The Current Burden of Tuberculosis and Hansen's Disease

in the U.S. Territory of Guam and efforts to mitigate the problem

Office of Epidemiology and Research
and
Tuberculosis/Hansen's Disease Control Program
Bureau of Communicable Disease Control
Department of Public Health and Social Services
Government of Guam
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Executive Summary

This report summarizes the burden of tuberculosis and Hansen's disease on the island Territory of Guam, along with current programmatic efforts to alleviate the problem. The U.S. Territory of Guam has some of the highest incidence rates of tuberculosis and Hansen's disease compared to the continental U.S. for its small population. Such high rates of tuberculosis on Guam are a result of continued transmission and case finding among (1) local Chamorro, Filipino and Filipino-Chamorro residents of Guam, along with (2) high rates of both tuberculosis and Hansen's disease among migrants to Guam from the U.S. Affiliated Pacific Islands (USAPI), mainly the Federated States of Micronesia, particularly Chuuk State. Current costs for treating tuberculosis infections and multi-drug resistant tuberculosis infections were more than $U.S. $8 million over the past five years. The Guam Tuberculosis and Hansen's Disease Program has implemented numerous strategies and activities to address the tuberculosis and Hansen's disease burden on Guam. Video Directly Observed Therapy (VDOTS via an Emocha App) is being used to observe treatment among tuberculosis patients and their contacts, for residents as well as migrants and immigrants to Guam with tuberculosis. The Territory of Guam is also working closely with the Centers for Disease Control and Prevention and in cooperation with the U.S. Affiliated Pacific Islands jurisdictions to coordinate activities to mitigate the on-going problems of tuberculosis and Hansen's disease in the Western Pacific.

Introduction:

Tuberculosis is a preventable and curable infectious disease caused by bacteria (Mycobacterium tuberculosis) which most often affects the lungs, and is spread through the air when people with lung tuberculosis cough, sneeze or spit.[1] The World Health Organization notes that tuberculosis causes the highest mortality of any infectious disease worldwide (1.5 million deaths per year), and one-half of the yearly 10 million new cases can be found in eight countries: Bangladesh, China, India, Indonesia, Nigeria, Pakistan, the Philippines and South Africa.[2] Tuberculosis is a major contributor to antimicrobial resistance and is the leading cause of death among people with HIV. There are two tuberculosis related conditions: latent TB infection and TB disease,[3] because not everyone infected with tuberculosis becomes ill. Hansen's disease (leprosy) is an infection caused by slow-growing Mycobacterium leprae bacteria. Hansen's disease can affect the nerves, skin, eyes, and lining of the nose (nasal mucosa), yet with early diagnosis and treatment, the disease can be cured. This article summarizes the burden of tuberculosis and Hansen's disease on the island Territory of Guam, along with current programmatic efforts to alleviate the problem.

Methods:

All data were compiled from paper and electronic copies of existing morbidity reports from the Annual Summary of Notifiable Diseases from 1968-2020, Guam Department of Public Health and Social Services (DPHSS), Office of Epidemiology and Research, along with the most recent data from the DPHSS Tuberculosis and Hansen's Disease Programs.[4] These are new cases of tuberculosis and Hansen's disease that are reported to the Centers for Disease Control and Prevention each year through the National Notifiable Diseases Surveillance System (CDC-NNDSS).[5] Morbidity reports were tallied by hand until 1992 when the data were computerized.[6] Guam incidence rates were calculated using the reported U.S. Census population data for all Census years. Population estimates from the Guam State

Data Center, Bureau of Statistics and Plans were used for intercensal years prior to 2010 and the Guam Statistical Yearbook-2018 for the intercensal years 2011-2020.[7,8] If available, comparable U.S. incidence rates for specific infectious diseases were obtained directly from the CDC-MMWR and the searchable MMWR historical CDC stacks.[9] All U.S. data exclude U.S. territories, and comparisons with Hawaii are included.[10]

Results:

