


Pulmonary Tuberculosis in the Navy and Marine Corps

2008 - 2021 Report

October 2, 2024

NAVY AND MARINE CORPS FORCE HEALTH PROTECTION COMMAND
IMPROVING READINESS THROUGH PUBLIC HEALTH ACTION

Contents

Executive Summary

Pulmonary Tuberculosis (TB) incidence in the Department of the Navy (DON), continues to be observed at lower rates than the U.S. civilian and global populations. However, the threat still exists.

This report summarized TB cases among the Navy and Marine Corps population identified in the four year period, 2018-2021, and provides historical trends from 2008 through 2021. In 2018 through 2021, there were a total of 34 confirmed TB cases among DON beneficiaries, particularly among family members. TB cases within Navy and Marine Corps active duty and recruit populations continue to be primarily among foreign-born members, with 66% of active duty cases and 65% of recruit cases born outside of the U.S. across the 14 year timeframe.

The report also curated fourteen years of lessons learned from TB contact investigations requiring reach back subject matter expertise. Contact investigations were complicated by delayed index case diagnosis, the nature of DON's high risk training and operating environments and tracking of case contacts across duty stations. Recommendations include reinforcement of travel medicine clinic visits for members traveling overseas, a review of BUMED INST 6224.8 series' risk assessment tools, and consideration of rapid laboratory diagnostic testing by MTFs.

Background

Tuberculosis trends worldwide and in the United States have seen a resurgence in the past two years (2021-2022) since the decline in diagnosis and reporting numbers observed during the COVID-19 pandemic. This indicates a need for renewed emphasis on TB identification and control, valued efforts seen within our Navy TB Program. Navy and Marine Corps active duty service members are at added risk for TB transmission due to environmental risk factors like close living quarters, closed-loop ventilation systems, and routine overseas on-duty and off-duty travel to countries where TB is endemic. Some high TB burden countries of note include multiple African nations, Korea, Pakistan, Philippines, Thailand, and Vietnam. When cases occur within our population there exists the potential for significant impacts on mission readiness, particularly aboard ships.

BUMEDINST 6224.8C, Tuberculosis Surveillance and Control Program (25 APR 2018) provides policy and procedures for screening, testing, treating, documenting, and tracking DON personnel at risk for TB. Under this instruction, all Navy and Marine Corps accessions are tested for latent TB infection (LTBI) through the tuberculin skin test (TST) or interferon-gamma release assay (IGRA). Those with a history of active TB, a positive TST or IGRA, or previous treatment for LTBI must provide medical documentation of clinical evaluations, hospitalizations, diagnoses, and treatments. LTBI screening is also performed annually via questionnaire for all active and reserve component personnel to assess new exposures. Individuals subsequently identified as having increased risk are then referred for medical evaluation. Additional TB exposure risk screening and targeted LTBI testing may also be performed if directed by a Combatant

Command Surgeon or recommended by the area Navy Environment Preventive Medicine Unit (NEPMU) during a TB contact investigation.

Technical Notes

Pulmonary Tuberculosis cases included in this report met one or both of the following criteria: 1) a medical event report for TB in the Disease Reporting System internet (DRSi) or 2) a positive laboratory result for *Mycobacterium tuberculosis* in the electronic Military Health System (MHS) Composite Health Care System (CHCS) or MHS GENESIS. Navy and Marine Corps beneficiaries treated at military Medical Treatment Facilities (MTF) are included in this analysis. This includes active duty, recruits, retirees, and the family members of these groups. DON reservists were not included in this report.

Collected data includes data source, identifiers for record reviews, gender, date of birth, country of birth, beneficiary status, patient service affiliation, name and code of the assigned installation and treating MTF, service affiliation of the MTF, event dates, hospitalization dates (where applicable), laboratory tests performed, laboratory confirmation dates, and medical and public health record notes. Gaps existed in some of the data for service members, recruits, and other beneficiaries, i.e., the collection of country of birth, admission and discharge dates, and MTF where hospitalized.

Additional details were collected from Defense Manpower Data Center personnel rosters, and all cases were verified and confirmed using provider notes from encounter records within the MHS electronic health record.

Case Inclusion Criteria

Potential DON active pulmonary TB cases were identified from DRSi reports, MTF clinical chemistry/microbiology laboratory results, and MTF hospital admissions. These were then screened and verified with Electronic Health Record (EHR) reviews.

DON case reporting within DRSi is mandated by BUMEDINST 6220.1C, Medical Surveillance and Medical Event Reporting (27 SEP 2011), which requires that a medical event report be submitted to DRSi when a reportable medical event is suspected and or confirmed. Criteria for reporting are laid out in the Armed Forces Reportable Medical Events Guidelines and Case Definitions dated October 2022. Pulmonary TB has been a reportable event for the duration of the period being examined. All reports for tuberculosis in Navy and Marine Corps beneficiaries were reviewed and those with a case status of “confirmed” or those that also had an associated positive laboratory test for TB (regardless of report case status) were put on the “case list” for further EHR review.

Cases identified from the MHS microbiology and chemistry laboratory results data where *M. tuberculosis* was identified from an acid-fast bacteria (AFB) stain, AFB smear, AFB culture, or nucleic acid amplification test (NAAT) from a respiratory source were also added to the “case

list" for further review. Tests resulting from extra-pulmonary specimens were excluded from analysis.

Hospitalized pulmonary TB cases were identified within the MHS inpatient data. Admissions were identified by either the International Classification of Disease (ICD), 9th Revision, Clinical Modification (CM) code, pulmonary tuberculosis code, 011, or tuberculosis of the lung ICD-10 CM code, A15.0, in the first diagnostic position. The cases list was limited to include admissions records of cases with either a status of 'discharged and complete' or that had an 'unknown' discharge status.

The DRSi, MHS laboratory and admissions "case lists" were then combined, deduplicated using the earliest record for each person, and then verified through EHR review using provider notes and radiology reports in AHLTA or MHS GENESIS. The list of verified cases is what was then used for this analysis.

Data Limitations

No cases were identified in MHS GENESIS at the time of the data pull, likely due to data quality issues impacting MHS GENESIS laboratory testing data at that time. The issues have since been resolved, and data are being repulled to reanalyze.

Cases who sought care outside of MHS were not captured in this report unless confirmatory laboratory tests were performed within the MHS, or a medical event report was recorded in DRSi. This limitation should have minimal impact on the analysis of active duty and recruit cases, as they would largely be expected to be followed by Navy Medical department for continuity of care. It is difficult to quantify the impact on the analysis of family members and retirees, who may seek care within the MHS but may also seek care from civilian providers or the Veterans Administration (VA). These practices may have caused an undercount of the true burden within the MHS.

The laboratory results data do not include records from shipboard facilities, battalion aid stations, purchased care, or in-theater facilities. However, cases identified in these settings would be reportable in DRSi and would still be captured if reported.

Results

Fourteen Year Review, 2008-2021

From 2008 to 2021, 131 confirmed cases of TB were identified among DON beneficiaries, which included active duty, recruits, retired service members and their families. Most cases continued to be observed in family members and retirees (n=91, 69.5%), followed by active duty service members (n=23, 17.6%), and recruits (n=17, 13.0%). Overall, the medical treatment facilities with the highest percentage of cases were Naval Medical Center San Diego (n=43, 32.8%),

James A Lovell Federal Health Care Center (n=13, 9.9%), Naval Medical Center Portsmouth (n=11, 8.4%), Naval Hospital Okinawa (n=10, 7.6%), and AMC Tripler-Shafter (n=9, 6.9%).

