

# The Protection Gap - Diagnosis, Treatment Status, and Disease Control for People with Diabetes and Hypertension in the US-Affiliated Pacific Islands

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## Abstract

*Hypertension and diabetes are major causes of disability and mortality in the US-Affiliated Pacific Islands (USAPI). Control of these conditions has the potential to avert much of the burden of non-communicable diseases in the region. To realize this potential, people living with hypertension and diabetes must be identified and receive treatment of sufficient intensity to control their blood pressure and blood glucose. Data from recent cross-sectional surveys conducted in 5 jurisdictions—Pohnpei, Palau, Kosrae, Marshall Islands and American Samoa—were used to estimate the adult prevalence of hypertension and diabetes as well as diagnosis awareness, treatment, and control status of the adults with these conditions. In addition to traditional prevalence indicators, the authors provide a novel presentation of non-communicable disease (NCD) data, using the concept of “protection gaps”, defined as the number of people living in a community who have an NCD for which effective control is not attained. The protection gap is determined by applying survey-derived population prevalence estimates to the community’s population size using census data. The protection gap is further divided into 3 groups: (1) case-finding gap—those who are unaware of their conditions; (2) tracking and outreach gap—those who are aware of their condition but not receiving treatment; and (3) treatment efficacy gap—those who are receiving treatment but whose disease is not under control. The findings show a large protection gap, with a majority of adults living with hypertension (80.8%) and diabetes (91.6%) not having their condition under control. The case-finding gap accounts for more than half of these, followed by treatment efficacy, and tracking and outreach gaps. These findings can guide public health strategies and monitoring for control of hypertension and diabetes in the USAPI region.*

## Keywords

*Pacific islands, Non-communicable diseases, Secondary prevention, Protection gap, Case-finding gap, Tracking and outreach gap, Treatment efficacy gap*

## Abbreviations

*CI = confidence interval  
NCD = non-communicable diseases  
PIHOA = Pacific Islands Health Officers Association  
US = United States  
USAPI = United States Affiliated Pacific Islands*

## Introduction

The US-Affiliated Pacific Islands (USAPI) consist of 1 Polynesian US territory (American Samoa), 2 Micronesian US territories (Guam and the Commonwealth of the Northern Mariana Islands), and 3 Micronesian sovereign states in “Free Association” with the US (the Republic of Palau, the Republic

of the Marshall Islands, and the Federated States of Micronesia comprised of the states of Kosrae, Pohnpei, Chuuk and Yap). Together the USAPI have mounted a concerted response to non-communicable diseases (NCDs) since the Pacific Islands Health Officers Association (PIHOA) issued a regional Declaration of Health Emergency in 2010.<sup>1</sup> The Declaration called for improved surveillance to inform policy and practice in the fight against NCDs. In 2011, PIHOA convened a technical working group to develop an NCD surveillance framework with standardized data collection methods, indicators, and timelines to ensure consistency within and across USAPI jurisdictions. The resulting framework called for monitoring youth and adult NCD risk factors, diabetes and hypertension prevalence, and NCD cause-specific death rates, using school-based surveys, adult community-based surveys, and vital statistics as data sources.<sup>2</sup> Diabetes and hypertension management can greatly reduce cause-related deaths and morbidity.<sup>3,4</sup> To achieve these benefits on a population level, a large proportion of people with these conditions must be identified, given appropriate treatment, and maintained on treatment. The term “protection gap” can be used to designate the number of people in a population with diabetes or hypertension whose blood glucose and blood pressure are not kept under control. The protection gap can be further divided into several components. The first is comprised of those with diabetes or hypertension who have never been diagnosed. Since case finding is necessary to identify these, the term “case-finding gap” is used for this component. The second is comprised of those who have been diagnosed but are not in treatment. Since tracking of patients is needed to guide outreach to bring these cases into care, this component is referred to as the “tracking & outreach gap”. The third is comprised of those who are in treatment but whose conditions are still not under control. This component is referred to as the “treatment efficacy gap”. The purpose of this article is to provide data on the prevalence of hypertension and diabetes and determine the size of the protection gap in the adult population in USAPI.

