medical condition and the applicant's service record. An applicant may appeal the initial decision to the Board of Veterans Appeals; subsequent appeals are then made to the Court of Veterans Appeals and the Court of Appeals for the Federal Circuit.

Disabilities and their severity are identified by the use of the VA's Schedule for Rating Disabilities. The Schedule defines and quantifies each disability using a disability percentage scale ranging from 0% (generally a non-compensable rate) to 100% (totally disabled) by increments of 10%. If a veteran exhibits multiple service-connected disabilities, a combined ratings table is used to aggregate the severity ratings, and the final level of disability is rounded to the nearest multiple of 10%. The disability compensation benefit is determined by this combined degree of disability.

[3] As a compensation program, disability benefits are not offset by earned or unearned income.

To determine the benefit amount, the VA considers the average reduction in earnings capacity associated with a combined degree of disability.[4] The benefit amount increases nonlinearly with the combined degree of disability. In 2001, monthly payments to a single veteran with no dependents whose combined disability rating was 10%, 50%, and 100%, were $103, $625, and $2,163, respectively.[5]

Compensation for multiple and/or partial disabilities is a defining feature of the VA disability compensation program - SSDI and SSI do not provide benefits for partial disabilities - and is quite common among disability compensation beneficiaries.[6] The impact of an additional disability on the combined disability rating is based on residual capacity, so the loss in earnings resulting from each additional disability are not considered additive. For example, if a veteran has two separate disabilities both rated at 50%, only 50% of his or her ability is subject to the second 50% disability. The overall disability would therefore be 75%, which is subsequently

[4] "The Secretary shall adopt and apply a schedule of ratings of reductions in earning capacity resulting from specific injuries or combination of injuries… based, as far as practicable, upon the average impairments of earning capacity resulting from such injuries in civil occupations (USC Title 38, Part II, Chapter 11, Subchapter VI, Section 1155)."

[5] At the end of fiscal year 2005, there were 7.68 million compensated disabilities and 2.64 million DC beneficiaries, averaging 2.9 disabilities per beneficiary. Dependency benefits are payable to beneficiaries who have a combined disability rating that is at least 30%.

[6] While SSDI does not explicitly compensate for partial disabilities, an SSDI applicant can satisfy the severity requirement of the general disability standard maintained by SSA -'inability to engage in any substantial gainful activity' – with either a single impairment or a combination of impairments.

rounded to 80%. In this manner, the combined ratings table precludes a beneficiary from receiving a combined disability rating greater than 100%.

B. Amending Title 38

Exposure to Agent Orange, an herbicide used extensively during the Vietnam War, is associated with the onset of certain medical conditions. From 1965 to 1971, approximately 18 million gallons of Agent Orange were sprayed in all four military zones of Vietnam, intended to destroy foliage that would otherwise serve as cover for opposing forces. Soon after the War ended, Vietnam Era veterans became increasingly concerned about the long term health effects that exposure to dioxin, a compound contained in Agent Orange, may have. In 1978, the VA established the Agent Orange Registry to monitor the long-term health consequences of Agent Orange; however, no conclusive evidence existed at that time which linked Agent Orange exposure to the onset of any determinable medical condition. Therefore, most veterans who sought DC benefits for conditions believed to have resulted from Agent Orange exposure were presumably denied.

Diabetes was perhaps the most common medical condition anecdotally associated with dioxin exposure. However, in 1994, a scientific review committee comprised of Institute of Medicine (IOM, 1994) researchers concluded that there was inadequate or insufficient evidence of an association between dioxin exposure and the onset of diabetes.[7] This decision was reversed by the IOM in 1999, based on new research conducted by the National Institute for Occupational Safety and Health (Calvert et. al.,1999) and the U.S. Air Force (AFHS, 2000), concluding that

[7] Subsequent IOM reports, Update 1996 and Update 1998, upheld this initial position.

there was limited or suggestive evidence of an association between dioxin exposure and diabetes. Its conclusion, which reversed the conclusion of three preceding committee publications, was published in a report, "Veterans and Agent Orange: Herbicide/Dioxin Exposure and Type 2 Diabetes," released in October, 2000 (IOM, 2000).

One month after this publication's release, the Acting Secretary announced that diabetes associated with Agent Orange exposure would be deemed a *presumptively service-connected disability* for Vietnam Era veterans (DVA, 2000), though the policy did not go into effect until July, 2001.[8] This opened the possibility that diabetes was indeed service related. Additionally, *presumption* meant that Vietnam Era veterans did not have to prove direct exposure to Agent Orange; instead, the VA would presume exposure based on period and location of service. Because of the extensive use of Agent Orange in Vietnam, presumably all diabetic Vietnam veterans became eligible for compensation for diabetes.[9]

Compensation by the DC program for diabetes could be substantial. Because the change in benefits due to diabetes is determined by residual functional capacity, the impact of AT38 on a beneficiary's disability payment depends on his or her initial disability ratings (unrounded combined disability rating). Table 1 illustrates the initial benefit amount and the change in benefits resulting from an appended diabetes case, illustrating the varied, and considerable, incentives for Vietnam Era veterans to seek compensation for diabetes after AT38's

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[8] Currently, eleven diseases are presumptively service-connected due to Agent Orange exposure, including Hodgkin's disease, chronic lymphocytic leukemia, prostate cancer, and respiratory cancers.

[9] Certain Vietnam Era veterans who served in the Korean War would also become eligible for DC benefits; but their exposure and consequent service-connectedness would not be presumed.

implementation. A veteran whose diabetes was rated at 10% (requiring a restricted diet only) and was not previously receiving disability compensation benefits (an initial rating of 0%) would receive $1,236 in benefits annually after AT38. The change in benefits could be as large as $25,956 annually, resulting from a 0% initial disability rating and a 100% diabetes rating.

