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Rates of diabetes screening in Kentucky before and after implementation of the Affordable Care Act (ACA)

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Abstract

Diabetes mellitus, commonly referred to as "diabetes", is currently at epidemic proportions in the United States as its prevalence has drastically increased over the past several decades. The percentage of Americans with diagnosed diabetes has risen from 0.93 percent of the population in 1958 to 10.5 percent in 2018 (ADA, 2021). Diabetes also impacts record numbers of Kentucky residents.

Regular screening for those considered at-risk can encourage patients to implement lifestyle modifications, pharmacological therapy, or other interventions earlier in the course of disease. This can help prevent or delay onset of T2D and can reduce diabetes-related complications in those who go on to develop T2D (Ahmad, 2010).

Obtaining health insurance makes preventive care measures such as T2DM screening more accessible for those who need it. This project used Kentucky Behavioral Risk Factor Surveillance System (BRFSS) survey data from 2011 to 2019 to analyze screening data for Kentuckians at risk of developing prediabetes or T2DM, based on the ADA guidelines described above. Survey data from before and after Kentucky's rollout of the Affordable Care Act (ACA) in 2014 were examined to determine the variation in diabetes screening rates for eligible residents comparatively. The goal was to determine whether increased insurance coverage rates affected diabetes screening rates, with emphasis on comparing regions of the state with one another, i.e. Appalachian versus non-Appalachian areas.

Results were not significant between regions of Kentucky or when comparing pre-ACA and post-ACA data. While findings did not support the original prediction that increasing access to health coverage would also increase diabetes screening as a preventive care measure, there is still room for optimism. In the meantime, targeted interventions such as identifying/addressing disparities, policy education, increased advertising and expanded screening events could encourage uptake of ACA-driven preventive care opportunities.

Introduction

Diabetes mellitus, commonly referred to as "diabetes", is currently at epidemic proportions in the United States as its prevalence has drastically increased over the past several decades. The percentage of Americans with diagnosed diabetes has risen from 0.93 percent of the population in 1958 to 10.5 percent in 2018 (ADA, 2021). Diabetes also impacts record numbers of Kentucky residents. In 2017 it was the sixth leading cause of death for the state overall, and as high as the third leading cause of death for the state's African American residents (Kentucky Cabinet for Health and Family Services [KCHFS], 2020). Diabetes can cause problems both directly and indirectly and affects many patients for the entirety of their lives. Complications such as heart disease, stroke, blindness, kidney failure, ketoacidosis and neuropathy are commonly seen in people with diabetes (KCHFS, 2020). There are two types of diabetes, typically referred to as "type 1" and "type 2". T1D is an autoimmune disease in which the pancreas produces little or no insulin. T1D is typically diagnosed in children or adolescents. It is not preventable and requires lifelong insulin therapy. Type 1 is much rarer than type 2, and there are no definitive causes or preventions currently known.

Conversely, type 2 diabetes (T2DM) is influenced by a multitude of factors and can be prevented. It relates to desensitization to insulin, rather than its production. Unhealthy lifestyles play the largest role in developing T2DM, as high body mass index (BMI) and high levels of low-density lipoproteins (LDL) are strongly correlated predictors of the disease (Ahmad, 2010). T2DM prevalence has skyrocketed in Kentucky over the last 20 years: rates increased from 6.5 percent of adults in 2000 to 13.7 percent in 2018 (KCHFS, 2020). Another 158,200 Kentuckians in 2018 may have T2DM but have not been diagnosed (KCHFS, 2020).

Thankfully, early detection of T2DM or prediabetes—blood sugar levels that are higher than normal but not yet high enough to be diagnosed as diabetes (CDC-"Prediabetes – your chance", 2020) can significantly improve health outcomes (Ahmad, 2010). The American Diabetes Association (ADA) publishes guidelines for management of diabetes and prediabetes on a yearly basis. According to the 2018 ADA guidelines, adults fitting certain criteria should be screened for T2DM at least every three years (Riddle, 2018). These criteria include age of at least 45 years, or BMI of at least 25 combined with at least one other risk factor from the following: physical

inactivity, first-degree relative with diabetes, screening-eligible race/ethnic group (Black, Asian, American Indian/Alaska Native, Hispanic), women who delivered a baby > 9 pounds, women who were diagnosed with gestational diabetes (GDM), HDL cholesterol <35 mg/dL ± triglyceride >250 mg/dL, hypertension (≥ 140/90 mm Hg or on therapy), A1C ≥ 5.7%, impaired glucose tolerance (IGT) or impaired fasting glucose (IFG) on previous testing, conditions associated with insulin resistance and cardiovascular disease (CVD) history (Riddle, 2018). Regular screening for those considered at-risk can encourage patients to implement lifestyle modifications, pharmacological therapy, or other interventions earlier in the course of disease. This can help prevent or delay onset of T2D and can reduce diabetes-related complications in those who go on to develop T2D (Ahmad, 2010).