The U.S. Territory of Guam has some of the highest incidence rates of tuberculosis and Hansen's disease compared to the continental U.S. for its small population, although Guam is not ranked in official Centers for Disease Control and Prevention (CDC) reports.[11] Guam's current incidence of rate for tuberculosis is 51.3 per 100,000 population, compared to 2.8 per 100,000 population for the U.S. overall in 2017.[11] Guam's current incidence of Hansen's disease is 8.5 per 100,000 population, compared to 0.3 per 100,000 for the continental U.S. overall in 2017.[12] The State of Hawaii also has high rates for both tuberculosis (8.2 per 100,000 population) and Hansen's disease (1.2 per 100,000 population) compared to the continental U.S.[10], but not nearly as high as Guam (Figures 1 and 2). On Guam such high rates of tuberculosis are a result of continued transmission and case finding among (1) local Chamorro, Filipino and Filipino-Chamorro residents of Guam, along with (2) high rates for both tuberculosis and Hansen's disease among migrants to Guam from the U.S. Affiliated Pacific Islands (USAPI), mainly the Federated States of Micronesia, particularly Chuuk State.[13]

Guam Population Characteristics Relevant to Tuberculosis (and Hansen's Disease):

The U.S. Territory of Guam in the Western Pacific had an estimated population of 168,322 in 2020 which was comprised of 37.3% Chamorros, 26.3% Filipinos, 7.1% Chuukese (from the Federated States of Micronesia), 7.1% 'whites', 5.0% other Pacific Islanders (mainly other Micronesians), 5.9% other Asians and 11.3 % other groups.[7,8]

Guam's indigenous Chamorro population, based on single ethnic group designation in U. S. Censuses has remained at approximately 35-40% of the population since 1980. Guam's resident Filipino population comprised 21-22% of the population in 1980 and 1990 and now represents 29-30% of the population. It is important to point out that Guam has had an established significant resident Filipino population, beginning in the 1950s (and up to the present time), when skilled Filipino males were brought to Guam to help the Navy Seabees rebuild the island after World War II.[14] Guam's pre-historical and historical connection to the Philippines are also quite extensive and well-documented, as is the connection between both Spanish and U.S. military colonialism in the Philippines and Guam. This continued connection, propinquity and travel to the Philippines among Guam's resident Filipino and Filipino-Chamorro population is a major contributing factor to Guam's high rates of tuberculosis, treatment of disease and potential for eradication. Guam also experiences continued immigration from the Philippines, as well as South Korea, which can also contribute to additional tuberculosis cases. The incidence of tuberculosis in the Philippines is 554 per 100,000 population (including HIV+ tuberculosis).[15] Tuberculosis is the 6th leading cause of morbidity and mortality in the Philippines, and the Philippines ranks 9th out of the 22 highest tuberculosis -burden countries in the world, and the country also has one of the highest burdens of multi-drug-resistant tuberculosis.[16]

Guam has also experienced increased migration since the mid-1980's from the Federated States of Micronesia (FSM) (mainly from Chuuk State) as well as from other U.S. Affiliated Pacific Islands (USAPI) (e.g. the Republic of Palau), that began after the Compacts of Free Association (COFA) which established that residents of the USAPI could travel freely throughout the U.S. Based on single ethnic group designation, in the 1980 U. S. Census for Guam, the number of Micronesians on Guam was low (1,662 persons) and constituted less than 2% of the population in 1980. This grew to 4.1% of the population in 1990 (4,872),