## Methods

This is a cross-sectional study using existing data compiled from the NCD hybrid surveys, which are cross-sectional, community-based surveys designed to be conducted every 5 years and to fit with the standardized USAPI NCD surveillance framework.<sup>5</sup> Study households for the hybrid survey within

each jurisdiction were selected randomly and a single subject age 18 or greater, was selected from each of these households using the Kish methodology, as described by Cash, et al.<sup>6</sup> Study households were selected separately from main island vs. outer island geographical strata in Pohnpei and the Marshall Islands, while households were selected from single pools in Kosrae and American Samoa, which do not have substantial outer island populations. The surveys included a questionnaire regarding NCD risk factors, physical measurements of height, weight, and blood pressure, as well as measurement of fasting blood sugar, providing estimates of risk factor prevalence, as well as diabetes and hypertension prevalence and disease awareness, management, and control.

Survey sample sizes and dates include Palau (2017, n=1768), the Marshall Islands (2018, n=2869), American Samoa (2018, n=1005), Kosrae (2019, n=604), and Pohnpei (2019, n=1536), for a total of 7782 respondents. Questionnaires were administered using face-to-face interviews by trained surveyors in local language translations. Three blood pressure readings and a fasting blood glucose measurement was collected after the interview. The survey was explained to each participant and voluntary consent was obtained at the time of interview.

Participants were considered to have diabetes or hypertension if they were under current treatment for the condition or if they had elevated fasting blood sugar measurements ( $\geq 126\text{mg/dl}$ ) or blood pressure measurement (average of 3 resting blood pressure readings of  $\geq 140\text{mm Hg}$  systolic and/or  $\geq 90\text{mm Hg}$  diastolic), respectively. Participants were considered to be aware of their conditions if they answered “yes” to the questions: “Have you ever been told by a doctor, nurse, or other health worker that you have high blood pressure or hypertension?” and “Have you ever been told by a doctor, nurse, or other health worker that you have high blood sugar or diabetes?” Participants were considered to be on treatment for hypertension if they answered “yes” to the question: “Are you currently receiving medicine prescribed by a doctor or other health worker for your high blood pressure or hypertension that you have taken in the past two weeks?” Participants were considered to be on treatment for diabetes if they answered “yes” to either of the following questions: “Are you currently receiving insulin prescribed by a doctor or other health worker for your high blood sugar or diabetes?” or “Are you currently receiving other types of medicine prescribed by a doctor or other health worker for your high blood sugar or diabetes that you have taken in the past two weeks?” Participants with hypertension were considered “under control” if their systolic blood pressure was  $< 140$  and diastolic blood pressure was  $< 90\text{mm Hg}$  (3 blood pressure readings are taken for each participant in the NCD Hybrid Surveys, and the average of the 3 is used). Participants who were newly identified with hypertension or diabetes, and those with known disease but not under control were referred to primary care clinics for management.

The prevalence of hypertension and diabetes were reported for adults 18 years and above in each jurisdiction. The prevalence of each condition was further broken down by the following categories: those with each condition who were aware of their diagnosis, those with each condition who were both aware of their diagnosis and in treatment, and those who were both in treatment and under control. Z scores were used to calculate 95% confidence intervals for prevalence estimates, using EpiInfo software, version 7 (Centers for Disease Control and Prevention, Atlanta, GA).

Population disease state estimates were applied to the adult population sizes of each jurisdiction (obtained from the most recent population censuses and using projections for annual changes in population from these censuses<sup>7-9</sup>). This extrapolation was performed to provide estimates of the numbers of adults in each jurisdiction with hypertension, and with diabetes; compared with the numbers with each condition who were under control. The differences between the numbers with each condition versus the numbers under control are designated here as the hypertension and diabetes “protection gaps”. The protection gap for each condition is further divided into several components. The “case finding gaps” are the estimated numbers living with each condition who are unaware of their condition. The “tracking and outreach gaps” are the estimated numbers who are aware of their conditions but have dropped out of treatment. The “treatment efficacy gaps” are the estimated numbers with each condition who are in treatment but not under control.

