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Are the U.S. Territories Lagging Behind in Diabetes Care Practices?

Rachel P. Ogilvie, PhD, MPH¹, Shivani A. Patel, PhD², K.M. Venkat Narayan, MD, MSc, MBA², and Neil K. Mehta, PhD³

¹Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA

²Hubert Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, GA

³Department of Health Management and Policy, University of Michigan, Ann Arbor, MI

Abstract

Aims—Although U.S. territories fall within the mandate outlined by Healthy People 2020, they remain neglected in diabetes care research. We compared the prevalence and secular trends of four recommended diabetes care practices in the U.S. territories of Guam, Puerto Rico, and the U.S. Virgin Islands to the 50 United States and D.C. (“U.S. States”) in 2001–2015.

Methods—Data were from 390,268 adult participants with self-reported physician diagnosed diabetes in the Behavioral Risk Factor Surveillance System. Diabetes care practices included biannual HbA1c tests, attendance of diabetes education classes, daily self-monitoring of blood glucose, and receipt of annual foot examination. Practices were compared by U.S. territory and between territories and U.S. states. Multivariable models accounted for age, sex, education, and year.

Results—Of adults with diagnosed diabetes, 7% to 11% in the U.S. territories engaged in all four recommended diabetes care practices compared with 25% for those, on average, in U.S. states. Relative to the U.S. states, on average, the proportion achieving biannual HbA1c testing was lower in Guam and the U.S. Virgin Islands (45.6% and 44.9% vs. 62.2%), while annual foot examinations were lower in Puerto Rico (45.9% vs 66.1% in the U.S. states). Diabetes education and daily glucose self-monitoring were lower in all three territories.

Conclusions—U.S. territories lag behind U.S. states in diabetes care practices. Policies aimed at improving diabetes care practices are needed in the U.S. territories to achieve Healthy People 2020 goals and attain parity with U.S. states.

Correspondence to: Rachel Ogilvie, 3471 Fifth Avenue, Suite 1216, Kaufmann Medical Building, Pittsburgh, PA 15213, Phone: 412-802-8498, Fax: 412-802-6395, ogilvierp@upmc.edu.

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Keywords

diabetes; epidemiology; Healthy People 2020

1.1 Introduction

As in the United States, diabetes is an important public health problem in the U.S. territories, and the prevalence of diabetes in the U.S. territories (Guam, Puerto Rico, the U.S. Virgin Islands (USVI), American Samoa, and the Northern Mariana Islands) ranges from a low of 9.6% in Guam to a high of 16.4% in Puerto Rico.¹ Much evidence indicates that the risk of diabetes complications, such as cardiovascular disease, retinopathy, neuropathy, and nephropathy, could be reduced through engagement in evidence-based diabetes preventative care practices.^{2–4} Specifically, recommended measures of processes of practices to prevent diabetes complications include but are not limited to testing glycosylated hemoglobin (HbA1C) twice a year, attending formal diabetes education classes, daily glucose monitoring, and obtaining an annual foot examination. While the uptake of these practices at the population-level is suboptimal across the U.S.,^{5–8} prior data indicate that U.S. territories lag behind U.S. states in several practices. For example, in the early 2000s, Puerto Rico lagged behind in diabetes education, daily glucose monitoring, and annual foot examinations,^{9,10} while Guam lagged behind in HbA1c and daily glucose monitoring.¹¹

The Healthy People program outlines 10-year national objectives for diabetes care alongside other measures to improve the health of all Americans. Although U.S. territories fall within the mandate of Healthy People 2020, we are not aware of published studies that have examined diabetes care practices in U.S. territories nor recent comparisons of progress in U.S. territories compared with U.S. states. To address this gap in the literature, we estimated the prevalence and secular trends of diabetes preventive care practices in three of the five inhabited U.S. territories, Guam, Puerto Rico, and the USVI, and compared them to U.S. States from 2001–2015.