to 8.3% in 2000 (11,094), 12.7% in 2010 (18,286) and the projection for 2020 is almost 20,000 people (19,485) or 12.7% of the population. In 2012 it was estimated that Guam had 13,588 migrants from the FSM (while Hawaii had 7,948) and it was estimated that Guam's FSM population grew by 350 migrants and 355 births per year,[17] estimating that Guam's FSM population would be 18,698 in 2020, very close to the Guam Statistical Yearbook estimate of 18,628 in 2020.[18] The continued connection, propinquity and travel to and from the USAPI among Guam's Micronesian populations is a major contributing factor to Guam's high rates of tuberculosis, treatment of disease and potential for eradication. The incidence of tuberculosis is 165 per 100,000 population (including HIV+ tuberculosis) in the Federated States of Micronesia in 2017.[19] The ten year average rate from 2002-2011 from available data shows the highest rates among Micronesians (98.6 per 100,000 population), followed by Filipinos (57.0), Chamorros (40.9) and Other Asians (38.6), with all others at 27.8. Micronesians had the highest rates for extra-pulmonary tuberculosis at 7.6 per 100,000 population, with Filipinos at 1.9 per 100,000 population and Chamorros at 1.5 per 100,000 population.

Tuberculosis on Guam (Historical):

According to *The History of Health on Guam* (2010),[20] edited by Guam's retired Territorial Epidemiologist, Dr. Robert Haddock, tuberculosis has been a serious public health problem on Guam in the past and still continues to be. From 1905 to 1970, one-half of the deaths of persons between ages 15 and 50 were due to tuberculosis (Haddock et. al., 2010:134), and as late as 1952, tuberculosis was the greatest single cause of death on Guam, with a mortality rate of 71 per 100,000.

Tuberculosis on Guam (Recent):

The most accurate recent data on tuberculosis on Guam come from the Tuberculosis and Hansen's Disease Control Program at the DPHSS. From 2011-2020 (Table 1), Guam had

a total of 693 new cases of tuberculosis diagnosed: 303 were among Filipinos (43.7%), followed by 194 Chamorros (28.0%) and 166 Other Pacific Islanders (24.9%), the majority of whom were from the Federated States of Micronesia, along with 3.3% Other Asians. There were more males (419 persons or 58.4%) than females (298 persons or 41.6%) among new cases. By age, the 10 year average from 2011-2020 shows the majority of new cases among those aged 45-64 (24.3%), followed by those aged 25-44 years (17.5%), those aged older than 65 (14.2%), those aged 0-14 years (9.9%), and the lowest among those 15 to 24 years (6.0%). In 2020, there was a definite decrease in the numbers of new tuberculosis cases identified, likely due to the response to the SARS-CoV-2/COVID-19 pandemic.

From 2011-2020, the mean age of new tuberculosis cases has decreased, as has the proportion under age 15 years. In addition, the tuberculosis death rate on Guam has also been decreasing (Figure 3), although it is still higher than the U.S. overall.

While Filipinos have the largest number of new cases of tuberculosis, they tend to be more compliant in taking their tuberculosis drugs than Chamorros or Micronesians, who need more follow-up and monitoring, particularly for Multi-drug-resistant-tuberculosis (MDR-TB).

Hansen's Disease on Guam:

Guam's high rate of Hansen's disease is a direct result of migrants to Guam from the Federated States of Micronesia (FSM) (mainly Chuuk State). Persons born in Oceania had the highest rate of Hansen's disease diagnosis during the period 1994-2011, with an average annual rate of 556.9 cases per million population, more than 10 times the rate observed for any other region (in the U.S.).[21] Ninety-seven percent of those diagnosed during the period 1994-2011 from Oceania were born in the Federated States of Micronesia or the Marshall Islands, and almost half of these persons were diagnosed in Hawaii.[21] Many others from the USAPI were diagnosed on Guam, while others have been diagnosed in places in the

continental U.S. where migrants from Micronesia have concentrated, such as Oregon and Arkansas.[21]

On Guam from 2011-2020, there were a total of 134 new cases of Hansen's disease diagnosed (Table 2): 4 were Chamorro (3.0%), 3 were Filipino (2.2%), 1 was Marshallese (0.7%) (Republic of the Marshall Islands-RMI), 1 was Palauan (0.7%) (Republic of Palau-ROP) and 125 (93.3%) were from the Federated States of Micronesia (FSM). Of the 125 cases from FSM, the majority were from Chuuk State in the FSM (69.6%), with another 23.2% from Pohnpei, 5.6% from Yap State and 1.6% from Kosrae State. In total, 93.3% of all new Hansen's disease cases were among non-Chamorro Micronesians. In 2020, there was a decrease in the numbers of new Hansen's cases identified, which could be due to the response to the SARS-CoV-2/COVID-19 pandemic.