Recent Trends, 2018-2021

From 2018-2021, 34 pulmonary TB cases were identified among all DON beneficiaries. Distribution by beneficiary category largely remained consistent over time while trends in diagnosing MTF shifted over the past four years with 24% of cases diagnosed by NMC San Diego, 15% by NH Okinawa, and 12% by James A Lovell FHCC.

Top DON Pulmonary TB Trends (n=131), 2008-2021

Top Beneficiary Categories:

- Family members (70%)
- Active Duty (18%)
- Recruits (13%)

Top Reporting MTFs:

- NMC San Diego (33%)
- James A Lovel FHCC (10%)
- NMC Portsmouth and NH Okinawa (15% each)

Table 1. Demographics of Navy and Marine Corps Pulmonary Tuberculosis, All DON Beneficiaries (n=131), 2008-2021

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Grand Total
Service															
Marine Corps	1	3	2	3	0	1	2	3	1	1	3	3	3	3	**29**
Navy	9	11	10	9	9	11	6	6	7	2	5	8	4	5	**102**
Age Group															
<16	0	0	1	1	0	0	0	0	0	0	0	0	0	1	**3**
17-25	1	3	1	2	2	1	3	3	3	0	5	3	1	1	**29**
26-35	2	4	1	4	3	4	2	2	2	0	1	2	2	3	**32**
36-45	1	2	1	0	1	3	1	1	1	2	1	2	1	2	**19**
46-55	4	3	3	2	2	1	1	0	0	0	0	2	1	0	**19**
56+	2	2	5	3	1	3	1	3	2	1	1	2	2	1	**29**
Beneficiary Status															
Active Duty	4	3	1	1	1	4	0	2	1	0	2	1	2	1	**23**
Marine Corps	1	0	0	0	0	1	0	2	0	0	1	0	1	1	7
Navy	3	3	1	1	1	3	0	0	1	0	1	1	1	0	16
Recruit	0	1	0	2	1	1	4	2	1	0	1	3	0	1	**17**
Marine Corps	0	1	0	1	0	0	1	1	0	0	0	2	0	0	6
Navy	0	0	0	1	1	1	3	1	1	0	1	1	0	1	11
All Others	6	10	11	9	7	7	4	5	6	3	5	7	5	6	**91**
Marine Corps	0	2	2	2	0	0	1	0	1	1	2	1	2	2	16
Navy	6	8	9	7	7	7	3	5	5	2	3	6	3	4	75
Grand Total	**10**	**14**	**12**	**12**	**9**	**12**	**8**	**9**	**8**	**3**	**8**	**11**	**7**	**8**	**131**

Figure 1. Pulmonary Tuberculosis Case Distributions by Service, All DON Beneficiaries (n=131), 2008-2021

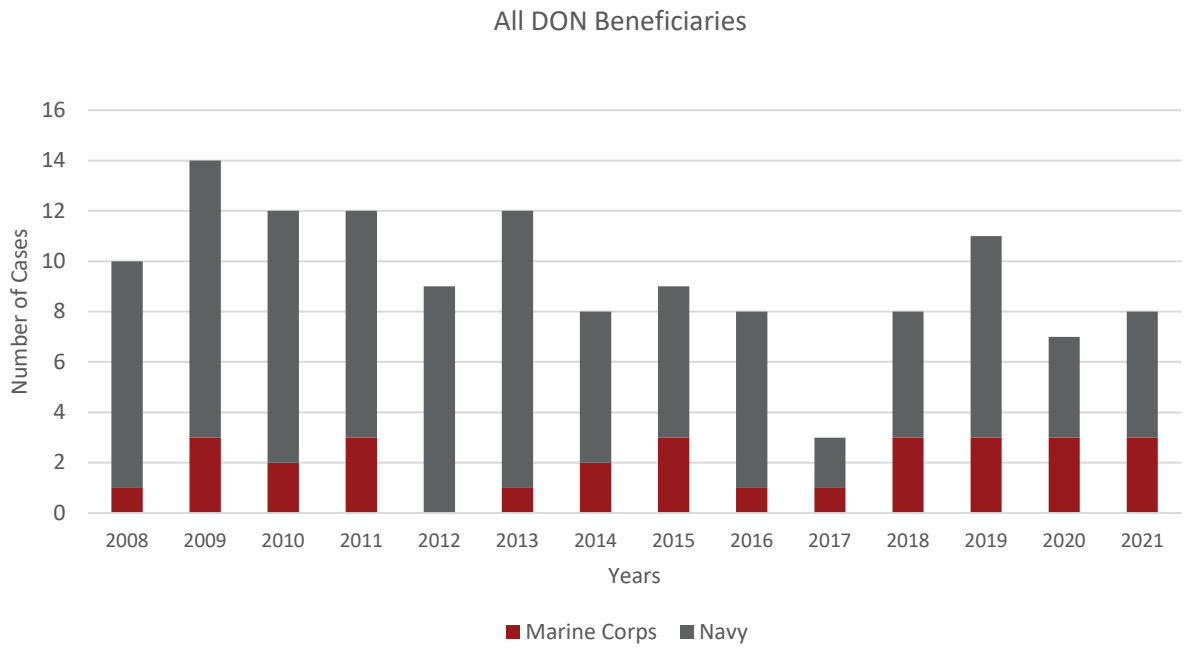


Figure 2. Pulmonary Tuberculosis Case Distributions by Beneficiary Status, All DON Beneficiaries (n=131), 2008-2021

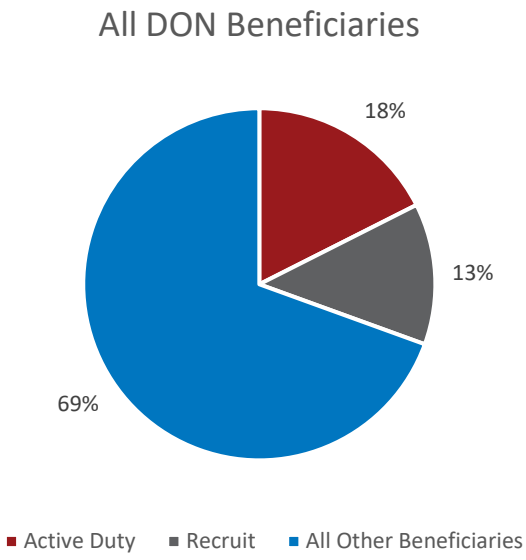


Figure 3. Pulmonary Tuberculosis Case Distributions by Beneficiary Status, Marine Corps Beneficiaries (n=29), 2008-2021