1.2 Methods

Initiated by the Centers for Disease Control & Prevention (CDC), the Behavioral Risk Factor Surveillance Survey (BRFSS) is the world's largest telephone-based survey system and has been run by state health departments since 1984. It is a cross-sectional survey conducted annually with per-year respondents ranging from 212,510 in 2001 to 506,467 in 2011. It consists of a core question set that all states and included territories complete and optional modules that individual states and territories may elect to complete. Previous research has found that the majority of BRFSS questions have moderate reliability and validity.¹²

Our sample consisted of respondents aged 18 and older who were sampled in one of the annual surveys conducted from 2001 through 2015 by BRFSS, reported prior diagnosis of diabetes by a physician, and provided a response for at least one of the key diabetes preventive care practices. The survey was not conducted in Guam in 2004–2006, Puerto Rico in 2005, or USVI in 2011–2015. The final analytic sample included data from 390,268

respondents with diabetes (377,022 in U.S. states, 1,444 in Guam, 9,578 in Puerto Rico, and 2,224 in USVI).

The outcomes for this study were four binary indicators of diabetes care as defined by the Healthy People 2020 diabetes objectives in BRFSS. Although Healthy People 2020 includes additional diabetes care indicators, they are measured in datasets beyond BRFSS and do not provide information about the U.S. territories. The four outcomes used in this study included the respondent's report of past-year biannual HbA1c testing, any formal diabetes education, daily glucose monitoring, and receiving a foot examination. Each of the four diabetes practices was assessed with a single question. A final composite indicator summarized whether an individual engaged in all four practices.

Place of residence was the primary exposure of interest. Place of residence was categorized into four groups: (1) all 50 U.S. states and the District of Columbia (reference), (2) Guam, (3) Puerto Rico, and (4) USVI.

All analyses were weighted and accounted for the complex survey design of the BRFSS. We described demographic characteristics including age (18 to 99 years), sex (men versus women), race (Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Asian, other Non-Hispanic, or Hispanic), and education (< 9 years, Grades 9–11, Grade 12/GED, 1–3 years of college, or 4 or more years of college) by place residence. The age-adjusted proportion achieving each diabetes preventative care practice was calculated in the four locations annually and in three time periods: 2001–2005, 2006–2010, and 2011–2015. Age adjustment was conducted using the direct method of standardization with weights from the 2010 U.S. Census Bureau population stratified into five age groups: 18–24, 25–34, 35–44, 45–64, and 65+. Multiple logistic regression models were used to estimate the relative odds of engaging in each diabetes care practice for each territory compared to U.S. states after adjustments for sex, age, education, and survey year. Race/ethnicity was not included in these models due to collinearity with place of residence. In sensitivity analyses, we additionally adjusted for age at diabetes diagnosis and examined the proportion achieving the SMBG recommendation by insulin use status.

1.3 Results

Table 1 describes the characteristics of respondents with diagnosed diabetes in U.S. territories and states for the 2001–2015 period. There were notable differences in demographic composition across the US territories. Approximately 30% of those residing in Puerto Rico and 22% of those in the USVI had not completed ninth grade, while only 8% of those in the U.S. states had not completed ninth grade. Nearly all respondents in Puerto Rico reported being Hispanic and 70% of respondents in the USVI reported being non-Hispanic black.

The age-adjusted proportion achieving the four diabetes care practices in three time periods are shown in Table 2. In each period, 23% to 26% of the population with diabetes in the US states met all four care goals. In comparison, 6% to 11% of the population in any of the territories met all four care goals in any given time period. Among the territories, there was

no consistent pattern in the best or worst performer. Across time periods, a lower percentage of people with diabetes in Guam, Puerto Rico, and the USVI were meeting recommendations for all four practices compared to the U.S. states. Similar results were found for diabetes education and daily glucose monitoring. For annual foot examinations, the U.S. states had a greater percentage of its residents with diabetes meeting the recommendation than Puerto Rico in all years, though USVI was similar. Guam was higher than the U.S. states in 2001–2010, but dropped below the U.S. in 2011–2015. For HbA1c, a greater percentage of people with diabetes in the U.S. states met the recommendation than those in Guam and USVI in all years, while Puerto Rico was lower in 2001–2005 but similar to the U.S. states in 2006–2015. Sex stratified estimates can be found in Supplemental Table 1.

Figure 1 shows the annual proportion achieving four practices in each of the four locations from 2001–2015. The U.S. states had a higher proportion achieving all the practices except for annual foot examinations, where Guam had a higher proportion during the first half of the time period. The largest changes over time were seen for daily glucose monitoring, where the proportion in Puerto Rico and USVI increased over the time period faster than the U.S. states. No large changes in proportion achieved over time were seen for the other three diabetes care practices.