On Guam during 2016, the majority of Medicaid claims (U.S. citizens who meet the requirements) were made by Chamorros at 56.5% (who constituted 41.1% of the population in 2016), 13.6% of Filipinos (29% of the population in 2016) and 19% of Chuukese (7.8% of the population in 2016, mainly their children who are U.S. citizens).[14] Among the claims for the Medically Indigent Program (MIP) in 2016, Chuukese constituted 57.4% of the MIP claims, while Chamorros constituted only 15.4% and Filipinos only 8.0%.[14] If all non-U.S. citizen migrants from the USAPI are counted in the MIP program (Chuukese, Pohnpeians, Palauans, Yapese, Kosraeans. Marshallese, along with Chamorros from the CNMI), 72.5% of MIP claims are made from migrants from the USAPI. Clearly the migrants from the Federated States of Micronesia, and particularly Chuuk State, are using both federally and locally funded health care at disproportionately higher rates than their numbers in the population.

It was found that in addition to infectious diseases in the local population, migrants from the U.S. Affiliated Pacific Islands (USAPI), particularly migrants from the Federated

States of Micronesia (FSM), have had a major impact on Guam's public health system both in terms of high costs and disproportionately high rates of (and subsequent treatment for) infectious diseases for several decades. Diseases where Micronesians on Guam have much higher rates of notifiable infectious diseases compared to other ethnic groups on Guam include tuberculosis and Hansen's disease.[19]

As a result of the unique relationship that the USAPI have established with the federal government, after the Compact of Free Association (COFA), which allows residents of the USAPI to travel freely throughout the U.S., Guam has experienced significant financial impacts as well as increased infectious disease burden from FSM migrants. From FY 2004 to FY 2017, the Guam DPHSS has expended a total of $180,304,474 for services to the citizens of the Freely Associated States (FAS) or COFA migrants, of which $3,914,580 was specifically for the Bureau of Communicable Disease Control.[20] For tuberculosis alone, over the past five years, Guam has incurred an estimated $6,950,240 in treatment for tuberculosis cases and $1,442,632 for MDR-TB cases, for a total of $8,372,872 (Table 3).

The Guam Tuberculosis and Hansen's Disease Program has implemented numerous strategies and activities to address the tuberculosis and Hansen's disease burden on Guam. Video Directly Observed Therapy (via the Emocha App) is being used to observe treatment among tuberculosis patients and their contacts, for residents as well as migrants and immigrants to Guam with tuberculosis. The TB program utilizes the CDC Tuberculosis Elimination Management System (STEMS), for LTBI (latent TB infection) and TB case management, contact investigations, LTBI surveillance, identification of barriers to LTBI diagnosis and treatment completion. The TB program also utilizes the Electronic Disease Notification system (EDN) a centralized electronic reporting system that notifies US state and local health departments and screening clinics of the arrival of refugees, migrants and immigrants with health conditions requiring medical follow-up. The Hansen's Disease

program is expanding their efforts for contact tracing with the addition of more staff. The Territory of Guam is also working closely with the Centers for Disease Control and Prevention and in cooperation with the U.S. Affiliated Pacific Islands jurisdictions to coordinate activities to mitigate the on-going problems of tuberculosis and Hansen's disease in the Western Pacific.

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For more information, contact: Ann Pobutsky, PhD-Territorial Epidemiologist, phone: (671) 888-9276 (WARN) **or e**mail: ann.pobutsky@dphss.guam.gov

Figure 1. Guam new tuberculosis cases and incidence rate per 100,000 population, 1968-2020, and rate comparison with Hawaii & the U.S.