The increased generosity of DC benefits had a measurable impact on DC enrollment and expenditures. According to Duggan, Rosenheck, and Singleton (2008), 7 percent of Vietnam veterans either became newly eligible for or received an increase in DC benefits; new DC enrollees account for two-thirds of the increased enrollment. The increase in DC rolls and expenditures - and the abundance of VA sponsored pamphlets and websites to disseminate information regarding Agent Orange and DC benefits – suggest that veterans were well informed of the policy change. Because a diagnosis is a requisite for DC benefit eligibility, the rise in DC enrollment for diabetes may be partially accounted for by the detection of diabetes among the previously undiagnosed population. If monetary incentives do increase the incidence of diabetes detection, then the prevalence of diabetes should rise in tandem with the growth in disability rolls. This is examined in the next section.

III. Data

A. Data Specifications

The empirical objective is to estimate detection effects of disability insurance, identified by the advent of DC benefits for diabetes. The National Health Interview Survey (NHIS), conducted annually by the National Center for Health Statistics, is well suited for this study. The NHIS is a standard data source for tracking trends in health behavior and illness in the US, non-institutionalized population, including diabetes prevalence. In contrast to the Behavioral Risk Factor Surveillance System, another commonly used health survey, the NHIS is conducted nationally and is considerably more standard across both US states and time. Additionally, the sample sizes of the NHIS surveys are quite large relative to the National Health and Nutrition and Examination Survey, another common source for health statistics.

I use annual NHIS data from 1997 through 2006 and restrict them to the population of interest. The years were chosen to adequately span before and after the implementation of AT38, which occurred in July, 2001. Only males are included in the analysis sample since most veterans are indeed male. Furthermore, I drop observations that had missing or unreported values for variables pertinent to the study; education, marital status, military history, health insurance status, and self-reported diabetes.

A limitation of the NHIS, as well as the other health surveys, is that respondents are only asked whether they are veterans; era or location of service is not ascertained. Because the presumption clause of AT38 only applied to Vietnam veterans who served in or around Vietnam, it is difficult to precisely identify veterans affected by AT38 in these data. To identify those most likely to have been affected by the policy, I examine the Veteran Supplements of the Current Population Survey, available biannually, which contain information on period of service as well as location. To increase the sample size of male veterans, I pool Veteran Supplements from years 1997, 1999, and 2001.

In Figure 1, I plot separately the percentages of veterans, Vietnam Era veterans, and Vietnam veterans who served in or around conflict areas by year of birth.[10] The graph illustrates a downward trend in the proportion of veterans from older to younger birth cohorts, but there is a

[10] The Veterans Supplement does not contain year of birth; it is approximated by subtracting age reported in the survey from the survey year. Vietnam veteran refers to veterans who served on the ground in, in the water surrounding, or in the air above Vietnam, Laos, or Cambodia.

noticeable spike in the proportion of veterans between birth years 1944 and 1950. The increased demand for manpower during the Vietnam War explains nearly the entire spike, indicated by Vietnam Era veteran line. However, not all Vietnam Era veterans actually served in Vietnam. According to the Vietnam veteran line, approximately half of these Vietnam Era veterans served in or around Vietnam. Thus, in the NHIS, I focus on veteran and non veteran males born between 1944 and 1950, keeping in mind that AT38 applied to only half of these veterans.

B. Data Summary

Table 2 contains standard demographic information from the NHIS by veteran status among males born between 1944 and 1950. By construction, veterans and non veterans are similar in age. Rates of marriage, which may provide protective health effects, are also similar across these two groups. One notable difference is that veterans are almost entirely black or white, compared to 8 percent of non veterans belonging to a different racial group. There is also a disparity in education. More specifically, the distribution of educational attainment among nonveterans has more dense tails compared to veterans: 17.9% of nonveterans have less than a high school education and 35.6% have a college degree or more, compared to 6.5% and 27.7%, respectively, among veterans.

Veterans and non veterans also differ by insurance rates: 7.4 percent of veterans report no health insurance, compared to 12.2 percent of non veterans. This disparity is not due to differences in rates of insurance through an employer, which is reported by 80 percent of both veterans and non veterans. Health insurance through the VA partially covers the gap in insurance coverage; 12.7 percent of veterans report health insurance through the VA, though 4.1 percent report health insurance report both VA health insurance and employer-provided insurance.

C. Diabetes Prevalence and Difference-in-Differences Estimates

Keeping the differences in demographic characteristics across veterans and non veterans in mind, I construct preliminary evidence of the impact of AT38 on diabetes prevalence by plotting the prevalence of diabetes by veteran status and year (Figure 2, estimates and standard errors are given in the Appendix Table 1). To reduce sampling noise, estimates are calculated within two-year increments. If AT38 increases the detection of diabetes, the trend of diabetes prevalence among veterans should shift discretely in 2001 (if the response was precipitous); change in slope after 2001 (if the response were gradual); or both.

According to the graph, the series of prevalence estimates before AT38 appear similar in level and slope between the two groups, but the prevalence increases discretely among veterans shortly after AT38 was implemented, whereas much of the change among non veterans can be explained by the pre-existing trend. From 1997/1998 to 2001/2002, the prevalence of diabetes increased by 3.4 percent points among veterans compared to an increase of 4.6 percentage points among nonveterans. However, from 2001/2002 to 2005/2006, the prevalence of diabetes increased by 6.5 percentage points among veterans compared to just 2.0 percentage points among nonveterans. Using the standard difference-in-differences estimator from 2001/2002 to 2005/2006, AT38 increased the prevalence of self-reported diabetes by 4.6 percentage points (standard error: 1.8) among veterans. However, this estimate does not take into account that only 50 percent of veterans are Vietnam veterans and are therefore affected by AT38. Assuming the rise in diabetes is similar among non veterans and veterans who did not serve in or around Vietnam over this time period, the prevalence of diabetes increased by approximately 9.2 percentage points among veterans affected by the policy.

In addition to year of birth, I consider other instruments in the Veteran Supplement to further identify veterans who served in or around Vietnam. However, to be a reasonable and feasible instrument, the policy should have no impact on the instrument, and the variable must be available in both the Veteran Supplement and the NHIS. Conditional on veteran status, educational attainment is the only reasonable and observable characteristic correlated with Vietnam veteran status. According to the Veteran Supplement, 43.2 percent of male veterans born between 1944 and 1950 served in or around Vietnam, compared to 52.6 percent of male veterans without a college degree. Therefore, if less educated, veteran males are more likely to have served in Vietnam, then the rise in diabetes should be greater relative to their more educated, veteran counterparts.