Table 3 displays odds ratios comparing each diabetes care practice in individual U.S. territories compared with U.S. states in 2001–2015. After adjustment for age, sex, education, and year, the relative odds of meeting several of the diabetes care recommendations was lower in the territories compared to the U.S. states. In all three territories, the odds of meeting the diabetes care recommendations was much lower compared to the U.S. states for the composite of all four practices. For the individual recommendations, all territories lagged behind in diabetes education, and daily glucose monitoring compared to the U.S. states. For annual HbA1c testing, Guam (OR = 0.55 95% confidence interval 0.47–0.63) and USVI (OR = 0.52, 0.47–0.58) had lower odds of meeting the recommendation, while Puerto Rico had similar odds to the U.S. states (OR = 1.00, 0.94–1.07). Additionally, Puerto Rico had much lower odds of meeting the recommendation compared to the U.S. states (OR = 0.39, 0.37–0.41), while Guam (OR = 0.86, 0.74–1.01) and USVI (OR = 0.88, 0.78–0.99) had slightly lower odds. In sensitivity analyses, across locations those taking insulin were at much lower odds of meeting the SMBG recommendation compared to those not on insulin (OR=0.19, 0.14–0.27) and there was no multiplicative interaction between territory and insulin use. Additional adjustment for age at diabetes diagnosis produced no appreciable changes in the estimates (data not shown).

1.4 Discussion

During 2001–2015, residents of the U.S. territories of Guam, Puerto Rico, and the USVI consistently lagged behind the U.S. states in meeting four of the Healthy People 2020 objectives measured in BRFSS. All three territories lagged behind in the composite of the four diabetes care practices, as well as in two key recommended practices shown to reduce complications arising from diabetes: receiving formal diabetes education and daily glucose monitoring. Throughout the 2001–2015 time period, the proportion achieving biannual

HbA1c was testing lower in Guam and the USVI than in U.S. states, while the proportion achieving annual foot examinations was lower in Puerto Rico compared to U.S. states.

The current Healthy People 2020 (HP2020) objectives are to increase the proportion of the adult population diagnosed with diabetes engaging in these key practices to the following levels: biannual HbA1C testing to 71.1%, receipt of formal diabetes education to 62.5%, daily glucose monitoring to 70.4%, and annual foot examination to 74.8%.¹³ We found that none of these objectives were met, regardless of which diabetes care practice, location, or calendar year.

The overwhelming majority of adults with diabetes in U.S. territories failed to engage in all four diabetes preventive care practices. Our findings were consistent with previous research, which found that small percentages of people with diabetes in the territories were meeting the diabetes care recommendations.^{9–11} Like previous studies, we found that Puerto Rico has the greatest percentage of people meeting the objective for HbA1c, while proportion achieving diabetes education, daily glucose monitoring, and annual foot examinations were much lower.^{11, 12} Similarly, previous research found a higher proportion meeting the annual foot examination objective in Guam and a much lower proportion achieving the other diabetes care practices.¹³

By analyzing each practice separately, our results inform specific areas for improvement in diabetes care in the U.S. territories. After adjusting for demographic factors, individuals in Guam and USVI were as likely as those in the U.S. states to receive an annual foot examination in most years, but less likely to engage in any of the other recommended practices. In most years, residents of Puerto Rico were also as likely to receive HbA1c testing twice per year, but were less likely to engage in any of the other practices. These differences may reflect local programmatic deficiencies and strengths that may be addressed by policy makers. In the United States, the 2010 Affordable Care Act included multiple pay for performance programs. The Centers for Medicare & Medicaid Services assesses physicians on quality and cost for several diabetes care practices, including HbA1c testing and foot examinations.¹⁴ While these programs only recently became mandatory, they may lead to continued improvements in future diabetes care practices. This study, therefore, provides benchmark data for the period before these features were introduced.

We also found that some territories were changing over time compared to the U.S. states for specific diabetes care practices. For daily glucose monitoring, both Puerto Rico and USVI improved over time relative to U.S. states. It is possible that daily glucose monitoring is emphasized more prominently by doctors and diabetes programs, while newer less integral practices like diabetes education and annual foot examinations are less of a major focus.

There are several reasons why these disparities in diabetes care practices are persistent. In some of the territories, there is a shortage of physicians and hospitals. In these areas, infrastructure has not kept up with the increasing number of people with diabetes,¹⁵ so many have to travel to receive proper care.¹⁶ As a result, many people with diabetes may not be taught the proper self-care practices needed to control their diabetes. In addition, some territories lack the health programming necessary to serve their population with diabetes.