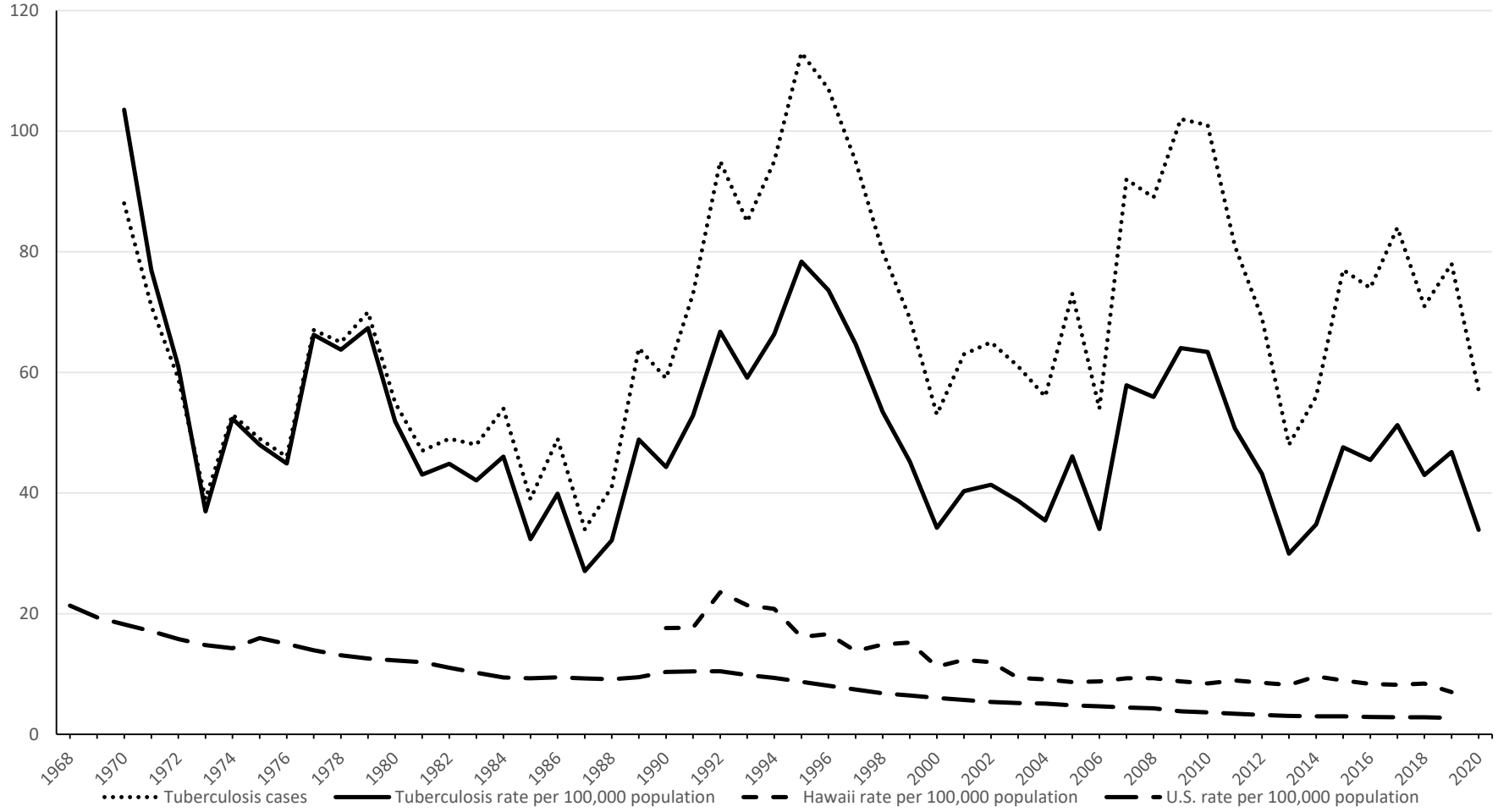

Figure 2. Guam new Hansen's disease cases and incidence rate per 100,000 population, 1968-2020, and rate comparison with Hawaii & the U.S.