Prediabetes is very common in Kentucky (KCHFS, 2020). Prediabetes involves blood glucose readings that are higher than normal, but not high enough to merit diagnosis of T2DM (Knowler, 2002). Based on predictive modeling, around 812,000 adults in Kentucky are likely living with undiagnosed prediabetes, with a total estimation of 1.1 million prediabetes patients statewide (KCHFS, 2020). Furthermore, the prevalence rate of T2DM was much higher in the Appalachian region of the state: 16.8% of Appalachian adults had been diagnosed with T2DM in 2018, compared to only 12.5% in non-Appalachian counties (KCHFS, 2020).

Historically, Kentucky's Appalachian residents have faced several barriers to good health and receiving healthcare, including low socioeconomic status (SES), lower levels of education, and longer distances to the nearest healthcare facility (Sohn, 2016). This has been well-documented through health insurance records. According to the Census Small Area Health Insurance Estimates (SAHIE) data, Kentucky's rollout of the Affordable Care Act (ACA) in 2014saw much lower uninsured rates and expanded coverage in the Appalachian region (Small, 2021). Although Appalachia was affected by this policy change, the distribution of counties with most drastic improvement was spread more uniformly throughout the state. Western Kentucky's Todd County experienced the highest decline in uninsured of 15.8 percent (Small, 2021).

With statewide rates of uninsured adults under 65 years old dropping from 16.8% in 2013 to 7.1% in 2015, access to health coverage became much less of an obstacle to receiving proper care (Small,

2021). Obtaining health insurance makes preventive care measures such as T2DM screening more accessible for those who need it. As an example, the National Diabetes Prevention Program (DPP) is offered as a covered benefit through most insurances and focuses on early screening for T2DM and implementing lifestyle changes accordingly (Offering, 2018). A recent study showed that those who received access to the program via their insurance were more likely to take advantage of program benefits and achieved higher weight loss than participants who paid out of pocket (Offering, 2018). Given Kentucky's diabetes prevalence, risk factors, and regional diversity, the state provides an important case for examining changes in uptake of T2DM screening benefits following Medicaid expansion under the ACA.

This project used Kentucky Behavioral Risk Factor Surveillance System (BRFSS) survey data from 2011 to 2019 to analyze screening data for Kentuckians at risk of developing prediabetes or T2DM, based on the ADA guidelines described above. Survey data from before and after Kentucky's rollout of the ACA in 2014 were examined to determine the variation in diabetes screening rates for eligible residents comparatively. The goal was to determine whether increased insurance coverage rates affected diabetes screening rates, with emphasis on comparing regions of the state with one another, i.e. Appalachian versus non-Appalachian areas.

Methods

Kentucky BRFSS survey data from 2011 through 2019 provided information about health and demographic status of participating Kentucky residents. Stata (Version 16; StataCorp., College Station, TX) was used for all statistical analysis.

Respondents were considered eligible for diabetes screening according to ADA guidelines (Figure 1). However, some screening criteria were not specifically asked about in the BRFSS survey; those variables included account of first-degree relatives with diabetes, women who delivered a baby over nine pounds, HDL cholesterol levels less than 35 mg/dL and triglyceride levels above 250 mg/dL (Improving, 2021). All other screening conditions were quantified in the survey and were used in the algorithm to establish how many respondents were considered screening-eligible and thus needed to be screened. Individuals with in the following groups were excluded: 1) those

with self-reported diabetes and 2) those over 65 years of age. Individuals with self-reported diabetes were excluded as we were examining diabetes screening in adults without diagnosed diabetes. Those over 65 were excluded because they were not likely to experience increased coverage due to Medicaid expansion since they already have coverage through Medicare. (Figure 3).

Statistical analysis

Primary statistical analysis consisted of cross-tabulating various demographics with diabetes screening status for those classified as screening-eligible according to ADA guidelines (Figure 1). Demographics included before/after ACA expansion, age (years), race, ethnicity, gender, regional status (Appalachian or non-Appalachian), education level and income. A robust Poisson was chosen over a standard logistic regression due to the relative frequency of the outcome, since common outcomes can produce biased odds ratios.

Results

There were 61,090 total BRFSS respondents in Kentucky during the 2011-2019 period. and 30,801 were categorized as "screening-eligible". There were 67.4% of study participants who met ADA screening criteria that had been screened for diabetes over the previous three years of the given survey year.