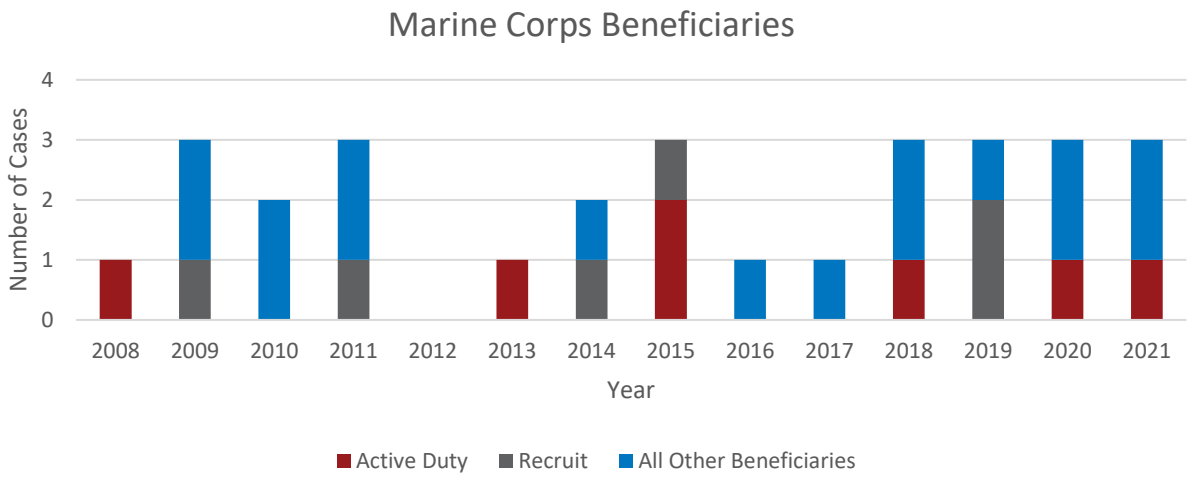


Figure 4. Pulmonary Tuberculosis Case Distributions by Beneficiary Status, Navy Beneficiaries (n=102), 2008-2021

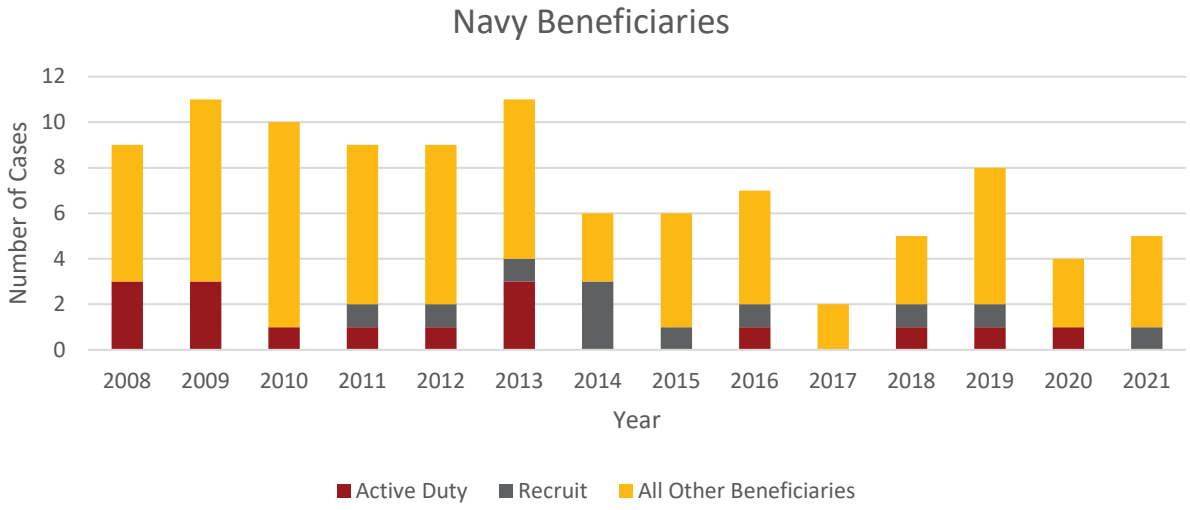


Figure 5. Pulmonary Tuberculosis Cases by Beneficiary Status and Age Group (in Years), All DON Beneficiaries (n=131), 2008-2021

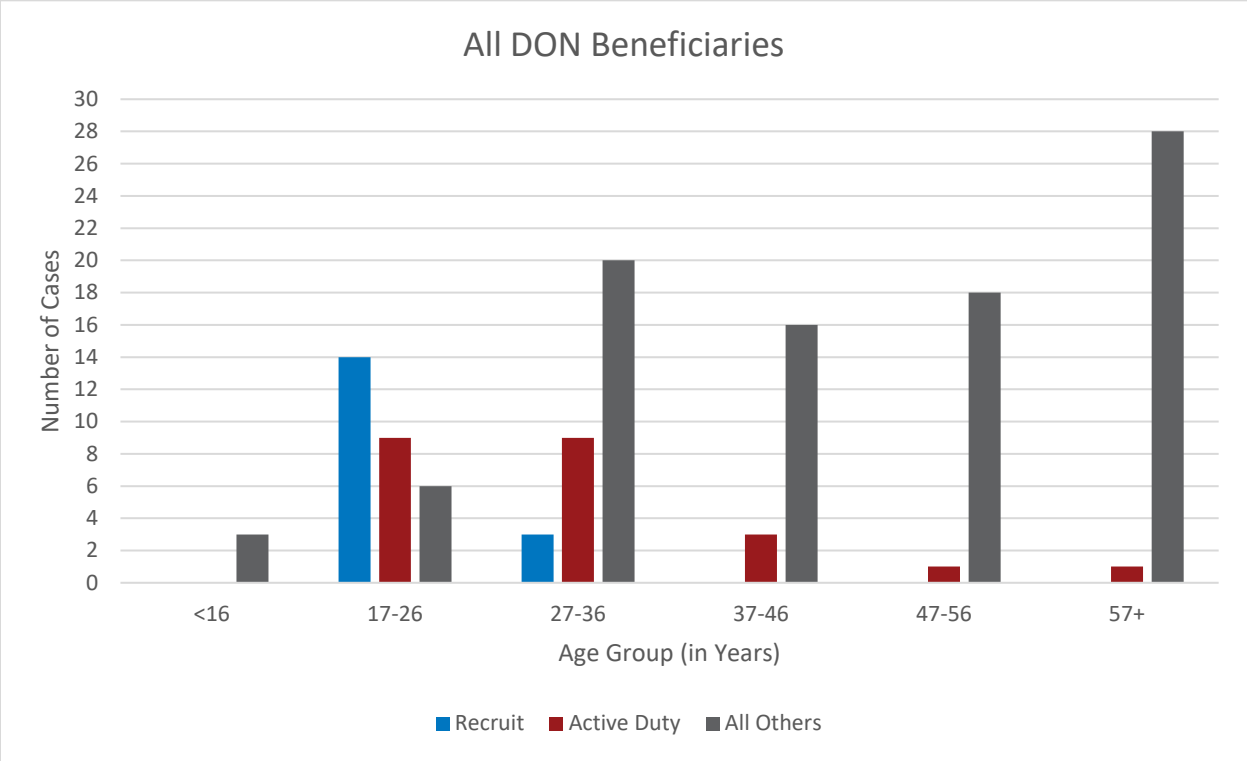
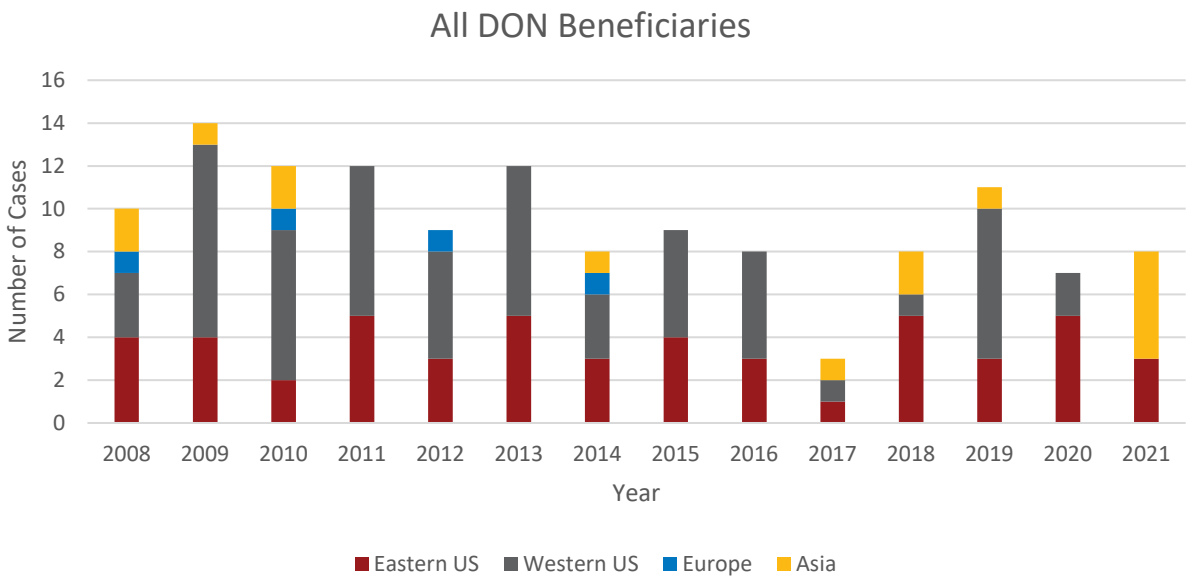