## Results

**Table 1** shows the prevalence of adults with hypertension and diabetes who were aware of their condition, in treatment, and under control. **Figures 1** and **2** show aggregate results. For hypertension, the prevalence across the 5 jurisdictions was 29.3% (95% CI: 28.3-30.3) and jurisdiction-level prevalence of hypertension ranged from 22.5% to 39.8%. Among adults with hypertension, the proportion who were aware of their diagnosis ranged from 35.5% to 66.9%. Between 22.4% and 51.2% were receiving treatment for hypertension and between 10.8% and 25.2% were under control. For diabetes, the aggregated prevalence for the 5 jurisdictions was 27.6% (95% CI: 26.6-28.6) and jurisdiction-level prevalence ranged from 22.2% to 33.6%. Among adults with diabetes, the proportion who were aware of their diagnosis ranged from 29.5% to 46.5%. Between 18.3% and 44.8% were receiving treatment for diabetes, and between 2.8% to 15.1% under control.

The estimated numbers of hypertension or diabetes cases comprising the protection gap and its components are shown in **Table 2** by jurisdiction, and in aggregate in **Figures 1** and **2**. Across all 5 jurisdictions the protection gap (number not in control) is large for both hypertension (n=23 354 of 28 895) and diabetes (n=24 991 of 27 297). All 3 protection gap

Table 1. Prevalence of Hypertension and Diabetes; and Awareness, Treatment, and Control Status Among Adults 18 Years and Older in Selected US-Affiliated Pacific Island Jurisdictions, 2017-2019.<sup>a</sup>

Prevalence	Pohnpei	Palau	Kosrae	Marshall Islands	American Samoa
<b>Hypertension</b>					
Hypertension Prevalence, % (CI) <sup>b</sup>	22.5% (20.4-24.6)	33.0% (30.7-35.2)	27.0% (23.5-30.7)	21.0% (19.5-22.6)	39.8% (36.7-43.0)
Aware of Hypertension % (CI)	35.5% (30.4-40.8)	63.4% (59.3-67.4)	66.9% (59.1-74.0)	36.7% (32.8-40.7)	47.4% (42.4-52.5)
Treating Hypertension % (CI)	27.3% (22.7-32.4)	51.2% (47.0-55.4)	44.2% (36.4-52.2)	22.4% (19.1-26.0)	42.8% (37.8-47.9)
Controlled Hypertension % (CI)	15.1% (11.5-19.4)	19.4% (16.1-23.1)	25.2% (18.7-32.5)	10.8% (8.4-13.7)	24.1% (19.8-28.7)
<b>Diabetes</b>					
DM Prevalence, % (CI)	22.8% (20.7-24.9)	22.2% (20.2-24.3)	29.4% (25.7-33.2)	26.8% (25.2-28.5)	33.6% (30.7-36.7)
Aware of Diabetes % (CI)	29.5% (24.8-34.6)	48.5% (43.3-53.7)	41.2% (33.9-48.9)	39.8% (36.2-43.4)	53.4% (47.8-58.9)
Treating Diabetes % (CI)	18.3% (14.4-22.8)	37.5% (32.5-42.6)	29.9% (23.3-37.3)	25.4% (22.4-28.7)	44.8% (39.3-50.4)
Controlled Diabetes % (CI)	3.4% (1.8-5.9)	6.3% (4.0-9.3)	2.8% (0.9-6.5)	3.9% (2.7-5.6)	15.1% (11.3-19.5)

<sup>a</sup> As determined by NCD Hybrid Surveys and most recent census numbers for adults 18 years and above.