Table 1 showed a breakdown of basic demographics based on the survey participants who met eligibility criteria for screening. Characteristics included status before or after ACA expansion, age, race, ethnicity, gender, regional status (Appalachia or non-Appalachia) education level and yearly income. Of those factors, age, ethnicity, gender, education level and income were considered statistically significant with p-values of less than 0.05 when performing s chi-squared test.

Similar to Table 1, Tables 2.1 and 2.2 both show results of chi-squared tests. Table 2.1 shows differences from before and after ACA expansion for screening-eligible survey participants, while Table 2.2 compares the Appalachian region of Kentucky to the non-Appalachian region. Neither

chi-squared test produced significant results as both p-values were above 0.4. Figure 2 provides a yearly breakdown of Table 2.1, illustrating little difference in screening rates from year to year, and when comparing before and after Kentucky Medicaid expansion in 2014.

Table 3 focuses on similar demographics to Table 1, with an added variable asking if study participants saw a personal doctor. This table displays results of a robust Poisson test with diabetes screening rate ratios. Upon analysis of screening-eligible participants, there were significant differences between those who were between 55-64 years of age, black, had attended college and who did not have a personal doctor when compared to the respective reference groups.

Screening rates before and after Kentucky's expansion of the ACA in 2014 were non-significant, with a p-value of 0.663. Although statewide health insurance rates increased, screening rates did not increase significantly. Diabetes screening rates within the last three years of completing the survey were slightly better after Medicaid expansion but not enough to be considered significant, with a chi-squared p-value of 0.4150. Even after adjusting to ensure responses were not included from the transitional period of 2014, 2015 and 2016, results were still not significantly different. Screening rates still did not improve despite increasing the number of people with access to health insurance in all 120 Kentucky counties.

Appalachian and non-Appalachian sub-populations displayed similar screening rates throughout the eight-year period. No significant differences were found between the two groups. No significant differences were found within the groups for the pre-/post-ACA conditions. Both regions experienced a notable increase in insured residents. Overall, Appalachian counties showed the largest increase in health insurance coverage, although some non-Appalachian counties, such as Todd, also saw large increases. However, counties outside of Appalachia displayed more growth in percentage of screening-eligible people being screened following the ACA .

No single year between 2011 and 2019 was considered significant in relation to one another when using a robust Poisson regression. A marginally significant p-value (p=0.086) occurred in 2012, two years before changes from the ACA took effect.

Although both age groups were considered eligible for screening by the ADA guidelines, respondents 45 to 54 were screened significantly less than those 55 to 64 years of age over the eight-year period, with a p-value of less than 0.001. Interestingly, Hispanic survey respondents had higher screening rates than non-Hispanics over the full study period, as did females when compared with males. As one might expect, screening rates increased proportionally to education and income levels, with the exception of families who made over $75,000 per year. The weighted percentage of non-screened adults increased from 33.2 percent in those with a household income between $50,000 and $75,000 to 36.8 percent for those who made above $75,000. Likewise, individuals who indicated that they lacked a primary care provider showed much lower rates of screening than did those who reported to have a personal doctor, with a p-value of less than 0.001.

Discussion

No temporal trend in diabetes screening potentially related to the ACA Medicaid expansion in Kentucky was observed. Underwhelming screening rates may be related to such social determinants as lack of transportation, distance to nearest facility, neighborhood conditions and/or community and social context, especially in Appalachia (VPIC-CDC, 2021). An examination of social determinants at each level of the socio-ecological model may provide assistance in identifying lingering T2DM screening barriers, as well as opportunities for targeted action to further increase screening behaviors (Figure 4).

The ACA's attempt to address potential drivers of health status at the policy level may not be sufficient to offset all other potential barriers present at lower levels such as communities, interpersonal relationships and ultimately individuals. Better access to coverage does not necessarily mean better access to healthcare, as the ACA did not focus heavily on improving access to healthcare providers themselves (Affordable, 2021). In some parts of Appalachia, residents are located more than an hour away (by car) from the nearest healthcare facility (Lee, 2020). Accounting for travel each way and for an hour at the facility, that is a minimum of three hours out of a person's day. On the individual level, it is not guaranteed Appalachian residents will have a car or money to pay for gasoline. Then, if they do have suitable transportation, that person may not have three hours to spare from their personal obligations, e.g. work and/or caretaking for

others. When addressing barriers to adequate healthcare below the policy level, it is important to account for all tiers of the socio-ecological model in order to successfully impact services such as diabetes screening.