To determine if this is indeed the case, I plot diabetes prevalence of veteran by educational attainment between 1997 and 2006 in Figure 3. Although the prevalence trends are noisier among veterans due to smaller samples, the figure suggests that much of the rise in diabetes among veterans is driven by the less educated.

Ostensibly, the aggregate trends suggest AT38 increased the prevalence of diabetes among veterans, and the increase is concentrated among those more likely to have served in Vietnam. But the results remain inconclusive. The most pressing concern is that males born in 1944 through 1950 are between the ages of 46 and 62 during the analysis period; ages at which diabetes prevalence is on the rise. Therefore, if there are unobservable factors that generate a heightened prevalence of diagnosed diabetes at these ages – due to different rates of diabetes onset or detection or both - that are correlated with veteran status or their socioeconomic characteristics, then it would be misleading to attribute the entire rise in diabetes among veterans to AT38.

The first concern is whether unobservable factors unique to veterans affect the prevalence of diabetes, through differential rates of diabetes onset or detection. To explore this possibility, I estimate veteran-specific profiles of diabetes prevalence by age using NHIS data. To avoid pre-test bias, I only use data before AT38 was implemented: 1997 through 2001. The age profiles are plotted in Figure 4. As indicated, the diabetes-by-age trajectories are nearly identical between veterans and non veterans, suggesting that the differential rise among veterans in Figure 1 is not due to factors unique to veterans.

Second, there may be factors unique to Vietnam veterans that affect diabetes onset. The most obvious factor is dioxin exposure: if dioxin is indeed a causal factor for diabetes onset, then veterans may exhibit a differential rise in diabetes diagnosis as they age. However, this alternative mechanism seems unlikely based on a statement in a follow-up report by the National Academy of Sciences: "The increased risk, if any, posed by herbicide or TCDD exposure appears to be small… the known predicators of diabetes risk – family history, physical inactivity, and obesity – continue to greatly outweigh any suggested increased risk posed by wartime exposure to herbicides (IOM, 2002)." Thus, differential exposure to Agent Orange should not drive the empirical results.

Third, there may be differential rates of diabetes detection between Vietnam veterans and non Vietnam veterans. To be sure, all Vietnam veterans are eligible for free diabetes screenings through the Agent Orange Registry, whereas 12 percent of non veterans are uninsured. Although the ease of diabetes detection for Vietnam veterans may affect to degree to which they responded to AT38, and therefore the generality of the empirical findings, it is difficult to reconcile the precipitous increase in diabetes prevalence without considering AT38 as a causal factor. Additionally, the number of examinations conducted through Agent Orange

Registry examinations increased shortly after AT38 was implemented as well. In 1999 and 2000, just before AT38 was implemented, 5377 and 7957 examinations were conducted; compared to 23406, 23548, and 30836 examinations in 2001, 2002, and 2003 (Agent Orange Review, 2004). The discrete increase in examinations provides suggestive evidence for the proposed mechanism; the policy increased the incidence of diagnosis among the previously undiagnosed population.

And finally, veterans and non veterans vary across observable demographic dimensions. If socioeconomic status is associated with differential rates of diabetes onset and detection, then the differential rise among veterans may not be a result of AT38. In the next section, I control for differences in socioeconomic characteristics by estimating the difference-in-differences estimator in a regression framework.

IV. Regression Framework

A. Empirical Specification

The aggregate trends suggest that the rate of self-reported diabetes increased among the Vietnam veteran population in response to AT38. However, veterans and nonveterans systematically differ along observable characteristics. If the incidence of diabetes differs along these dimensions, the change in diabetes diagnoses may be spurious.

A regression framework addresses this issue by estimating the impact of AT38 on diabetes among the veteran population while simultaneously controlling for observable characteristics. The preferred, linear probability specification is given by:

$$P(D_{it} = 1|.) = \alpha + \beta Vet_i * Post_t + \sum_{\tau=1}^{4} \delta_t Period_t + \gamma Vet_i + \theta X_{it},$$

where $P(D_{it} = 1|.)$ is the conditional probability that individual i in time t reports having been diagnosed with diabetes. The variable Vet_i is an indicator of veteran status, equaling one if the respondent is a veteran and zero otherwise. The variable $Post_t$ is an indicator for post-AT38 reform; it equals zero for years 1997 through 2001 and one thereafter.[11] Variation in the interaction of these two variables identifies β, the differential change in the prevalence of diagnosed diabetes among veterans. Period fixed effects, which are coded in two-year increments, control for average changes in diabetes prevalence over time; and the veteran fixed-effect captures time-invariant differences between veterans and non veterans. X_{it} is a vector of individual characteristics; race (black only and other race relative to white only), education (high school, some college, and college and beyond relative to no high school degree), and individual age fixed effects.

The coefficient on the interaction term β represents the discrete change in diabetes prevalence after AT38 was implemented. To causally associate β with the advent of DC benefits for diabetes, it must be assumed that veterans and non veterans would have exhibited similar changes in diabetes prevalence over time in the absence of AT38, quantified by the period fixed effects. Since veterans systematically differ along socioeconomic and demographic dimensions, which may interact with age over time, this identification assumption may not be valid. To plausibly control for the effects of socioeconomic and demographic on diabetes prevalence over time, I include full interaction terms of race and educational attainment with age.

B. Baseline Results

The baseline estimates from the NHIS sample of males are presented in Table 3. Initially, I exclude the vector of individual characteristics and estimate the model of diabetes diagnosis with the veteran, post-AT38 interaction term and veteran, age, and period fixed effects.

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[11] Though the policy was implemented in July, 2001, the post variable first equals one in 2002, the first full year in which the policy was applicable.

The estimate of β, presented in column A.1 of Table 3, implies that AT38 increased the prevalence of diabetes by 2.9 percentage points among veterans shortly after the policy was implemented. Only half of veterans actually served in or around Vietnam, so AT38 increased the prevalence of diabetes among Vietnam veterans by 5.8 percentage points.