Table 2. Pulmonary Tuberculosis Cases by Diagnosing MTF and Geographic Location, All DON Beneficiaries (n=131), 2008-2021

Geographic Location	Reporting MTF	Active Duty	Recruits	All Others	Total Active Duty and Recruits (Percent)	Grand Total (Percent)
Western US		12	4	46	**16 (40%)**	**62 (47%)**
	NMC SAN DIEGO	7	4	32	11 (28%)	43 (33%)
	AMC TRIPLER-SHAFTER	2	0	7	2 (5%)	9 (7%)
	NH BREMERTON	1	0	1	1 (3%)	2 (2%)
	NH CAMP PENDLETON	1	0	1	1 (3%)	2 (2%)
	99TH MEDGRP-NELLIS	0	0	2	0 (--)	2 (2%)
	NH LEMOORE	0	0	1	0 (--)	1 (1%)
	USS PELELIU (LHA5)	1	0	0	1 (3%)	1 (1%)
	60TH MED GRP-TRAVIS	0	0	1	0 (--)	1 (1%)
	61ST MED SQ-LOS ANGELES	0	0	1	0 (--)	1 (1%)
Eastern US		8	13	29	**21 53%**	**50 (38%)**
	JAMES A LOVELL FHCC	2	11	0	13 (33%)	13 (10%)
	NMC PORTSMOUTH	2	0	9	2 (5%)	11 (8%)
	NH JACKSONVILLE	1	0	5	1 (3%)	6 (5%)
	WALTER REED NMMC	1	0	4	1 (3%)	5 (4%)
	NH PENSACOLA	0	0	3	0 (--)	3 (2%)
	NMC CAMP LEJEUNE	1	0	2	1 (3%)	3 (2%)
	AMC BAMC-FSH	0	0	2	0 (--)	2 (2%)
	NH BEAUFORT	0	2	0	2 (5%)	2 (2%)
	42ND MEDGRP-MAXWELL	0	0	1	0 (--)	1 (1%)
	NH CHERRY POINT	0	0	1	0 (--)	1 (1%)
	NH CORPUS CHRISTI	1	0	0	1 (3%)	1 (1%)
	NH PATUXENT RIVER	0	0	1	0 (--)	1 (1%)
	WILLIAM BEAUMONT AMC - FT. BLISS	0	0	1	0 (--)	1 (1%)
Asia		2	0	13	**2 (5%)**	**15 (11%)**
	NH OKINAWA	1	0	9	1 (3%)	10 (8%)
	NH YOKOSUKA	1	0	2	1 (3%)	3 (2%)
	NH GUAM-AGANA	0	0	2	0 (--)	2 (2%)
Europe		1	0	3	**1 (3%)**	**4 (3%)**
	NH NAPLES	0	0	2	0 (--)	2 (2%)
	86TH MEDGRP-RAMSTEIN	0	0	1	0 (--)	1 (1%)
	LANDSTUHL REGIONAL MEDCEN	1	0	0	1 (3%)	1 (1%)

Figure 6. Pulmonary Tuberculosis Cases by Geographic Location of Diagnosis, All DON Beneficiaries (n=131), 2008-2021



Trends in Recruits

Notably, the 17 pulmonary TB cases identified in recruits from 2008-2021 represented just a small portion of the overall number of cases, approximately 13%. However, these are cases that can result in large scale and multi-location contact investigations as seen in two contact investigations documented in Table 3. The nature of recruit training fosters continuous exposure to susceptible individuals potentially leading to large numbers of close contacts when a TB case is suspected and not identified early.

Top Pulmonary TB Trends in DON Recruits (n=17), 2008-2021

Top Reporting Military Treatment Facilities:

- NTC Great Lakes (65%)
- MCRD San Diego (24%)
- MCRD Parris Island (12%)

Top Regions of Birth:

- Asia (35%)
- United States (23%)
- Africa (18%)

Six of these 17 cases were accessions to the Marine Corps and 11 were accessions to the Navy. The largest percent of cases were identified in 17-26 year olds (n=14, 82%), at NTC Great Lakes (n=11, 65%), followed by MCRD San Diego (n=4, 24%), and MCRD Parris Island (n=2, 12%). Of the 15 cases with known country of birth, 73% were foreign-born (six from Asia, three from Africa, and one each from Mexico and South America).

Figure 7. Pulmonary Tuberculosis Cases by Region of Birth, DON Recruits (n=17), 2008-2021