Stronger support and resources for diabetes screening events in rural areas would benefit local communities. Screening events would increase access to care for residents who otherwise may not be able to travel longer distances to a traditional medical facility. Towns such as Pikeville, KY already offer diabetes screenings at community health fairs (Diabetes, 2021). However, the magnitude and awareness of such fairs/screenings are low. Increasing the scale of these events could bring in higher numbers of targeted, screening-eligible Medicaid recipients who otherwise would not have been able to take advantage of their health coverage.

Another potential barrier to receiving care may stem from knowledge/education level. Just because a person has Medicaid does not mean they know what is included in their plan. Seventy-eight percent (78%) of Medicaid enrollees in the US cannot identify the basic benefits their insurance is required to cover (Lalley, 2017). Policy education is a key step in preventive health and ensuring recipients are getting the most out of their healthcare. Similar to the model used with federal student loans, entrance counseling may be an effective means to inform policyholders of their specific benefits, as well as clarifying technicalities and jargon present in most contracts. Since most of the steps for enrolling in Medicaid are now online, patients could complete an online course with an exam at the end to ensure they have a basic understanding of their new policy and know how to obtain their benefits when necessary. There are also existing resources such as *www.healthcare.gov*, the website where members enroll, which breaks down policies into simpler language and highlights important aspects of the plan (Get, 2021).

Many less-educated Kentuckians also do not know the importance of preventive medicine. A 50-year longitudinal cohort—consisting originally of 10,000 Wisconsin high school students—revealed that those who attended college were up to fifteen percent more likely to use preventive care measures than those who did not (Fletcher, 2009). Preventive measures such as being screened for diabetes are significantly less likely in populations with a high percentage of people who have a high school degree/GED or below (CDC, 2020). The ACA mandated screening for

chronic diseases, including diabetes and cancer, under all Medicaid insurance plans (CDC, 2020). However, many barriers still exist such as awareness of policy coverage. In addition to making phone calls similarly to the BRFSS survey, social media platforms are ever-growing in popularity and can be used to target a large demographic much more efficiently (Tankovska, 2021). Since the Medicaid cutoff is below 65 years of age (Medicare takes over at 65), it may be reasonable to assume that most adults affected will have some type of social media. Statistics show that 70 percent of 18-29 year-olds, 77 percent of 30-49 year-olds and 73 percent of 50-64 year-olds are on Facebook (Tankovska, 2021). A Facebook advertising campaign—or some type of graphic informing enrollees of their lesser-known benefits such as preventive health measures—would likely reach a large proportion of the screening-eligible demographic in a more effective manner. As the number of diabetes and prediabetes cases continues to rise in Kentucky, it is increasingly important to spread awareness of preventive services, how to access them and why they are necessary.

Limitations

A limitation to this study could be considered due to the verbiage of some BRFSS survey questions, such as those about diabetes screening. The ADA guidelines recommend testing individuals eligible for screening for diabetes every three years (Improving, 2021); therefore, the BRFSS questionnaire asks if the respondent has been screened within the last three years. Although asking about a three-year screening window is necessary to judge compliance to guideline recommendations, this presented a challenge when determining whether respondents were actually screened before or after ACA expansion. Responses could have been recorded after the rollout in 2014 but screening may have occurred before 2014. Due to the three year window of diabetes screening as asked by the BRFSS survey, it is possible some patients may have been screened before the ACA took effect but did not complete the survey until after it was implemented, creating inaccurate data. Therefore, those responses should actually be counted in the pre-expansion category. Unfortunately, the only way to control for this was to exclude the years 2014-2016 in the analysis to ensure the data were accurate. However, this came at a tradeoff as it decreased the sample size and thus diminished power. Furthermore, eight years is a relatively short time period compared to the progression of a chronic disease such as T2DM. Although it

would be ideal to see a trend of higher screening rates, this study analyzed only five years, which may prove insufficient in gauging long-term effects.

Another limitation was in the data itself, as it was sourced from a survey. Survey data can carry many types of bias, including but not limited to response, sampling, attrition and recall biases. Income-based sampling bias is also probable, especially in landline survey participants. Many who are home to answer phone calls during typical work hours (roughly 9 am – 5 pm) may not be employed and could be overrepresented in the survey, thus underrepresenting the average income of Kentuckians. Though the addition of cellular phone surveys aimed to reduce the likelihood of such occurrences, it is still worth noting that other demographics such as younger people, those who rent rather than own a home and Hispanics are proven to be more likely to have only cellular phone services (Behavioral, 2021). Fortunately, BRFSS includes variables which help to account for these 'imperfections' in the data and weight it accordingly. BRFSS also uses a sophisticated "iterative proportional fitting (raking)" methodology to weight data (Behavioral, 2021). Raking was introduced into the 2011 BRFSS dataset, along with the use of cellular phones (Behavioral, 2021). Raking allows for the discernment of the telephone source, which is important in determining biases such as income-related sampling bias when weighting the data. Although weighting survey data is not as accurate as collecting objective primary data, surveys allow researchers to reach a wider demographic of participants more efficiently and cost-effectively.