Guam lacks a territory-wide or health department plan for diabetes, has no comprehensive tracking system for diabetes, and has no standard of care in its diabetes prevention and control program.¹⁷ Cultural norms may also influence these practices. In the USVI, people with diabetes were more likely to trust recommendations from friends and family than their doctors, and adjust their medications without consulting a health professional.¹⁸ These practices may affect uptake of appropriate diabetes care, which may contribute to the demonstrated health care disparities.

More broadly, the five territories of the United States have inferior health care compared to the mainland. The U.S. territories have fewer skilled health care professionals, ICU beds, and longer wait times in the emergency department compared to the U.S. states. The territories also have poorer adoption of electronic health records and are often excluded from important national databases.¹⁹ Medicare and Medicaid spending per capita is much lower in the territories than in the U.S. states, potentially resulting in less access to physicians and medications as well as fewer resources for nursing homes and hospitals.¹⁹ In addition, broader health care outcomes are also worse in the territories. For example, hospitals in the U.S. territories also have higher 30-day mortality rates compared to hospitals in the U.S. states.²⁰ These larger level disparities may have also contributed to the differences in uptake of diabetes care.

The results must be interpreted in light of several limitations. Data from BRFSS are self-reported, so objective measures of diabetes status or diabetes care practices were not used. However, only those with known diagnosed diabetes can engage in diabetes care practices. BRFSS also does not distinguish between Type 1 and Type 2 diabetes, though in the United States we expect Type 1 diabetes to be about 5% of the total population with diabetes. In addition, the 2001–2010 BRFSS data was only collected among individuals with landlines, while 2011–2015 data was collected among cell phone users, so data across years may not be directly comparable. The BRFSS does not include people who were institutionalized, including those in nursing homes or those who were homeless, so the results cannot be generalized to these populations. Additionally, every territory did not collect data on the diabetes module every year, leading to missing data in some years. The BRFSS did not collect data on the U.S. territories of American Samoa or the Northern Marianas, so it is unknown how people with diabetes in these areas compare to people in the other territories or U.S. states. Lastly, we only report on the Healthy People 2020 diabetes care objectives that were available in BRFSS because they were measured in the U.S. territories; other indicators may have different results.

In conclusion, from 2001–2015, people with diabetes in three of the U.S. territories were consistently less likely to engage in recommended diabetes care practices compared to those residing in the U.S. states. Efforts should be made to increase the uptake of these practices through more funding to diabetes programs and the development of diabetes plans at the territory level. With continued research and increased planning and funding, the persistent disparities in diabetes care practices may be addressed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Three U.S. territories consistently lagged the U.S. states in diabetes care
- Healthy People 2020 objectives for diabetes care are not being met
- Disparities in diabetes care practices need to be addressed

Figure 1.
Annual proportion achieving diabetes care practices in US States and territories 2001–2015

Table 1

Characteristics of adult BRFSS respondents reporting diabetes in the United States, Guam, and Puerto Rico, 2001–2015

	50 U.S. states and Washington D.C.	U.S. territories		
	U.S. States (n=377,022)	Guam (n=1,444)	Puerto Rico (n=9,578)	U.S. Virgin Islands (n=2,224)
Age, mean $\pm$ SE	59.7 $\pm$ 0.1	54.3 $\pm$ 0.6	60.6 $\pm$ 0.2	58.3 $\pm$ 0.4
Female, n (%)	221,082 (50.0)	820 (50.2)	6,202 (54.7)	1,472 (59.7)
Education, n (%)				
< Grade 9	23,747 (8.0)	59 (5.4)	3,070 (30.2)	475 (21.7)
Grades 9–11	38,249 (11.6)	154 (16.1)	1,157 (13.5)	262 (12.7)
Grade 12/GED	132,213 (33.3)	562 (37.5)	2,292 (24.4)	743 (34.1)
1–3 years of college	99,796 (26.6)	332 (22.8)	1,537 (16.4)	347 (15.2)
4+ years of college	83,017 (20.6)	337 (18.2)	1,522 (15.5)	397 (16.2)
Race/Ethnicity, n (%)				
White Non-Hispanic	278,104 (66.5)	66 (3.6)	48 (0.5)	176 (7.7)
Black Non-Hispanic	51,229 (15.7)	9 (0.5)	7 (0.1)	1,595 (69.4)
Asian Non-Hispanic	4,917 (1.9)	373 (25.4)	1 (0.0)	23 (1.2)
Other Non-Hispanic	20,140 (4.4)	835 (59.4)	25 (0.3)	120 (5.9)
Hispanic	22,632 (11.6)	161 (11.1)	9,497 (99.2)	310 (15.7)

Notes: Education refers to years completed.