Also in column A.1, veterans are 1.6 percentage points less likely to be diagnosed with diabetes relative to non veterans. This difference in diabetes prevalence is partially attributable to observable differences in socioeconomic and demographic characteristics. When race and education fixed effects are included, presented in column A.2, the difference in diagnostic rates between veterans and nonveterans falls from a statistically significant 1.6 percent to an insignificant 1.3 percent. As indicated, minorities and the less educated, factors partially correlated with veteran status, are significantly more likely to be diagnosed. However, the inclusion of socioeconomic and demographic characteristics has no impact on the estimated effect of AT38.

In the final column of panel A, I include full interaction terms between race and educational attainment with age, allowing for differential age trajectories along socioeconomic and demographic dimensions among veterans and non veterans alike. The estimated effect of AT38 declines to 2.7 percent, but remains statistically significant at the five percent level of confidence. The coefficients on the education fixed-effects, which are interpreted as relative differences in diabetes prevalence at age 46, reverse sign. One interpretation is that the prevalence of diabetes – both diagnosed and undiagnosed – is greater among the less educated, but diabetes is detected earlier among the more educated.

Because Vietnam veterans are less likely to have a college degree, I estimate the same specifications excluding those with college degrees. The estimates are presented in panel B of

Table 3. Across all specifications, the estimated effect of AT38 on the prevalence of diagnosed diabetes is greater than those in panel A. According to column B.3, diabetes increased by 4.2 percentage points among veterans relative to non veterans. Given the standard assumptions, this implies that diabetes increased by 8.4 percent among less educated Vietnam veterans. Furthermore, when full interactions of race and education with age are included, the coefficients on race reverse sign. As with the education in panel A, the results may reflect that minorities are more likely to be diagnosed with diabetes on average, but diabetes is detected earlier among whites.

C. Mechanism and Other Margins of Response

The increase in DC enrollment and expenditures and the simultaneous rise in diabetes prevalence among veterans suggest that monetary incentives encourage the detection of latent medical conditions. Factors associated with veteran status do not appear to driving the empirical findings, and the discrete increase in Agent Orange Registry examinations supports the contention that the rise in diabetes diagnosis results from the detection of previously undiagnosed diabetes.

To provide further evidence for the suggested mechanism, I estimate the probability of diagnosed diabetes within the past five years of the survey year using the same sample and empirical specifications above. A five year lag was chosen because the last year of the NHIS sample is 2006 and the policy was implemented in 2001. Controlling for race, education, and individual fixed effects, as well as full interactions between race and education with age, the difference-in-differences estimate of recently diagnosed diabetes is 2.6 percentage points (column one of Table 4). Because of the lag, the estimate is not directly comparable to the 2.7

percentage point increase in diagnosed diabetes over the same time period; however, the estimate does suggest that much of this rise in diagnosed diabetes is a result of recent diagnoses.

If veterans are more likely to report being diabetic without being formerly diagnosed (false-positives), then the detection effects of disability insurance may be overstated. To address this concern, I estimate the probability of treatment for diabetes, defined as taking insulin or diabetes pills, which is arguably less likely to be influenced by false-positive responses than diagnosis singly. The results, in column 2 of Table 4, indicate a differential rise in diabetes treatment, though the estimated growth is somewhat smaller than the increase in diagnosed diabetes (2.4 percentage points compared to 2.7 percentage points).[12] I also estimate the probability of having been diagnosed with hypertension, a condition associated with diabetes but not with AT38. The estimate, presented in column 3 of Table 4, indicates that the prevalence of diagnosed hypertensives increased by 3.4 percentage points, but the coefficient is only statistically significant at the 10 percent level of confidence. Agent Orange is also associated with the onset of certain cancers, though compensation for some types of cancer was deemed presumptively service-connected before AT38 was implemented; so false-positive responses for cancer may the affect prevalence estimates of cancer, but the rate should not change differentially when AT38 was implemented. Thus, as a specification check, I estimate a differential change in the prevalence of cancer among veterans and find no effect (column 4 of Table 4). Taken together, the results suggest that the observed rise in diabetes reflects the detection of undiagnosed diabetes and not false-positive survey responses.

[12] Treatment for diabetes increased by 4.2 percentage point among veterans without a college degree (not shown), which is quantitatively identical to the rise in self-reported diabetes.

I then turn to outcomes that are associated with diabetes diagnosis but do not necessarily require a diagnosis; self-reported health status, overweight, and obesity. As shown in column 4 of Table 4, there appears to be no change in the probability of reporting fair or poor health after the policy was implemented. There is also little to no change in the rates of overweight and obesity: the rates increased by 1.6 and .9 percentage points, respectively, compared to the average rates of 74.2 and 29.1 among the entire sample.

The estimates of body mass index have two implications. First, disability insurance theoretically induces moral hazard behavior, so Vietnam veterans may be less likely to abstain from behaviors that lead to diabetes. Since diet and exercise are two of the three known causes of diabetes – diet, exercise, and family background - changes in body mass index arguably serves as a proxy for changes in health behavior. Thus, the negligible change in overweight and obesity suggests moral hazard is not a major factor in this context. And second, to the extent that individuals understand the causal link between weight and diabetes, individuals may not necessarily know their diabetes status even if they are high risk for diabetes onset.

Finally, I consider differential changes in insurance status among Vietnam veterans. Generally all veterans, regardless of military service era or disability status, may enroll in the Veterans Health Administration healthcare system, but enrolled veterans are categorized into one of eight *priority groups* to ensure that VHA funds are directed to those who need care the most. Assignment to priority groups is partly a function of income and service-connected disabilities. A veteran with no prior service-connected disability who is recently awarded DC benefits could move from priority group seven or eight (depending on income) to group one, two or three (depending on the severity of diabetes).