<sup>b</sup> CI= 95% confidence interval

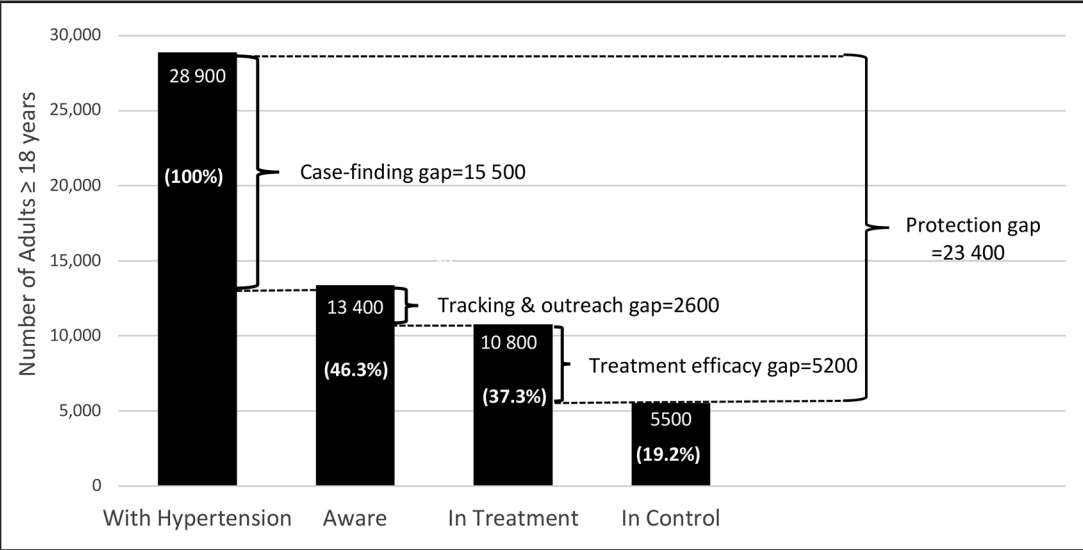


Figure 1. Hypertension- Estimated Aggregate Number (and Percent) of Adults Aware of, Receiving Treatment and In Control, in Selected US-Affiliated Pacific Island jurisdictions, 2017-2019

People with blood pressure of > 140/90 or in treatment for are considered to have hypertension

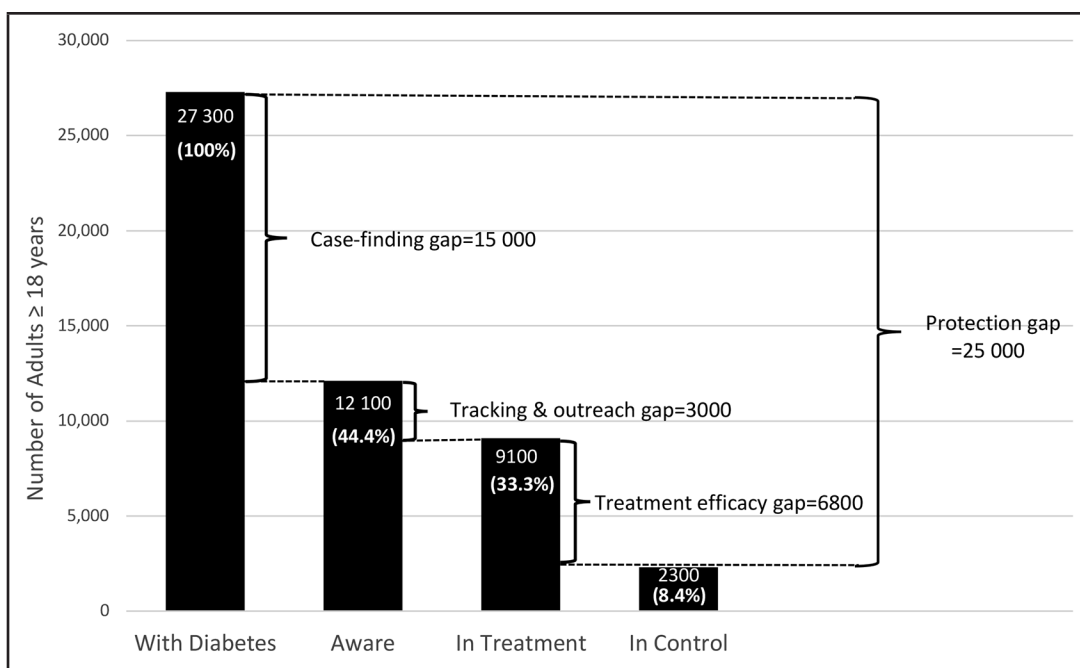


Figure 2. Diabetes- Estimated Aggregate Number (and Percent) of Adults Aware of, Receiving Treatment and In Control, in Selected US-Affiliated Pacific Island jurisdictions, 2017-2019