Conclusion

The ACA undoubtedly built a strong framework to provide health coverage for those who previously were not able to afford it. In the first six years since Medicaid was expanded in Kentucky, it is evident that there are still many implementation gaps between new policies and patients being able to use their insurance to its fullest extent. Further research is especially warranted in communities with high discrepancies between the number of newly-insured residents and the number who are actually using health services, including diabetes screening. The socio-ecological model is important to pinpoint where discrepancies may be occurring and how the public health sector can work to improve those conditions. The BRFSS also should be used as a tool to inform plans and policies related to preventive health and chronic diseases. It is possible

six years is not enough time to see significantly-lowered rates of eligible but non-screened individuals. According to the *Journal of the Royal Society of Medicine*, which researched 23 independent studies, it takes around 17 years from the time the idea is introduced for a policy to reach maximum effectiveness (Morris, 2011). The ACA is still relatively new, and it is reasonable to believe that if Medicaid expansion truly is effective, it may take approximately 5-10 more years to see significant results.

While findings did not support the original prediction that increasing access to health coverage would also increase diabetes screening as a preventive care measure, there is still room for optimism. In the meantime, targeted interventions such as identifying/addressing disparities, policy education, increased advertising and expanded screening events could encourage uptake of ACA-driven preventive care opportunities.

Tables

Table 1. Diabetes screening rates for adults eligible for screening (N=30801) by demographic characteristics (Behavioral Risk Factor Surveillance System (BRFSS) 2011-2019)

Variable	*n*	*Not Screened (wgt. %)*	*X^2 P-value*
ACA Expansion			
Before	12622	37.9	0.4150
After	18179	35.8	
Age (Years)			
45-54	11504	35.5	<0.001
55-64	14668	30.5	
Race			
White	26583	36.8	0.2148
Black	3502	35.5	
Other Eligible	455	42.8	
Other	261	45.9	
Ethnicity			
Hispanic	416	36.6	0.0118
Non-Hispanic	30385	46.8	
Gender			
Male	12047	38.6	0.0013
Female	18749	35.2	
Appalachian			
Yes	12615	37.2	0.6387
No	18186	36.7	
Education			
Less than High School	2852	46.7	<0.001
High School Graduate	10284	39.7	
Some College	8778	33.4	
College Graduate	8870	29.9	
Income (Thousand)			
<$25	9801	43.1	<0.001
$25-50	7664	37.9	
$50-75	5141	33.2	
$75+	8195	36.8	
Total	*30801*	*36.8*	

Table 2.1. Chi-squared analysis comparing diabetes screening rates of Kentucky residents eligible for screening, before and after Affordable Care Act (ACA) Implementation

Variable	*n*	*Not Screened (wgt. %)*	X^2	*P-value*
ACA Status				
Pre-Expansion:	9987	37.9	10.1	0.4150
Post-Expansion:	14822	35.8		
Total	*24809†*			

† N=24809, number of respondents eligible for Diabetes screening, who were asked about screening.

Table 2.2. Chi-squared analysis comparing diabetes screening rates of Kentucky residents eligible for screening, in Appalachian versus non-Appalachian regions before and after Affordable Care Act (ACA) implementation

Variable	*n*	*Not Screened (wgt. %)*	X^2	*P-value*
Appalachia				
Yes	9978	37.2	0.46	0.6387
No	14831	36.7		
Total	*24809†*			

† N=24809, number of respondents eligible for Diabetes screening, who were asked about screening.