The link between VA health insurance and service-connected disability status implies that AT38 may affect whether a veteran is insured and the type of insurance coverage. I present linear probability estimates of insurance through the VA and one's employer in columns 8 and 9 of Table 4, respectively. As indicated, the rate of insurance through the VA increased by 4.7 percentage points among veterans. But the interpretation of this coefficient is not straightforward since non veterans, who are not eligible for VA health coverage, do not serve as an adequate comparison group. Nonetheless, the increase in VA health coverage corresponds with a 3.0 percentage point decline in coverage through one's employer. One interpretation is that expanded healthcare coverage through the VA program crowds out private health insurance coverage, which is consistent with previous findings of the crowd out effects of social insurance (Cutler and Gruber, 1996). Better identification of AT38's effect on VA healthcare coverage, and the extent to which it crowds out private health insurance, is an important next step.

V. Policy Implications

The results presented here suggest that monetary incentives encourage the detection of latent medical conditions. In fact, based on simplifying assumptions, 40% of undiagnosed diabetes cases among Vietnam Era veterans – 80% of undiagnosed cases among Vietnam veterans – were detected as a result of AT38.[13] If identifying conditions among undiagnosed

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[13] The estimate is based on two calculations. First, to estimate the prevalence of diagnosed diabetes among Vietnam Era veteran in the absence of the policy, I assume that the prevalence rates would have been similar among Vietnam veterans and other Vietnam Era veterans in 2006 in the absence of the policy. The rate of diagnosed diabetes in 2006 was 16.0 percent (Appendix Table 1), so if 2.7 percent of these cases are newly diagnosed (5.4 percent among Vietnam veterans only), the prevalence would have been 13.3 percent (16.0-.5*5.4) in the absence of

populations is a prescribed policy goal, then the apparent response of veterans to AT38 has a direct policy implication: provide monetary incentives to encourage medical screening. The efficiency of such a policy, of course, depends whether the benefits of early detection outweigh the costs of the financial incentive.

One benefit of detecting and treating diabetes early is the value of additional time lived. According to Bunker, Frazier and Mosteller (1994), the detection and treatment of diabetes increases life expectancy, on average, by six months. The value of this additional time lived can be calculated from previous estimates of the statistical value life. Derived from a hedonic wage model, Kniesner and Viscusi (2005) estimate that the average value of statistical life is approximately $4.7 million.[14] This value, of course, represents all future benefits of life over the expected years remaining. The expected additional years remaining for veterans affected by AT38 is 12 years: the average age of veterans in this sample is 53 and, according Curtin and Strong (1988), the average life expectancy of an adult-onset diabetic is approximately 65 years

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AT38. Second, assuming one-third of diabetes cases would have been undiagnosed in the absence of the policy – the average rate in the US - the prevalence of diagnosed and undiagnosed diabetes is 20.0 percent in 2006. Thus, 40.0 percent (2.7/(20.0-13.3)) of undiagnosed diabetes cases had been detected as a result of AT38.

[14] The value of statistical life may need to be adjust downward as one ages since there are less years lived; however, Kniesner, Viscusi and Ziliak (2005) suggest that the value of statistical life should not be adjusted, and may even need to be adjust upward, because consumption over the life-course may be back loaded. I do not make such an adjustment.

of age.[15] Assuming the current value of statistical life is equal across all expected years of life remaining, the current value of life among is $429,000 per year.[16] Thus, the present discounted value of the additional six months of life, among those who detected their diabetes early due to AT38, is $142,000 on average ($215,000 discounted 13 periods at a rate of 3 percent). The value of increased life expectancy is interpreted as a social gain in welfare since the benefit of early detection would have been forgone otherwise.

To determine total welfare benefits from early detection, the value of additional time lived is factored by the number of newly diagnosed diabetics. To determine the number of new diagnoses, I factor the estimated effect of the AT38 on the prevalence of diabetes among Vietnam veterans (5.4 percent) and the estimated 3 million Vietnam veterans in 2006. Thus, approximately 160,000 diabetes cases were newly diagnosed.[17] The welfare gain per newly diagnosed diabetic is $142,000, so the total welfare gain due to increased life expectancy among new DC beneficiaries is approximately $22.7 billion.

The increase in DC expenditures is undoubtedly the largest cost component of AT38. According to Duggan, Rosenheck, and Singleton (2008), AT38 increased the average DC benefit

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[15] The assumption that undiagnosed diabetics expect to live to 65 is most applicable to cases where diabetes is certain though the individual chooses not to be diagnosed or treated.

[16] The present value of a nominal annuity of $429,000, discounted at a rate of 3 percent, is equal to $4.7 million in present value.

[17] According to tabulations from Census 2000 by the VA, there were 6 million veterans who served in Vietnam who did not serve in Korea, WWII, or after August 1990 (retrieved in February 2008 at http://www1.va.gov/vetdata/page.cfm?pg=1). Based on the CPS Veteran Supplement, approximately half of Vietnam Era veterans served in or around Vietnam.

by $11,000 per year among those affected by the policy, and total DC expenditures by $50 billion in net present value. However, their DC expenditure estimate is based on the total number veterans affected by AT38 - estimated to be 263,000 - not the total of veterans affected due to diabetes specifically – which is approximately 144,000.[18] Assuming the 144,000 beneficiaries receive $11,000 over the course of 13 years, the increase in DC benefits among diabetics is approximately $17.4 billion (approximately $120,000 per diabetic beneficiary).

Thus, the total increase in DC expenditures well exceeds the gains from the increased life expectancy among diabetics, but the gains in life expectancy exceed the expenditure costs attributable to diabetics by $5.3 billion. There are, however, important components of this simplified calculation that are omitted. First, the benefits may be understated because early detection may delay the onset of debilitating conditions associated with diabetes. To my knowledge, there is no precise measure of the effect of early diabetes detection on the reduction in morbidity or the value of reducing morbidity itself, so it is difficult to include this factor in the welfare calculation. Regardless, veterans are no less likely to report being in fair or poor health; so the welfare gains due to improved well-being, if any, have yet to be realized. And second, the costs do not reflect the continued expansion of DC rolls and expenditures in the years to come. To be sure, the discrete change in DC roll growth as a result of the policy persists well after the year in which it was implemented. And finally, costs may be understated or overstated depending on whether the costs of early detection and treatment are greater or less than the subsequent costs if the condition remained undiagnosed.