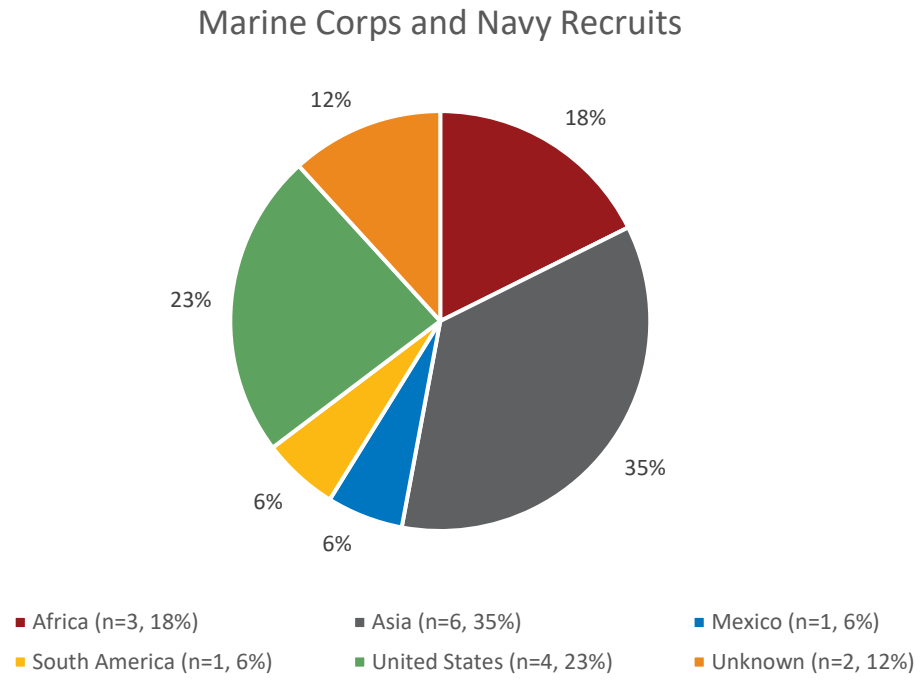
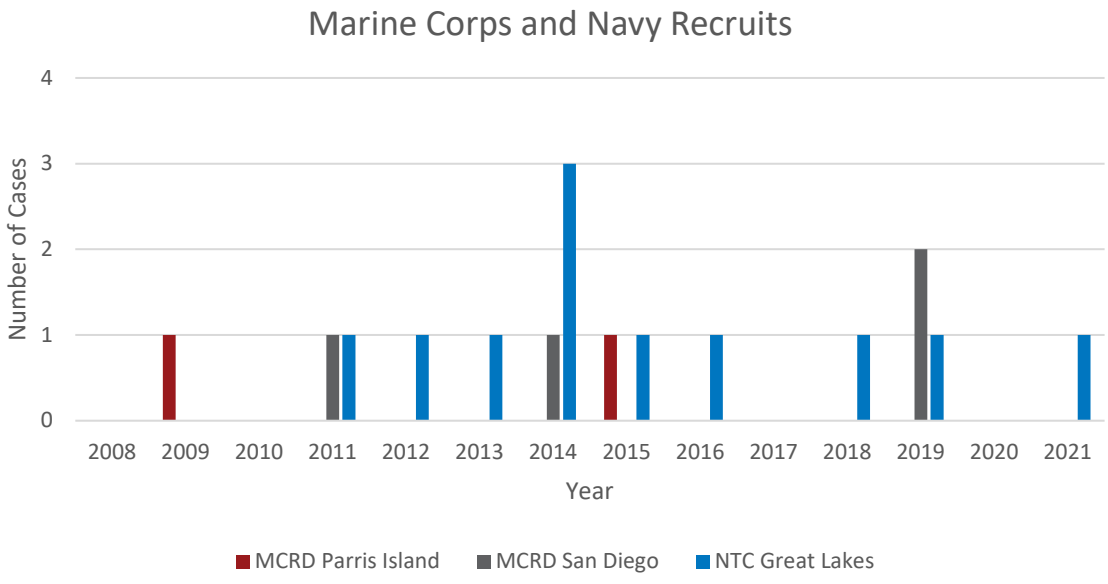


Figure 8. Pulmonary Tuberculosis Cases by Region of Birth and Training Center, DON Recruits (n=17), 2008-2021



Trends in Active Duty Service Members

There were 23 confirmed cases of TB among DON active duty from 2008-2021; 16 (70%) were Sailors and 7 (30%) were Marines. Incidence of Marine Corps active duty cases increased after 2014 while that of the Navy active duty cases decreased. Annual rates in both services were below one per 100,000 service members for the timeframe, except for 2015 when the rate for Marines slightly exceeded one per 100,000. In the period 2018 through 2021, the rates of Sailors lingered around 0.3 per 100,000, while Marines were just under 0.6 per 100,000, except in 2019 when there were no Marine TB cases.

DON rates continued to be well below the U.S. civilian rates of incidence reported by the U.S. Centers for Disease Protection and Control (CDC) for the entire period. The U.S. experienced a gradual descent in TB case rates over time plateauing in recent years. Navy and Marine Corps case rates constantly remained low.

Top Pulmonary TB Trends in DON Active Duty (n=23), 2008-2021

Service Distribution:
- Navy (70%)
- Marine Corps (30%); most cases occurred since 2015.

Top Reporting MTF for Active Duty:
- NMC San Diego (33%)
- NMC Portsmouth, James A. Lovell FHCC, and AMC Tripler Shafter (8% each)

Top Reporting Exposure Environment for Active Duty:
- CONUS Shore (61%)
- Ship (30%)
- OCONUS Shore (9%)

Country of Birth Categories for Active Duty:
- Foreign-born (68%)
- United States (32%)

Most active duty cases were observed in the 17-26 and the 27-36 year age groups, nine each (see Figure 5 above). Country of birth was available for 22 cases (96%); of these, 15 (68%) were foreign-born and 7 (32%) were born in the U.S. Unlike with recruits, active duty country of birth trends have shifted in recent years with 30% of all cases noting Philippines as their country of birth compared to 71% in the previous 2018 analysis. It is unclear whether this represented more distributed operations in recent years (and thus more opportunities for exposure in other countries) or more diversity of active duty members (with exposure resulting from visiting friends and relatives). The remaining foreign-born cases were born in Haiti, India, Kyrgyzstan, Mexico, Nepal, Peru, Senegal, and Trinidad and Tobago (one each).

Overall, 7 cases (30%) were known to have previously positive TST results (indicative of LTBI) and 6 of these completed treatment at the time of the positive TST. It is unknown if these cases were LTBI treatment failures or secondary exposures after LTBI treatment.

Most cases (n=16) reported symptoms, presenting with one or more of the following: fever/chills, rigors, night sweats, fatigue, weight change, cough, congestion, production of phlegm and or blood, headache, chest pain, and swollen lymph nodes. Twelve cases had positive AFB smears and 11 had negative or unknown smear results. One case had evidence of drug resistant TB (resistance to INH). Additional active duty case information is further summarized in the case series in Appendix A.

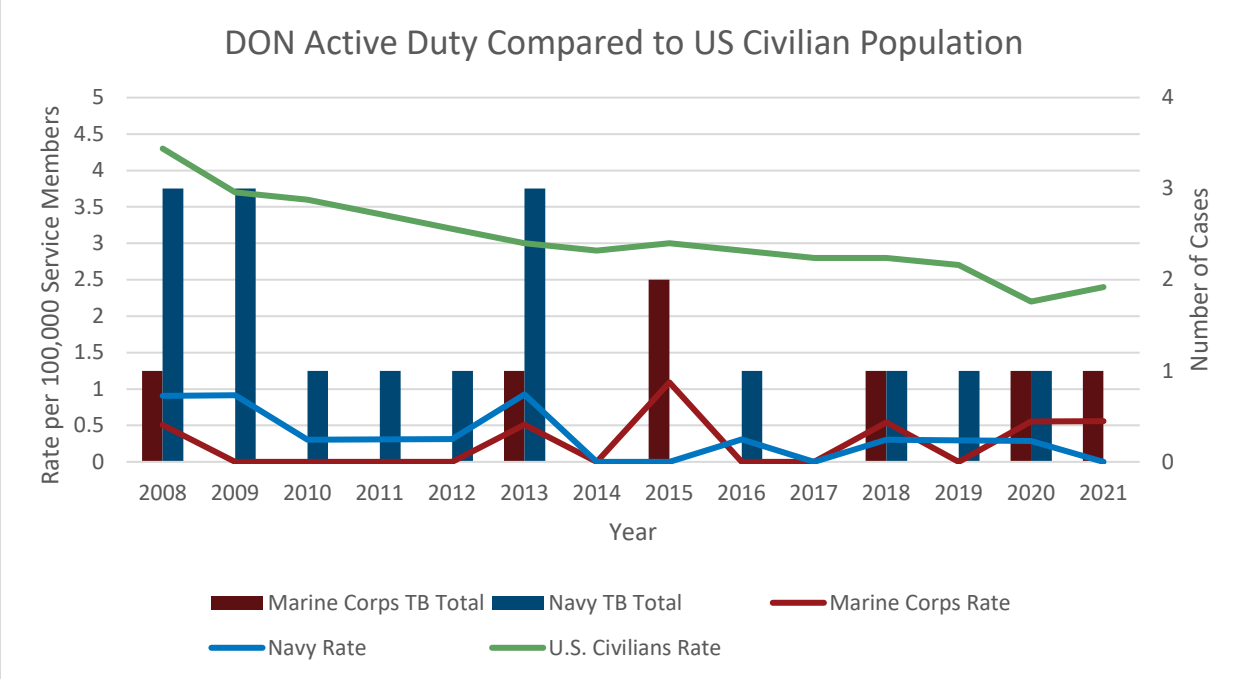
Top Pulmonary TB Trends in DON Active Duty (n=23), 2008-2021 (Cont.)