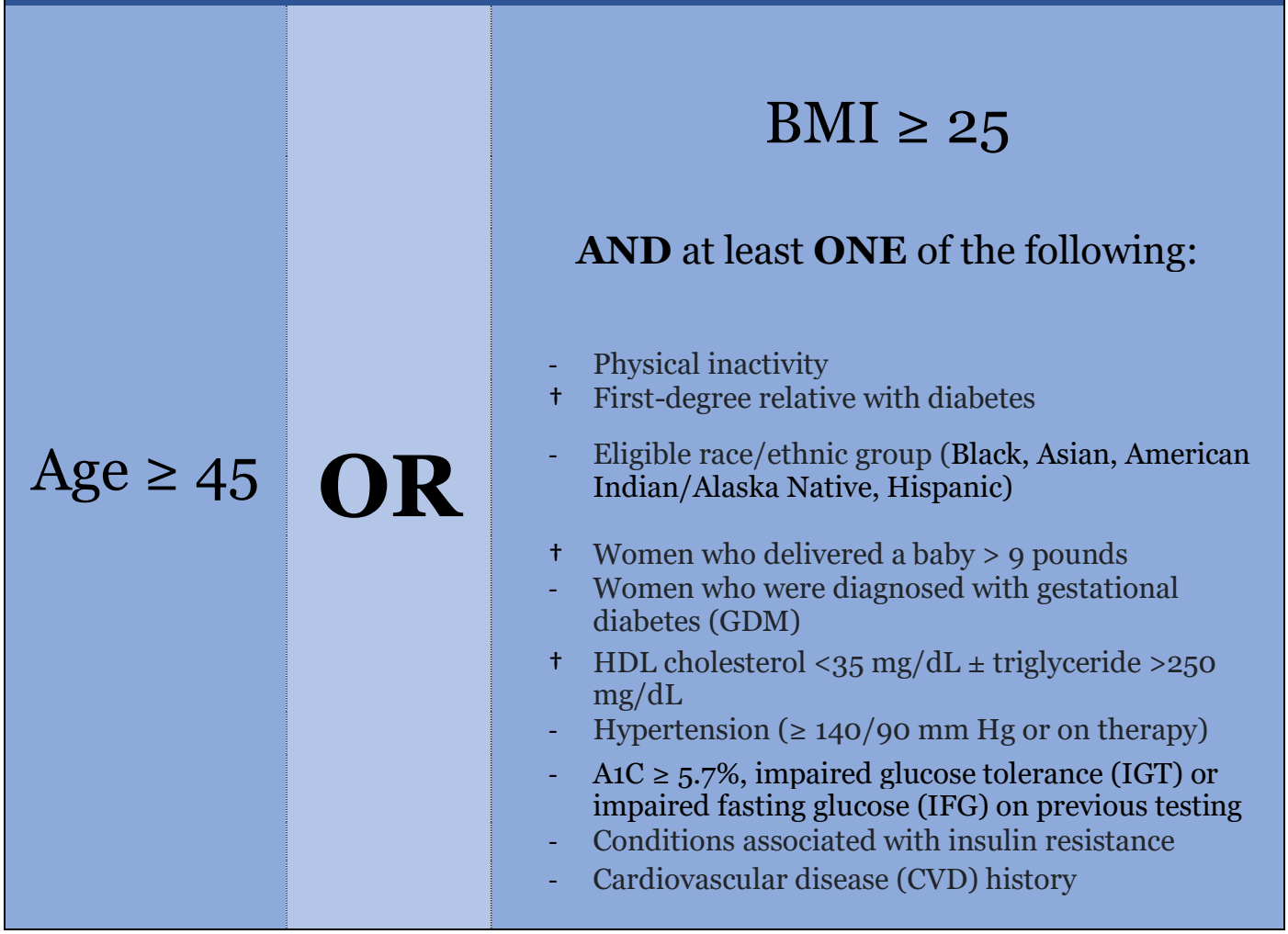
Table 3. Robust Poisson regression model for diabetes screening among Kentucky residents who were eligible for screening (N=30801)

Variable	*Rate Ratio*	*Confidence Interval (95%)*	*P-value*
ACA Expansion			
Pre	Ref.		
Post	1.000	(1.00, 1.00)	0.663
Age (Years)			
45-54	Ref.		
55-64	1.164	(1.11, 1.22)	<0.001
Race			
White	Ref.		
Black	1.141	(1.08, 1.21)	<0.001
Other Eligible	1.050	(0.91, 1.21)	0.508
Other	0.972	(0.79, 1.20)	0.795
Ethnicity			
Non-Hispanic	Ref.		
Hispanic	1.009	(0.86, 1.18)	0.913
Gender			
Male	Ref.		
Female	1.002	(0.97, 1.03)	0.897
Appalachian			
No	Ref.		
Yes	1.032	(1.00, 1.07)	0.062
Education			
Less than High School	Ref.		
High School Graduate	1.068	(1.00, 1.15)	0.066
Some College	1.170	(1.09, 1.26)	<0.001
College Graduate	1.183	(1.10, 1.27)	<0.001
Household Income (Thousand)			
<$25	Ref.		
$25-50	1.048	(1.00, 1.10)	0.061
$50-75	1.082	(1.03, 1.14)	0.003
$75+	1.075	(1.02, 1.13)	0.003
Personal doc.			
Yes	Ref.		
No	0.594	(0.55, 0.64)	<0.001