The results do, however, suggest that the net gain among newly diagnosed diabetics is positive: $142,000 versus $120,000. Therefore, if monetary incentives are considered to

[18] According to VBA Reports, there were 43,395 diabetes cases compensated at the end of fiscal year 2001, and 190,199 diabetes cases compensated at the end of fiscal year 2005.

encourage the detection of latent medical conditions among the undiagnosed population, it may be more efficient to target those who are most likely to be afflicted with a medical condition but are least likely to be diagnosed.

VI. Discussion and Conclusion

Economic theory predicts that the availability of disability insurance may encourage health disinvestment by inducing moral hazard behavior. The null hypothesis of moral hazard effects, therefore, is that the prevalence of the insured disability does not increase once disability benefits become available. However, if benefits encourage the detection of latent conditions, which also predicts a rise in the prevalence of the insured disability, then the empirical test of detection effects and moral hazard effects are indistinguishable.

This study provides suggestive evidence that disability insurance does increase the incidence of diagnosis. More specifically, the advent of DC benefits to Vietnam veterans for diabetes increased the prevalence of diagnosed diabetes among the Vietnam veteran population by 5.4 percentage points, which appears to be driven by newly diagnosed conditions and not false-positive responses. There is little evidence to suggest that rates of overweight and obesity increased after AT38 was implemented, casting doubt on the degree to which social disability insurance induces moral hazard behavior in this context.

The analysis also contributes to the discussion of the causal pathways responsible for the socioeconomic status and health gradient. First, if patient individuals are more likely to invest in health and education, as the argument goes, then we may expect a greater impact of AT38 on the prevalence of diabetes among the less educated. This hypothesis is supported in the data – the rate of diabetes increased considerably more among the less educated – though it is difficult to disentangle this effect from the fact that Vietnam Era veterans without a college degree are slightly more likely to have served in Vietnam. And second, free diabetes screenings have been available to Vietnam through the Agent Orange registry since 1978, yet some diabetic veterans chose not to be diagnosed. Thus, in the context of this study, it is difficult to argue that differential access to medical screening plays a large role in the rate of undiagnosed diabetes across socioeconomic strata. Developing a broader understanding of factors that affect the detection and treatment decision, and how this decision contributes to the socioeconomic and health gradient, is an important area of future research.

Appendix Table 1: Prevalence of Diabetes and Diabetes Treatment

	A. Veterans		B. Nonveterans	
Year	Diabetes	Treatment	Diabetes	Treatment
1997-1998	7.30	5.34	7.62	5.48
	(0.75)	(0.65)	(0.58)	(0.50)
1999-2000	8.52	5.61	9.60	8.05
	(0.82)	(0.68)	(0.68)	(0.63)
2001-2002	10.60	8.11	11.95	9.76
	(0.92)	(0.82)	(0.74)	(0.68)
2003-2004	16.37	13.06	13.55	11.73
	(1.59)	(1.44)	(1.18)	(1.11)
2005-2006	18.05	13.96	14.64	12.18
	(1.21)	(1.09)	(0.92)	(0.85)

Estimates are derived from NHIS data in 1997 through 2006. Standard errors are in parentheses. Sample weights were used.

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Table 1: Initial Monthly Benefit and Change after AT38 by Diabetes Mellitus Rating

A. Change in Monthly Benefit by Diabetes Mellitus Rating

Initial Rating	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Initial Benefit ($)	0	103	199	306	439	625	790	995	1155	1299	2163
Diabetes Rating											
10%	103	96	107	133	186	165	0	0	0	0	0
20%	199	203	240	133	186	165	205	160	0	0	0
30%	306	336	240	319	351	165	205	160	144	0	0
60%	790	687	796	689	716	530	365	304	144	864	0
100%	2163	2060	1964	1857	1724	1538	1373	1168	1008	864	0

B. Description of Diabetes Mellitus Severity: VBA Schedule for Rating Disabilities

10%: Manageable by restricted diet only

20%: Rating of 10% and requiring insulin or hypoglycemic agent

40%: Requiring restricted diet, insulin, and regulation of activities

60%: Activities with episodes of ketoacidosis or hypoglycemic reactions requiring one or two hospitalizations per year or twice a month visits to a diabetic care provider, plus complications that would not be compensable if separately evaluated

100%: Requiring more than one daily injection of insulin, diet, and regulation of activities (avoidance of strenuous occupational and recreation activities) with episodes of ketoacidosis or hypoglycemic reactions requiring at least three hospitalizations per year or weekly visits to a diabetic care provider, plus either progressive loss of weight and strength or complications that would be compensable if separately evaluated

Table 2: Demographic Characteristics by Veteran Status: NHIS males, 1997 - 2006

Veteran Status	Veterans	Non-Veterans
Observations	5033	8190
Age	53.8	53.3
	(0.05)	(0.04)
Married	74.6	74.6
	(0.61)	(0.48)
Race (%)		
White	89.1	82.1
	(0.44)	(0.42)
Black	8.0	9.7
	(0.38)	(0.330
Other	3.0	8.2
	(0.24)	(0.30)
Education (%)		
Less Than High School	6.5	17.9
	(0.35)	(0.42)
High School	30.3	24.5
	(0.65)	(0.48)
Some College	35.5	22.0
	(0.67)	(0.46)
College and Beyond	27.7	35.6
	(0.63)	(0.53)
Insurance Status (%)		
Private	80.4	80.0
	(0.56)	(0.44)
VA	12.7	0.4
	(0.47)	(0.07)
None	7.4	12.2
	(0.37)	(0.36)

Estimates are derived from pooled NHIS data in 1997 through 2006. Standard errors are in parentheses. Sample weights were used.