Top Symptoms Reported by Active Duty Symptomatic Patients (n=16):

- Fever/Chills
- Rigors
- Night Sweats
- Fatigue
- Weight change
- Cough

Most active duty cases (n=14, 61%) were assigned to shore duty stations within the continental United States (CONUS), 7 (30%) were assigned to ships, and 2 (9%) cases were assigned to overseas duty stations outside the continental United States (OCONUS). Six of the seven active duty TB shipboard cases occurred between 2008-2013. Most active duty cases were diagnosed and treated at NMC SAN Diego (n=43, 33%). NMC Portsmouth, James A. Lovell FHCC, and AMC Tripler Shafter reported 2 cases (8%) each.

Figure 9. Pulmonary Tuberculosis Rates and Cases by Service, DON Active Duty (n=23), 2008-2021



Source: U.S. Incidence Rate, CDC, https://www.cdc.gov/tb/statistics/reports/2022/table1.htm

Figure 10. Pulmonary Tuberculosis Cases by Region of Birth, DON Active Duty (n=23), 2008-2021

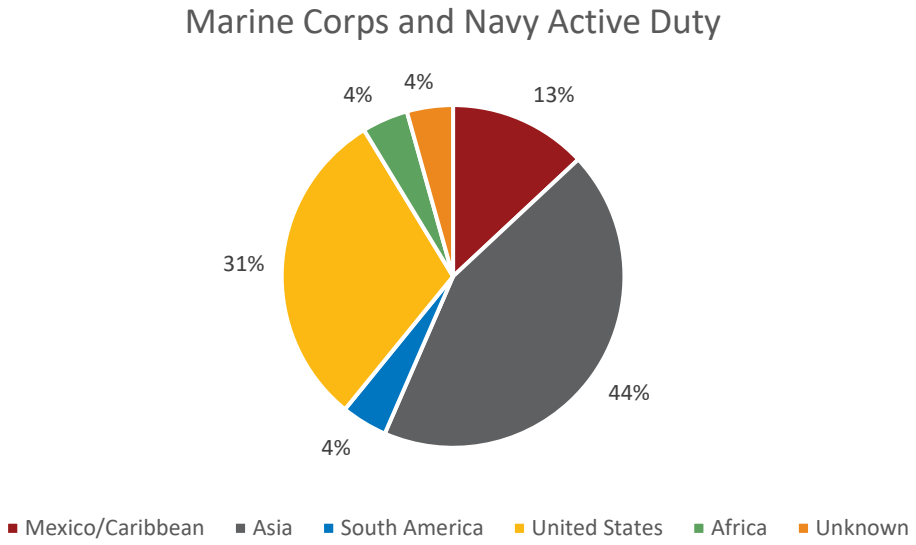
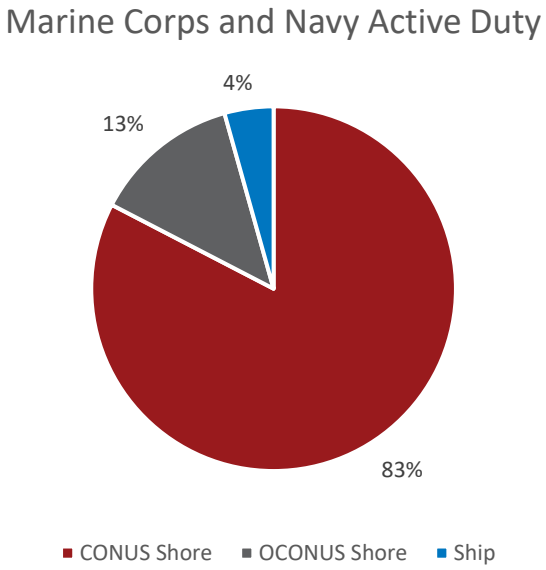


Figure 11. Pulmonary Tuberculosis Cases by Permanent Duty Station, DON Active Duty (n=23), 2008-2021



Tuberculosis Contact Investigations

Fourteen Year Review, 2008-2021

Thirteen after action reports (AARs) document Navy Medicine TB investigations conducted by the NEPMUs, particularly in high risk exposure environments. These represented contact investigations that occurred between 2008 and 2019. These reports address the cases observed and managed within military medicine domain and do not include case numbers or details about any related non-military investigation that may fall within the applicable civilian public health jurisdiction(s). For these 13 investigations, 12 active pulmonary TB cases (index cases) resulted in 2,467 close contacts tested, 74 (3%) of whom were diagnosed with LTBI and 2 of whom were diagnosed with active TB. Considering that this is an uncommon disease, the number of resources invested to curtail the disease can range dramatically based on the combination of the exposure setting and number of individuals exposed. The number of close contacts for each investigation ranged from 10 – 572; half of the documented investigations involved over 150 close contacts.

Three index cases were asymptomatic. Two suspected index cases that resulted in alternate diagnoses appeared to have mild symptoms. Chronic cough was reported by all remaining index cases. Most remaining cases also reported either pleuritic chest pain or back pain. Other symptoms included sore throat, fever, nausea, fatigue, malaise, nasal congestion, unintentional weight loss, night sweats, shortness of breath, weakness, and hemoptysis.

Over the past fourteen years, on average once a year an investigation occurred requiring reach back TB subject matter expertise and resources. Most of these document exposures occurring in high risk settings to include 5 ships, 2 training centers, and two youth programs (schools/Child Development Centers). Several factors appeared to contribute to high close contact numbers. Delayed clinical diagnosis of the index case and Commander's risk tolerance were two factors. Both the shipboard and recruit training environments naturally also led to high numbers of potentially exposed individuals. Four investigations involved active duty index cases, 2 involved recruit index cases, 3 involved contractor index cases, and 4 involved index cases of other beneficiary types. After testing high priority close contacts, only three investigation reports described expand testing to medium priority contacts. More detailed information on each investigation is available in Table 3.

Lesson Learned and Recommendations

Successful pulmonary TB contact investigations over the past fourteen years were attributed to active collaboration, command support, and early and consistent communication between the local MTF, patient's command, local public health authorities, NEPMUs, and all applicable stakeholders. Challenges encountered during TB contact investigations were centered on seven themes: (1) delayed diagnosis due to lack of provider awareness of the signs and symptoms of TB, (2) release of patients back to work or training prior to TB confirmatory labs OR prior to initiating treatment, (3) nature of the case's work or training program, (4) the highly mobile

population, (5) the need for efficient and effective systems of documentation for immunizations and TST results especially at training commands, (6) the differences between TB management for active duty versus contractors, and (7) familiarity with the current BUMED instruction and CDC Guidelines.