† 2019 data omitted

Figures

Figure 1: ADA Testing Guidelines for Type 2 Diabetes and Prediabetes in Asymptomatic Adults



† = Not available in BRFSS dataset

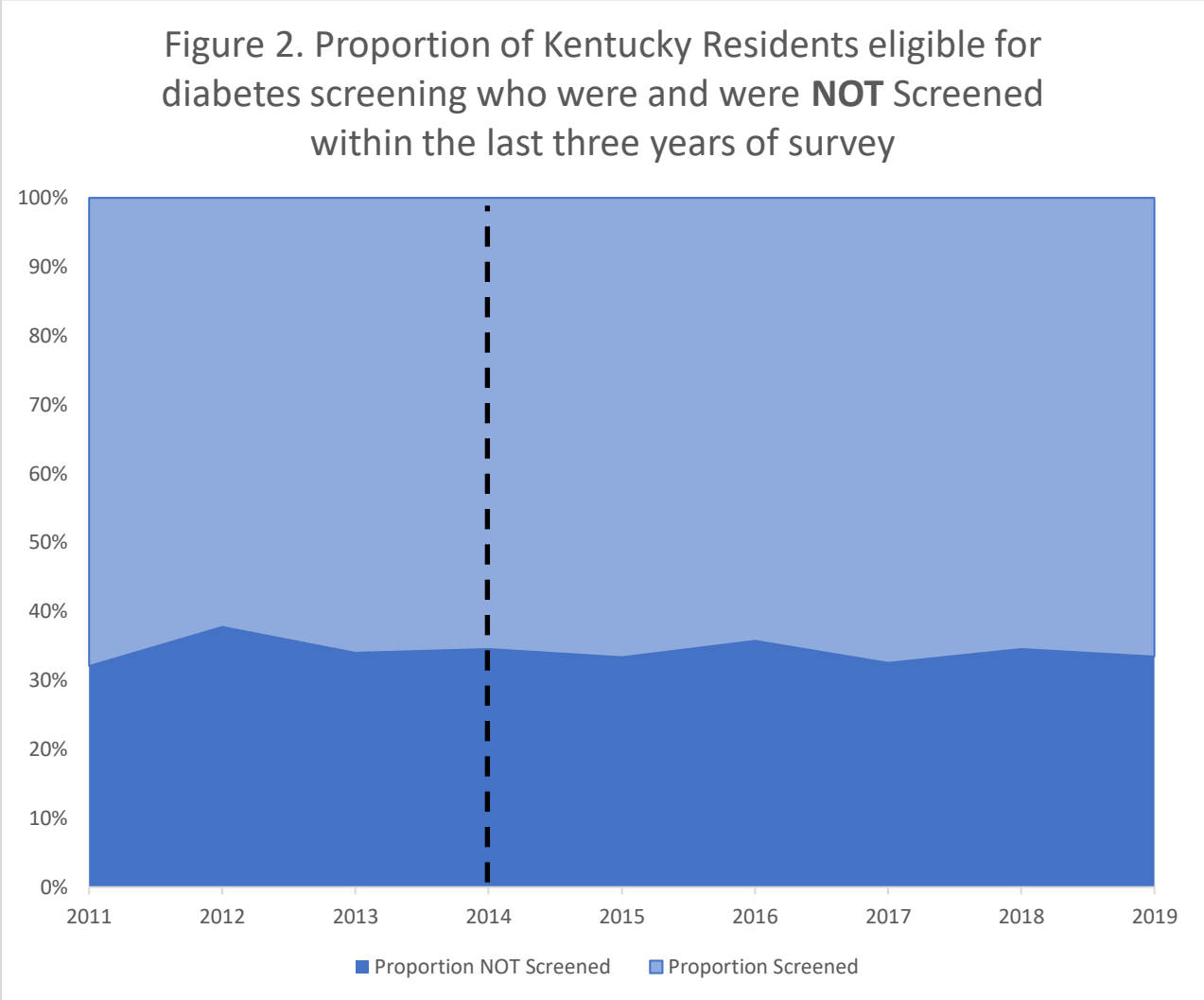


Figure 2. Proportion of Kentucky Residents eligible for diabetes screening who were and were **NOT** Screened within the last three years of survey
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2011
2012
2013
2014
2015
2016
2017
2018
2019
Proportion NOT Screened
Proportion Screened

Figure 3. Exclusion criteria for those considered eligible for diabetes screening