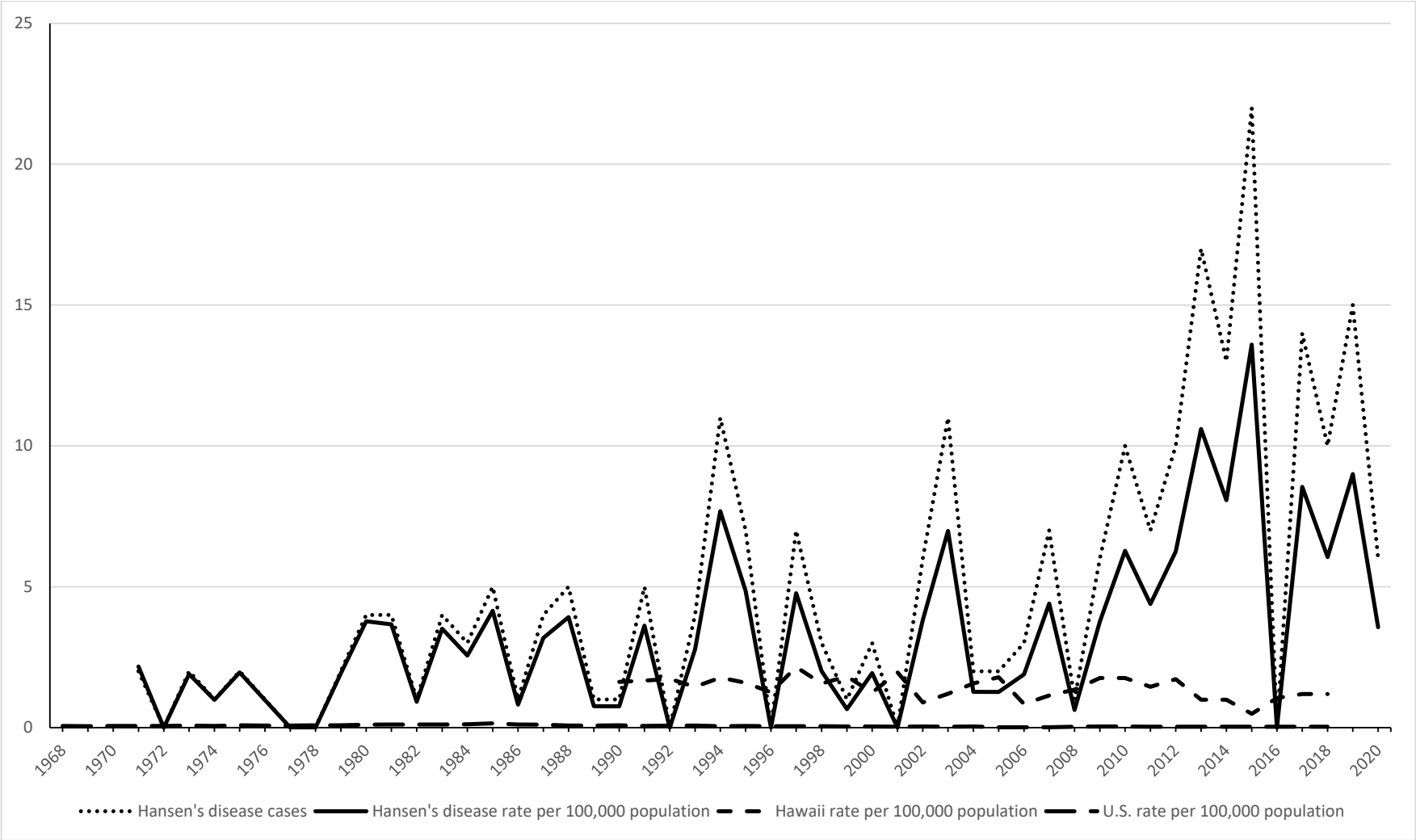

Table 1: Guam new tuberculosis cases and rate per 100,000 population and new cases by sex, age and ethnicity, 2011-2020