Three reports document delayed TB diagnosis resulting in prolonged exposure periods and close contacts to investigate. Additionally, two AARs noted release of individuals back to work or training just prior to the receipt of their confirmatory laboratory results. Primary provider education to remain vigilant for relevant TB signs and symptoms is important. Even more critical may be the adoption of more rapid laboratory testing modalities (e.g. *M. tuberculosis* NAAT) by MTFs. Culture results may take up to 6-8 weeks, during which time a mildly symptomatic patients may be suspected of LTBI and released for duty/training. PCR testing results may be returned within hours, days if lab specimens must be mailed out. Two of the 12 active TB index cases (17%) had negative AFB smears, further complicating clinical work-up. BUMED coordination with Defense Health Agency (DHA) to consider guidelines for the use of rapid diagnostic testing may be beneficial in reducing the investigative footprint at recruit training and shipboard settings.

At least four reports expressed challenges with communication. Highlighted areas, included tracking close contacts, risk communication, and messaging consistency and accuracy. Difficulty in contacting close contacts, particularly in recruit and active duty populations, were attributed to the high mobility of the population where individuals have either moved to gaining commands, have been sent on temporary assignments, are no longer associated with the military or are on personal travel. Additionally, sometimes risk communication challenges resulted in conflicting or incorrect messages going out to the contacts and or adjacent communities.

Several AARs that indicated a need for a more regimented manner of tracking recruit training center TB/LTBI history and TST results. At times, significant barriers exist in the recording of positive LTBI or TB results into a recruit's respective Electronic Health Record sometimes leading to long delays in documentation. Recruit documentation was noted as a matter of importance not just for the original recruit training center, but also for the edification of the gaining commands and within those respective MTFs. Additionally, identification of TB cases among service members diagnosed by civilian providers relies on member notification to their primary care manager (PCM) or civilian health department notification to the military MTF. A strong communication network between the MTF and civilian counterparts is important in ensuring timely investigation. Finally, lack of LTBI testing, tracking, and accountability for contract and foreign national workers continues to complicate investigations.

Many reports endorsed, ensuring that medical facilities and preventive medicine department staff are familiar with current BUMEDINST, CDC Guidelines, and SOPs pertaining to LTBI and TB contact investigations. Two AARs requested the update of the TB Exposure Risk Assessment. Specifically, to better capture travel of high-risk, to ensure that vigilant screening is performed for active duty during the annual periodic health assessments (PHAs). Finally, it was

recommended to have Commands underscore the need for active duty service members to visit the travel medicine clinic prior to high-risk travel for appropriate counseling to minimize exposure.

Table 3. Pulmonary Tuberculosis Contact Investigation Summary (n=13), All DON Beneficiaries, 2008-2021

After Action Report		Index Case Information					Index Case Clinical Work Up							Contact Investigtion					
AAR Year	Exposure Environment	Case Status	Duty Status	Country of Birth	BCG History	Prior Converter	Symptomatic	TST	IGRA	Imaging	PCR	AFB Smear	Culture	Number of Prior Converters/Prior LTBI Dx	Number Tested	Percent Positive	+ TST/New LTBI	New Active Case	Comments
2008	Ship	1 active TB case	AD	Philippines	Yes	No	No	Pos. (14mm)		Pos. CXR	Neg.	Neg.	Pos.	4	68	0%	--	--	Patient medically evacuated from ship circuitously via 3 ships and 2 medical facilities. Contact investigation involved civilian air travel. Initially dx and treated with LTBI and returned to ship while awaiting culture results.
2010	CONUS shore command	1 active TB case	Dep	Liberia	Yes	No	Yes	Pos. (10mm)	Pos.	Pos. CXR	Pos.	Pos. (4+)		2	23	13%	2	1	Household transmission among family members
2011	OCONUS CDC	1 active TB case	Civ/Dep	Philippines	--	Yes, treated for LTBI	Yes					Pos.	Pos.	--	357	1%	2	0	Delayed diagnosis approx 18 months after multiple medical encounters
2012	Ships (3)	2 active TB cases	A:Cont B:Cont	A:Mexico B:Mexico	--	--	A: Yes B: Yes			A: Pos. CXR & CT B:Pos. CXR		A:Pos. (4+) B:Pos. (4+)		26	321	1%	4	0	Both index cases unrelated
2013	OCONUS school	1 suspect TB case, LTBI diagnosed	Dep	Ethiopia	Yes	--	Yes		Pos.	Pos. CXR		Neg.	Neg.	--	20	0%	--	--	
2013	Ship	1 active TB cases	AD	Trinidad	--	--	Yes	Neg.		Pos. CT		Pos. (4/5)	Pos.	19	266	9%	26	1	Secondary case was close friends with index case
2016	Ship	1 active TB case	AD	Haiti	No	No	Yes			Pos. CXR & CT	Pos.	Pos. (2+)		--	10	0%	--	--	11mm TST upon inprocessing one year prior was read as negative due to lack of reliable exposure history.
2016	OCONUS shore command	1 suspect TB case, TB ruled out	Cont	United States	--	No	Yes			Pos. CXR, Neg. CT		Neg.		4	13	8%	1	0	
2017	CONUS shore Command	1 active TB case	Cont	--	--	Yes, not treated for LTBI	Yes			Pos. CXR		Pos.		4	572	1%	6	0	Exposure period ~18 months
2018	Training Center	1 active TB case	Recruit	Philippines	No	--	No	Pos. (16mm)	Pos.	Pos. CXR & CT	Neg.	Neg.	Pos.	3	508	3%	13	0	Delayed diagnosis resulting in exposure to four recruit classes and coordination with 89 gaining commands.
2019	OCONUS shore command	1 active TB case	Cont	Philippines	--	--	Yes			Pos. CXR & CT	Pos.	Pos.		2	38	42%	16	0	Prior work-up for active TB though lost to f/u
2019	Ship; CONUS shore command	1 active TB case	AD	Senegal	Yes	Yes, Treated for LTBI	Yes			Pos. CXR & CT	Pos.	Pos.			97	1%	1	0	Posisble re-exposure to TB after successful LTBI treatment. Delayed diagnosis approx 13 months after multiple medical encounters
2019	Training Center	1 active TB case	Recruit	Mexico	--	--	No	Pos. (26mm)		Pos. CXR & CT	Pos.	Pos.		--	174	2%	3	0	

Conclusion

The DON TB program continues to exhibit positive strides in the global efforts to minimize TB cases and subsequent exposures within the DON population. Case numbers saw overall declines across service and beneficiary categories since 2014. Additionally, the implementation of the strict DON TB program has long created a gap in TB rates between the DON population and U.S. civilian population.

Navy Medicine's TB investigation response has been comprehensive and successful. While there are areas of improvement noted to include local level medical and public health efforts, like administrative TST result capture and improvements for case identification, BUMED policies and guidance appear to have few gaps. The risk assessment forms of BUMED INST 6224.8 series may need to be reviewed in light of the shift in country of birth trends among active duty members. Additionally, guidelines for access to PCR testing for *M. tuberculosis* should be considered particularly in forward environments supporting Fleet concentration areas.

Continued diligence with TB surveillance, policy design, and implementation of the DON TB control program are paramount to the goal of reducing the TB threat for the DON population and DON global ship and shore operations, even while active duty operate or travel to countries with high TB incidence.