Table 3: Linear Probability Estimates of Diabetes Diagnosis by Educational Attainment: NHIS males, 1997-2006

Education	A. All			B. No College Degree		
	(1)	(2)	(3)	(1)	(2)	(3)
Vet*Post	2.91	2.93	2.73	4.04	4.12	4.20
	(1.27)*	(1.26)*	(1.25)*	(1.62)*	(1.62)*	(1.62)*
Vet	-1.58	-1.25	-1.11	-2.41	-1.59	-1.57
	(0.68)*	(0.70)	(0.70)	(0.85)*	(0.87)	(0.87)
Black		5.58	-1.93		4.16	-2.74
		(1.15)*	(2.71)		(1.28)*	(2.75)
Other		4.79	10.20		3.46	-1.31
		(1.39)*	(10.45)		(1.72)*	(0.96)
High School		-2.61	6.24			
		(1.10)*	(4.82)			
Some College		-2.85	0.38		-2.77	5.02
		(1.12)*	(1.17)		(1.11)*	(4.56)
College and Beyond		-7.03	3.28		-2.95	0.00
		(1.02)*	(3.04)		(1.12)*	(0.57)
N	13233	13233	13233	9135	9135	9135
R-Squared	0.0158	0.0271	0.0382	0.0228	0.0263	0.0404

Linear probability estimates are derived from NHIS data in years 1997 through 2006. The Post indicator is equal to one in years 2001 through 2006 and zero otherwise. The left-out groups for race and education are white and no high school diploma, respectively. Period effects, in two year increments, and individual age fixed effects are included, but the estimates are not presented for brevity. Estimates are factored by 100 and are interpreted as percentage point changes. Robust standard errors are in parentheses. * indicates significance at the 5 percent level of confidence.

Table 4: Linear Probability Estimates of Auxilliary Outcome Variables: NHIS males, 1997-2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Outcome	Recently Diagnosed	Treatment	Hyper-tension	Cancer	Overweight	Fair/Poor	Obese	VA Insurance	Private Insurance
Variable Mean	4.9	9.0	34.9	6.3	74.2	14.4	29.1	5.2	80.1
Vet*Post	2.56	2.36	3.37	0.00	1.59	-0.44	0.87	4.66	-2.96
	(0.91)*	(1.17)*	(1.90)	(1.03)	(1.67)	(1.31)	(1.85)	(1.16)*	(1.48)*
Vet	-0.91	-1.49	1.25	0.78	1.14	-0.62	1.39	10.33	-1.31
	(0.48)	(0.64)*	(1.21)	(0.62)	(1.14)	(0.78)	(1.19)	(0.68)*	(0.92)
Black	-2.66	-1.86	3.70	-1.13	-5.55	-5.52	3.19	3.13	-10.28
	(2.59)	(2.71)	(10.94)	(0.78)	(10.97)	(5.49)	(10.54)	(6.40)	(11.03)
Other	-1.10	10.49	-4.17	-4.13	-20.33	28.44	-5.15	-0.77	-7.36
	(0.66)	(10.49)	(9.39)	(2.84)	(13.45)	(14.45)*	(9.66)	(2.33)	(9.12)
High School	4.90	6.36	-13.13	-0.69	-2.56	-13.28	5.52	-13.19	31.22
	(4.60)	(4.82)	(14.26)	(0.48)	(13.86)	(12.78)	(10.66)	(8.51)	(14.28)*
Some College	-0.14	0.49	-25.23	0.72	11.74	-15.96	-3.38	-11.18	39.67
	(0.48)	(1.21)	(12.78)*	(1.21)	(12.30)	(12.21)	(9.27)	(8.69)	(13.54)*
College and Beyond	0.21	2.50	-11.51	7.27	-10.96	-22.01	10.75	-12.12	38.87
	(0.98)	(2.95)	(14.08)	(4.98)	(13.91)	(12.05)	(11.80)	(7.66)	(13.35)*
N	13223	13220	13198	13209	13223	13208	13223	13223	13223
R-Squared	0.020	0.038	0.048	0.019	0.025	0.090	0.024	0.097	0.114

Linear probability estimates are derived from NHIS data in years 1997 through 2006. The Post indicator is equal to one in years 2001 through 2006 and zero otherwise. The left-out groups for race and education are white and no high school diploma, respectively. Period effects, in two year increments, and individual age fixed effects are included, but the estimates are not presented for brevity. Estimates are factored by 100 and thereare are interpreted as percentage point changes. Robust standard errors are in parentheses. * indicates significance at the 5 percent level of confidence.

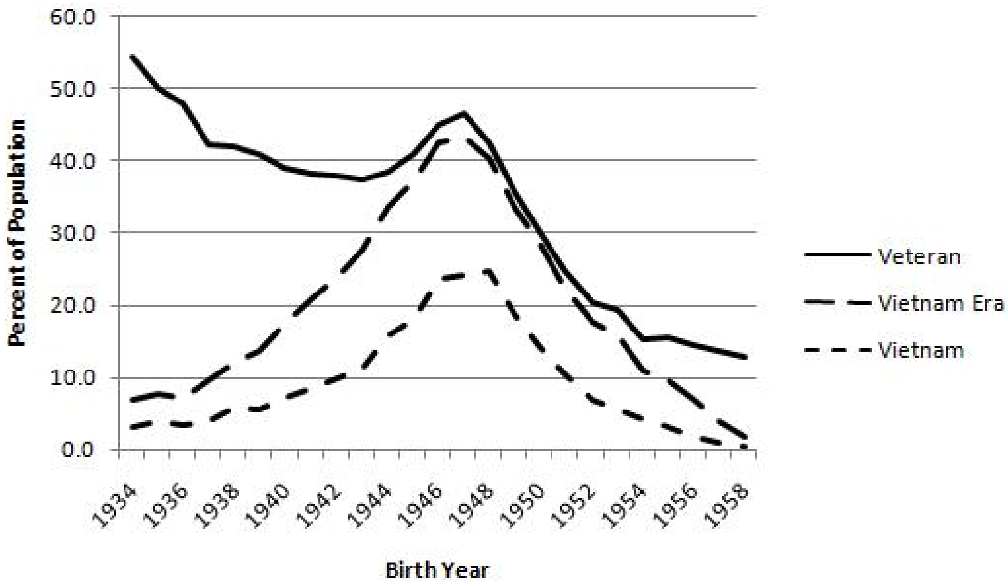

Figure 1: Veteran Status by Year of Birth among Males: CPS Veteran Supplements 1997, 1999, and 2001