People with fasting blood sugar  $\geq 126$  or in treatment are considered to have diabetes

Table 2. Number of Individuals with Hypertension and Diabetes by Protection Gap Components Among Adults  $n = 98\,749$  in Selected US-affiliated Pacific Island Jurisdictions, 2017-2019.

Estimated numbers of adults <sup>a</sup>	Pohnpei (2019)	Palau (2017)	Kosrae (2019)	Marshall Islands (2018)	American Samoa (2018)	Total (%)
	N	N	N	N	N	N (%)
Population, adults $\geq 18$ years	20 799	13 299	3 713	28 884	32 054	98 749 (100%)
<b>Hypertension</b>						
Estimated # of adults with hypertension	4 700	4 400	1 000	6 100	12 800	29 000 (29.3%)
Case-finding gap <sup>b</sup>	3 000	1 600	300	3 800	6 700	15 400 (53.7%)
Tracking & outreach gap <sup>c</sup>	400	500	200	900	600	2 600 (9.0%)
Treatment efficacy gap <sup>d</sup>	600	1 400	200	700	2 400	5 300 (18.2%)
Aggregated hypertension protection gap <sup>e</sup>	4 000	3 500	800	5 400	9 700	23 400 (80.8%)
<b>Diabetes</b>						
Estimated # of adults with diabetes	4 700	3 000	1 100	7 700	10 800	27 300 (27.6%)
Case-finding gap <sup>b</sup>	3 300	1 500	600	4 700	5 000	15 100 (55.6%)
Tracking & outreach gap <sup>c</sup>	500	300	100	1 100	900	2 900 (11.1%)
Treatment efficacy gap <sup>d</sup>	700	900	300	1 700	3 200	6 800 (24.9%)
Aggregated diabetes protection gap <sup>e</sup>	4 600	2 800	1 100	7 400	9 100	25 000 (91.6%)

<sup>a</sup> Estimated number of adults in each category is calculated by multiplying the number of adults 18 years and above according to the most recent census, by the proportion of adults in each category according to the most recent NCD Hybrid Survey results for each jurisdiction (rounded to the nearest hundred)

<sup>b</sup> Estimated number of adults with hypertension (or diabetes) who are not aware of their condition

<sup>c</sup> Estimated number of adults with hypertension (or diabetes) who are aware of their condition but not on treatment

<sup>d</sup> Estimated number of adults with hypertension (or diabetes) who are on treatment but not under control

<sup>e</sup> Aggregated hypertension (or diabetes) protection gap = Case finding gap + Tracking & outreach gap + Treatment efficacy gap

components contributed substantially to the protection gap, with the case-finding gap being the largest of the 3 (n = 15 507 for hypertension and n = 15 184 for diabetes), followed by the treatment efficacy gap (n = 5247 for hypertension and 6787 for diabetes), and the tracking and outreach gap (2600 for hypertension and 3020 for diabetes).