Appendix A: Active Duty Tuberculosis Case Series

Table 4. Pulmonary Tuberculosis Case Series, Active Duty (n=27), 2005-2021

Year	Service	Country of Birth	Duty Station	AFB Smear Results	Presentation	Reported in DRSi	Notes
2005	Navy	U.S.	OCONUS	Positive; 3+	Symptomatic: cough, fever, dyspnea. Chest x-ray with infectious process.	Yes	INH resistant TB. Prior converter in 2004; completed 9 months INH.
2006	Navy	Unknown	CONUS	Positive	Symptomatic: cough, x5 weeks, weight loss, headache.	No	Unknown TB history.
2006	Navy	Philippines	CONUS	Positive; 4+	Symptomatic: cough x1 month. Suspicious chest x-ray.	Yes	Originally diagnosed with pneumonia. Prior converter in 1995; completed 6 months INH.
2006	Navy	Korea	OCONUS	Positive	Symptomatic: cough, fever, chills, night sweats. Granulomas noted on chest x-ray.	Yes	Prior converter as teenager; no notes on treatment. History of BCG vaccination. Household contact with active TB as a child.
2008	Navy	Philippines	CONUS	None	Symptomatic: cough. Abnormal chest x-ray.	No	Originally diagnosed with and treated for pneumonia. Prior converter at accession in 1987; completed 12 months INH.

Year	Service	Country of Birth	Duty Station	AFB Smear Results	Presentation	Reported in DRSi	Notes
							History of BCG vaccination.
2008	Navy	Philippines	CONUS	Negative	Asymptomatic. CT given for other medical issue was concerning for TB.	Yes	Prior converter at accession in 1990; completed 6 months INH.
2008	Marine Corps	U.S.	CONUS	Negative	Asymptomatic. Positive PPD at screening. Suspicious chest x-ray.	No	Prior converter in 2005; no notes on treatment.
2008	Navy	Philippines	Ship	Negative	Asymptomatic. Positive PPD and Suspicious chest x-ray during deployment screening.	No	Prior converter at accession; no notes on treatment. History of BCG vaccination.
2009	Navy	U.S.	CONUS	Negative	Symptomatic: cough x5 months. Persistent infiltrate on chest x-ray x3 months.	Yes	No prior TB history.
2009	Navy	Philippines	Ship	Negative	Symptomatic: symptoms consistent with pneumonia.	Yes	Originally admitted for H1N1 pneumonia. Unknown TB history.
2009	Navy	Philippines	Ship	Negative	Asymptomatic. Suspicious chest x-ray at follow-up for previous	Yes	Diagnosed with LTBI at accession in 2007; completed 6 months INH.

Year	Service	Country of Birth	Duty Station	AFB Smear Results	Presentation	Reported in DRSi	Notes
					abnormal chest x-ray.		History of BCG vaccination.
2010	Navy	Peru	Ship	Positive	Symptomatic: fever, chills, headache, cough, sinus congestion. Suspicious chest x-ray.	Yes	Prior converter in 2001; completed 6 months INH.
2011	Navy	Nepal	Ship	Negative	Symptomatic: cough, hemoptysis, fever, chills.	No	Prior converter in 2005; completed 9 months INH.
2012	Navy	Philippines	CONUS	Negative	Asymptomatic . Positive PPD and suspicious chest x-ray during TB screening.	Yes	Prior converter in 2009; no notes on treatment.
2013	Navy	Mexico	CONUS	Positive; 4+	Symptomatic: cough x5 months, hemoptysis. Concerning chest x-ray and CT.	Yes	Originally diagnosed with and treated for pneumonia. Prior converter at age 16; treated for /6 months (treatment not specified).
2013	Navy	U.S.	CONUS	Negative	Symptomatic: fevers, night sweats. Positive QFT. Lesion on CT.	Yes	Originally diagnosed with and treated for pneumonia. Unknown TB history.
2013	Navy	Trinidad & Tobago	Ship	Positive	Symptomatic: Cough, chest pain, chills,	Yes	No prior TB history. Last PPD

Year	Service	Country of Birth	Duty Station	AFB Smear Results	Presentation	Reported in DRSi	Notes
					weight loss, night sweats.		within 2 years was negative.
2013	Marine Corps	U.S.	CONUS	Negative	Asymptomatic . Positive PPD and concerning CT and chest x-ray at physical.	Yes	No prior TB history. Exposure to foreign nationals with active TB during deployment.
2015	Marine Corps	Philippines	CONUS	Negative	Symptomatic: cough. Positive TST and concerning chest x-ray.	Yes	No prior TB history. Last PPD within 2 years was negative. BCG vaccination status unknown.
2015	Marine Corps	U.S.	CONUS	Negative	Symptomatic: hemoptysis. Positive IGRA. Concerning chest x-ray and CT.	Yes	No prior TB history. Deployed to Afghanistan in 2014.
2016	Navy	Haiti	Ship	Positive	Symptomatic: cough, sweats. Concerning chest x-ray and CT.	Yes	Prior converter in 2015; did not appear to have risk factors and was not treated.
2018	Navy	India	OCONUS	Negative	Symptomatic: swollen lymph nodes. Denies other signs or symptoms. PCR confirmed TB Lymphadenitis (Scrofula).	Yes	History of suppurative lymph nodes in 2016 and history of tuberculosis. History of BCG vaccination.
2018	Marine Corps	U.S.	CONUS	Positive	Symptomatic: coughing x2 months with	Yes	

Year	Service	Country of Birth	Duty Station	AFB Smear Results	Presentation	Reported in DRSi	Notes
					scant blood. Chest CT showing cavitary lesion and positive PPD.		
2019	Navy	Senegal	CONUS	Positive	Symptomatic with abnormal chest CT.	Yes	History of BCG vaccination.
2020	Marine Corps	Philippines	CONUS	Positive	Symptomatic: congestion and coughing up blood. Abnormal chest CT with cavitation and positive PPD.	Yes	History of BCG vaccination.
2020	Navy	U.S.	CONUS	Positive; 1+	Chest CT showing cavitary lesion.	Yes	
2021	Marine Corps	Kyrgyzstan	OCONUS	Unknown	Asymptomatic, positive QFT followed by neg PPD followed by positive PPD, negative chest x-ray.	YES	

Appendix B: Contact Information

NEPMUs

Navy Environmental and Preventive Medicine Unit Two
(Atlantic and European Regions)
COMM: (757) 953-6600; DSN: 377-6600
PLAD: NAVENPVNTMEDU TWO NORFOLK VA
Website: https://www.med.navy.mil/Navy-and-Marine-Corps-Force-Health-Protection-Command/Field-Activities/Navy-Environmental-Preventive-Medicine-Unit-2/
E-mail: usn.hampton-roads.navhospporsva.list.nepmu2norfolkthreatassess@health.mil

Navy Environmental and Preventive Medicine Unit Five
(Pacific Region)
COMM: (619) 556-7070; DSN: 526-7070
PLAD: NAVENPVNTMEDU FIVE SAN DIEGO CA
Website: https://www.med.navy.mil/Navy-and-Marine-Corps-Force-Health-Protection-Command/Field-Activities/Navy-Environmental-Preventive-Medicine-Unit-5/
E-mail: usn.san-diego.navenpvntmedufive.list.nepmu5-threat-assessment@health.mil

Navy Environmental and Preventive Medicine Unit Six
(Pacific Theater)
COMM: (808) 471-0237; DSN: (315) 471-0237
PLAD: NAVENPVNTMEDU SIX PEARL HARBOR HI
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Navy Environmental and Preventive Medicine Unit Seven
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INT'L COMM: 011-34-956-82-2274; INT'L DSN: (314) 727-2274
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