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
New cases	81	68	48	56	76	75	84	71	79	57
Guam population estimates	159,600	159,914	160,378	161,001	161,785	162,742	163,875	165,875	166,658	168,322
rate per 100,000 population	50.8	42.5	29.9	34.8	47.0	46.1	51.3	43.0	47.4	33.9
Sex:										
Male	49	39	26	27	39	41	53	43	47	45
Female	32	29	22	29	37	34	31	28	32	12
TOTAL	81	68	48	56	76	75	84	71	79	57
Age:										
0-14	12	15	11	7	16	12	9	10	10	0
15-24	6	6	5	3	10	5	8	7	7	3
25-44	13	10	10	15	15	17	21	17	18	19
45-64	33	23	9	17	21	28	33	25	24	24
65+	17	14	13	14	14	13	13	12	21	11
TOTAL	81	68	48	56	76	75	84	71	79	57
% under age 15 years	14.8%	22.1%	23.0%	12.5%	21.1%	16.0	10.7%	12.7%	10.2%	0%
Ethnicity:										
Chamorro	24	16	14	21	17	23	21	16	27	15
Filipino	36	40	14	25	33	23	40	37	33	22
Other Asian	5	1	2	1	1	3	1	1	5	3
Micronesian*	16	11	17	9	23	26	20	17	14	14
'White'	0	0	1	0	1	0	2	0	0	1
'Black'	0	0	0	0	1	0	0	0	0	0
Other ethnicities	0	0	0	0	0	0	0	0	0	2
TOTAL	81	68	48	56	76	75	84	71	79	57
*non-Chamorro Micronesian										

Table 2: Guam Hansen's disease new cases and rate per 100,000 population and new cases by sex, age and ethnicity, 2011-2020

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
New cases	8	9	17	20	22	15	14	8	15	6
Guam population estimates	159,600	159,914	160,378	161,001	161,785	162,742	163,875	165,875	166,658	168,322
rate per 100,000 population	5.0	5.6	10.6	12.4	13.6	9.2	8.5	4.8	9.0	3.6
Sex:										
Male	8	6	14	16	14	7	10	7	10	6
Female	0	3	3	4	8	8	4	1	5	0
TOTAL	8	9	17	20	22	15	14	8	15	6
Age:										
0-14	0	1	1	3	4	1	0	0	0	0
15-24	2	2	7	7	8	2	2	2	2	2
25-44	5	6	8	8	8	8	11	5	11	2
45-64	1	0	1	2	2	4	1	1	2	2
65+	0	0	0	0	0	0	0	0	0	0
TOTAL	8	9	17	20	22	15	14	8	15	6
Ethnicity:										
Chamorro	0	0	1	0	1	1	0	0	0	1
Filipino	0	0	0	2	1	0	0	0	0	0
Chuukese*	5	6	12	13	12	9	12	4	12	2
Other Micronesian*	3	3	4	5	8	5	2	4	3	3
TOTAL	8	9	17	20	22	15	14	8	15	6
*non-Chamorro Micronesian(s)										

Table 3. Guam multi-drug resistant tuberculosis cases, 2016-2020 and estimated treatment costs

YEAR	# TB cases	#MDR TB cases	Estimated direct costs of treatment per case[24] Non-MDR-TB= $19,360 per case MDR-TB= $177,829 per case
2016	72	3	$1,927407
2017	81	2	$2,477,310
2018	70	1	$1,533,029
2019	79	2	$1,885,098
2020	57	0	$1,103,520
5 year estimated total	359	8	$8,372,872

Figure 3. Guam tuberculosis Crude Death Rate (CDR) per 100,000 population, 1971-2017 and rate comparison with the U.S.