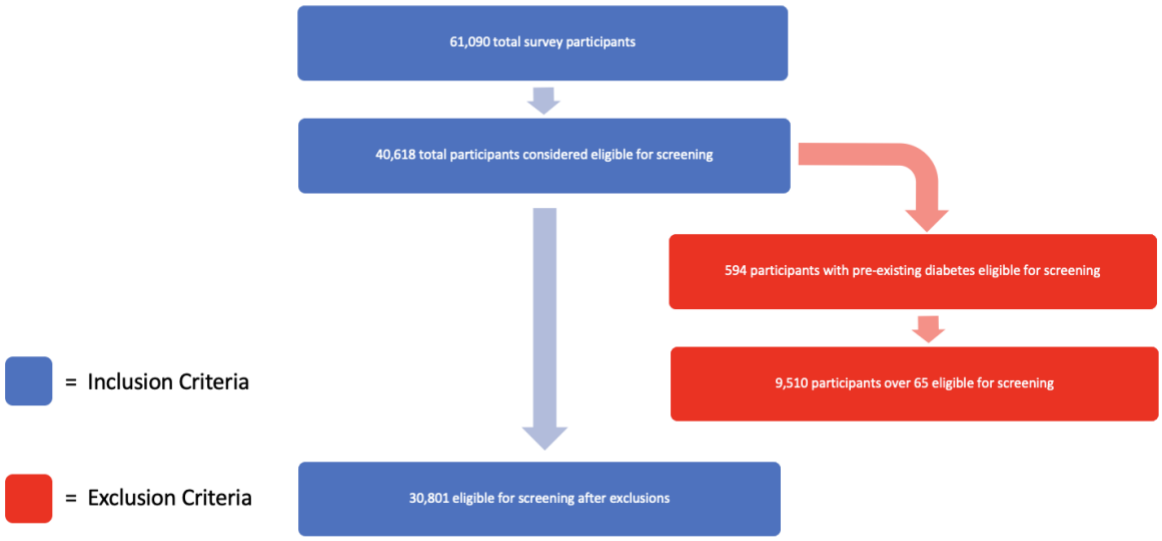
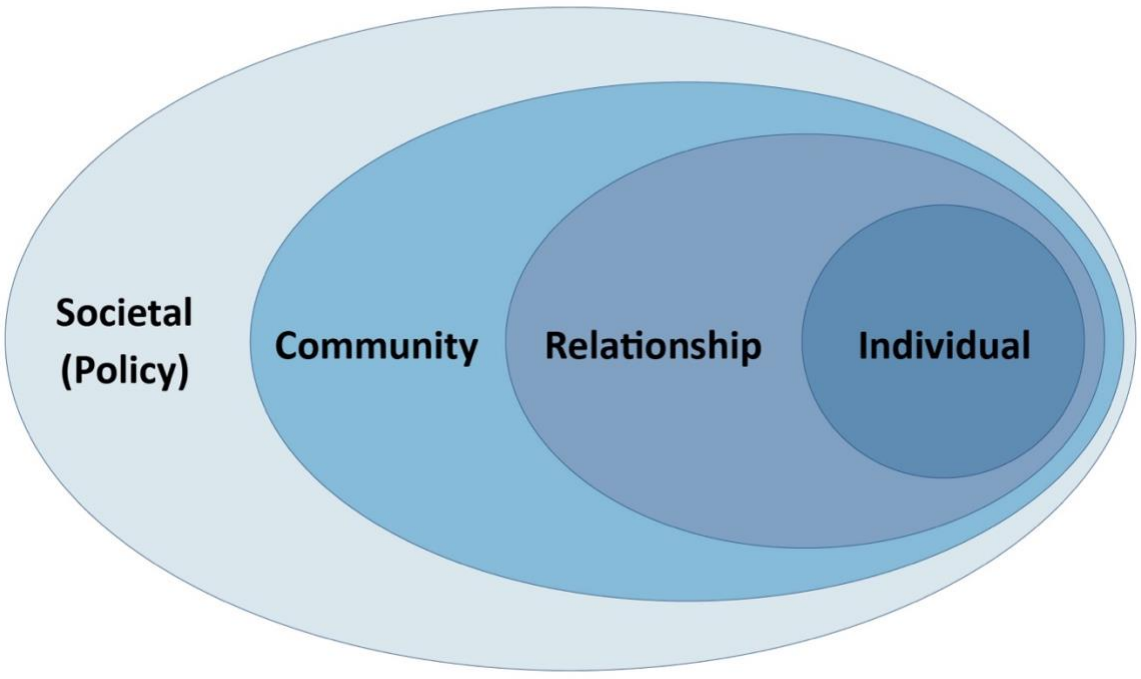


Figure 4. Socio-ecological model for conceptualizing interactions from individual to societal behaviors and how they relate



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