Guam provided no data in 2004–2006, Puerto Rico provided no data in 2005, USVI provided no data in 2011–2015

Source: Behavioral Risk Factor Surveillance System, 2001–2015

Table 2

Age-adjusted proportion of engaging in diabetes care practices

Year	Region	Unweighted N	All four practices	Diabetes care practices				Biannual HbA1c testing	Blood glucose self-monitoring
				Annual Foot Exam	Diabetes education	Annual Foot Exam	Diabetes education		
2001–2005	US States	87,420	22.6 (21.6,23.6)	66.1 (64.7,67.4)	53.7 (52.4,55.0)	62.2 (60.9,63.6)	59.2 (57.8,60.6)		
	Guam	188	10.8 (5.1,16.5)	71.8 (62.3,81.3)	45.3 (35.2,55.3)	45.6 (34.7,56.5)	38.1 (28.0,48.2)		
	Puerto Rico	2,199	5.9 (4.0, 7.8)	45.9 (39.9,52.0)	39.4 (33.7,45.1)	56.4 (50.7,62.0)	27.5 (22.3,32.6)		
	US Virgin Islands	955	7.3 (4.7,9.9)	59.9 (53.3,66.5)	35.7 (29.3,42.2)	44.9 (36.6,53.1)	43.0 (36.0,50.0)		
2006–2010	US States	157,713	26.3 (25.0,27.6)	68.4 (67.0,69.8)	56.8 (55.4,58.1)	64.1 (62.7,65.5)	64.8 (63.4,66.2)		
	Guam	354	9.0 (6.0,12.0)	72.5 (65.1,79.8)	43.2 (33.2,53.2)	41.7 (35.3,48.1)	41.4 (32.3,50.4)		
	Puerto Rico	3,877	7.6 (5.2,10.0)	38.9 (34.7,43.1)	34.8 (30.9,38.8)	62.0 (56.5,67.5)	47.4 (42.0,52.9)		
	US Virgin Islands	1,269	10.5 (6.2,14.8)	64.3 (57.1,71.5)	31.1 (25.5,36.8)	49.5 (42.8,56.2)	52.8 (46.9,58.7)		
2011–2015	US States	131,889	25.8 (24.8,26.8)	68.6 (67.4,69.7)	54.7 (53.6,55.9)	66.5 (65.3,67.7)	64.0 (62.8,65.1)		
	Guam	902	10.1 (6.5,13.8)	61.1 (54.6,67.6)	39.5 (32.9,46.0)	47.9 (42.0,53.9)	35.6 (29.3,41.9)		
	Puerto Rico	3,502	10.5 (7.3,13.7)	43.1 (38.4,47.7)	28.4 (24.3,32.6)	62.7 (57.8,67.6)	55.2 (50.4,60.1)		
	US Virgin Islands	0	N/A	N/A	N/A	N/A	N/A		

Age-adjustment conducted using direct standardization

Guam provided no data in 2004–2006, Puerto Rico provided no data in 2005, USVI provided no data in 2011–2015

Source: Behavioral Risk Factor Surveillance System, 2001–2015

Table 3

Adjusted odds of engaging in diabetes care practices comparing the territories to the US States: The Behavioral Risk Factor Surveillance System 2001–2015

Region	All four practices	Annual Foot Exam	Diabetes education	Annual HbA1c testing	Blood glucose self-monitoring
US States	Ref.	Ref.	Ref.	Ref.	Ref.
Guam	0.39 (0.31,0.48)	0.86 (0.74,1.01)	0.59 (0.52,0.69)	0.55 (0.47,0.63)	0.36 (0.31,0.42)
Puerto Rico	0.30 (0.27,0.33)	0.39 (0.37,0.41)	0.45 (0.43,0.48)	1.00 (0.94,1.07)	0.49 (0.47,0.52)
US Virgin Islands *	0.36 (0.30,0.43)	0.88 (0.78,0.99)	0.44 (0.39,0.49)	0.52 (0.47,0.58)	0.47 (0.43,0.53)

* Data from the US Virgin Islands only available 2001–2010

Odds ratios are adjusted for age, sex, and education.