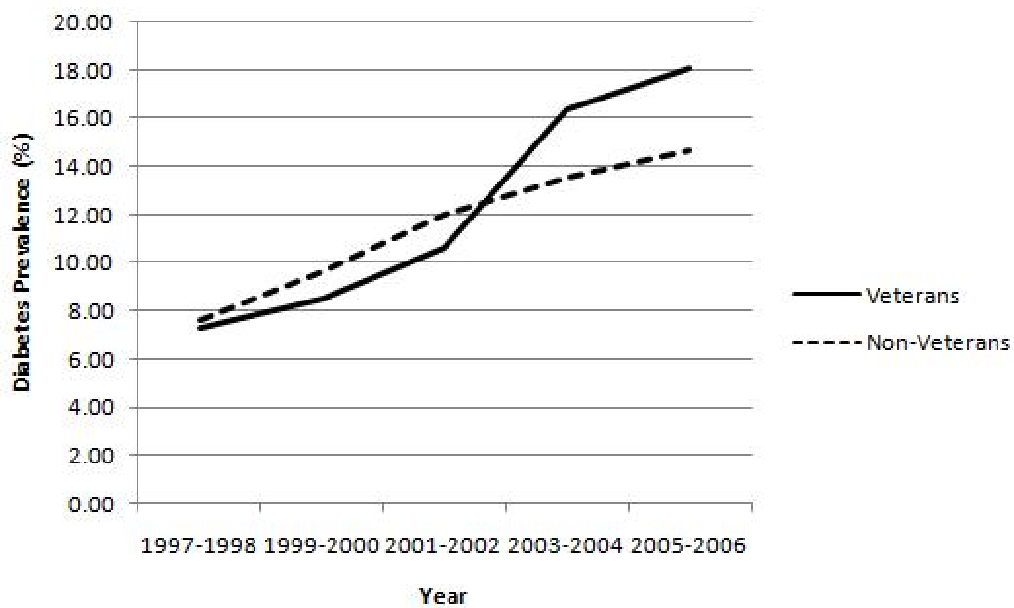

Figure 2: Diabetes Prevalence by Veteran Status among Males: NHIS 1997 through 2006

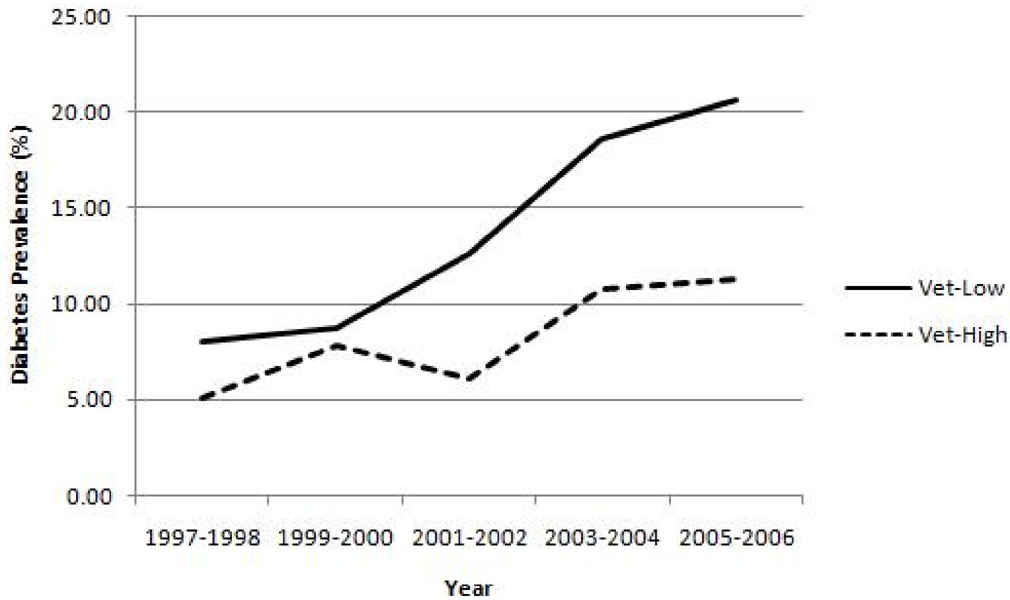

Figure 3: Diabetes Prevalence by Educational Attainment among Male Veterans: NHIS 1997 through 2006

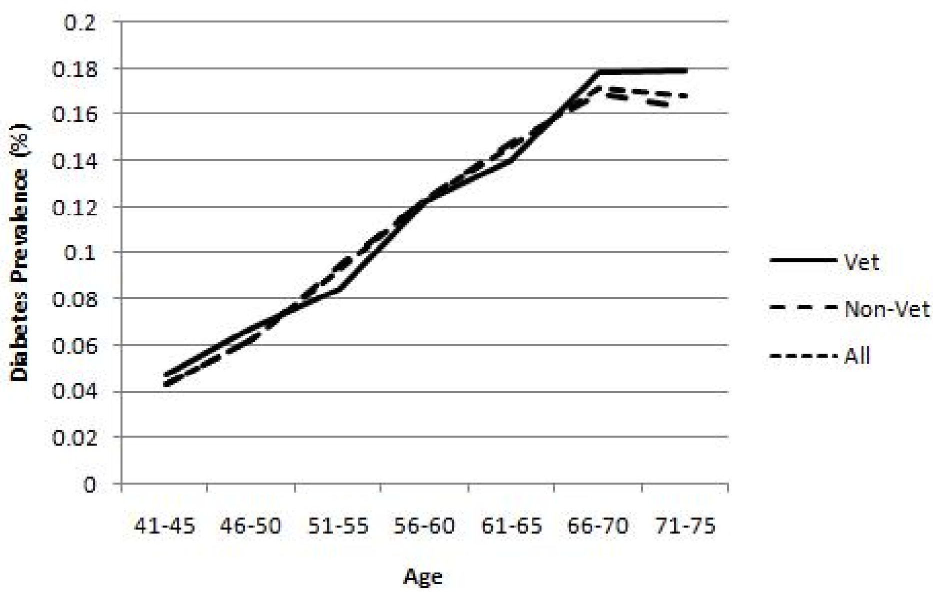

Figure 4: Diabetes Prevalence by Age and Veteran Status: NHIS 1997 through 2001