## Discussion

The protection gap is very large in the surveyed USAPI jurisdictions with substantial contributions from all 3 protection gap components. Most of the protection gap is generated by the many people with diabetes and/or hypertension who are not in care, either because they have never been diagnosed or because they have fallen out of treatment. There are large disparities between the study's jurisdictions and the US national average. The percentage of people with hypertension in the current study who are aware, under treatment, and in control (46.3%, 37.3% and 19.2%, respectively) are much lower than the US national average (82.6%, 75.0% and 51.8%, respectively).<sup>10,11</sup> The proportion of individuals with diabetes who are diagnosed and under control (44.4% and 8.4%, respectively) is also much lower than US national average (78.5% and 50.0%, respectively; note that the definition of control in the US report is most recent A1C test result < 7.0, and this differs from that used in the present study).<sup>12</sup> Bringing more people who are in treatment for hypertension and diabetes under control in the USAPI would require reaching a large percentage of people under treatment with effective health education, assuring that clinicians are aware of recommended treatment guidelines, overcoming treatment inertia, and, in some jurisdictions, improving the continuity of essential NCD medications and supplies. Although improving the care delivered in clinics is useful, without addressing the problem of the large numbers of patients not in care, the impact at a population level will be very limited. Addressing this gap will require building better systems for systematically identifying people with undiagnosed hypertension and diabetes, for addressing NCD stigma, and for tracking and recalling patients who have dropped out of care. Government sector health agencies provide almost all of the primary care and public health services to the populations of the countries studied, and the populations of these communities are very geographically circumscribed. This is a great advantage for the islands because it presents the opportunity to take a more unified approach to locating and assuring delivery of secondary preventive services for people with conditions such as hypertension and diabetes, than is possible in the fragmented care landscape of the US. The use of the protection gap concept and estimated counts (rather than prevalence percentages) to describe hypertension and diabetes in these communities highlights both the scale and nature of the interventions needed to improve health system performance. To give a hypothetical example, knowing that 28% of adults in a community have diabetes is not as useful for health leaders as knowing that 2200 people have diabetes, because knowing the estimated count allows calculation of number of clinic encounters

that will be needed as well as the number of providers, quantities of medications and supplies, and clinic space needed for their care. Furthermore, it is very useful to know that of these 2200, there are 2010 who are not under control; that 1000 of these don't know they have diabetes (which can be addressed by case finding activities); that there are 500 know they have diabetes but are not engaged in care (which can be addressed by use of tracking registries and outreach); and that there are 510 are in treatment but not in control (which can be addressed by attention to treatment efficacy- clinical guidelines, clinic-based quality improvement and the like). A focus on reducing the number of people in the community in each protection gap component encourages consideration of the needs of non-clinic users in parity with clinic users, encouraging the development of strategies for enhanced case-finding and targeted outreach. Second, once the estimated numbers of patients in each gap component are set forth based on occasional community-based surveys, targets can be set and ongoing monitoring can be done using clinic-based data alone (ie, by setting goals for registry enrollment, clinic attendance and number of cases under control based on jurisdiction-level numbers of people estimated to be in each protection gap component, and estimated numbers in the community with hypertension and diabetes). With very small private medical care sectors and the dominance of government health agencies which deliver both public health and curative services, most jurisdictions in the USAPI are positioned to build systems that integrate case-finding, tracking, and outreach with the clinical care of patients with hypertension and diabetes.

Even if successful at bringing non-diagnosed persons into care, most of the existing NCD clinics have far less capacity than needed to care for the large number who need care. Data such as those presented in **Table 2** can be used to determine optimal staffing for outreach functions and clinics, and for providing medication and supplies budget estimates. Extending treatment to most people with diabetes and hypertension will certainly require increased budgets for medications, supplies, and staffing. Moving care from specialty NCD clinics into general primary care settings and changing the service delivery package and process to favor simpler, less resource intensive styles of NCD care, such as the use of protocols from the World Health Organization's Package of Essential Noncommunicable (PEN) Disease Interventions for Primary Health Care, can limit the extra budget amounts needed to care for many more people and bridge the protection gap.<sup>13</sup>

Limitations of this study include availability of usable survey results from only 5 jurisdictions, limiting the generalizability of findings to all 9 USAPIs. Also, the survey definitions used for diabetes and hypertension categorization and questionnaire data are subject to recall and reporting bias. Study strengths include the use of population data, the standardization of surveys across jurisdictions with rigorous sampling methods, training of enumerators, and quality assurance procedures.

In summary, there is a large protection gap with a corresponding opportunity to greatly decrease the impact of hypertension and diabetes in the USAPI. Taking advantage of this opportunity will require innovations directed toward improving systems for case-finding, tracking and outreach, and intensification of treatment.

### Conflict on Interest

None of the authors identify a conflict of interest.

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