Navy Medicine's Actions and Support of the Navy and Marine Corps Public Health Center's Epidemiology Study's Findings on Former Residents of NAF Atsugi

<u>The objective of the report:</u>

Navy's Bureau of Medicine and Surgery (BUMED) tasked the Navy and Marine Corps Public Health Center (NMCPHC) to conduct a study to compare the former residents of NAF Atsugi to NS Yokosuka for differences in medical conditions for select conditions associated with the exposures of concern related to the Shinkampo Incinerator Complex (SIC) that operated adjacent to Naval Air Facility (NAF) Atsugi, Japan.

The limitations of the study are well documented in the report. BUMED was aware of, and accepted, these necessary limitations.

<u>Report's conclusion:</u>

The study found a significantly higher risk for dermal complaints, a non-cancer effect, in the Atsugi population when compared to the Yokosuka population. No other area of the analysis found significant differences in disease and illness incidence or health complaints.

<u>Navy Medicine's comments:</u>

BUMED will task NMCPHC to conduct a sub-analysis of the dermatological conditions noted in the Atsugi population to better understand these conditions and define what, if any, medical recommendations or information for providers is needed. Any additional medical recommendations will be provided via the NMCPHC's Atsugi webpage.

Final Report of Findings and Recommendations

I. Study title. Naval Air Facility (NAF) Atsugi Japan Health Study

II. Study question. Is the incidence of diseases associated with exposure to the emissions of the privately owned Shinkampo Incinerator Complex (SIC) significantly different for residents of NAF Atsugi from 1985 to 2001 when compared to a similar population over the same time period?

III. Study background.

A. Sometime around 1985, the SIC received a license from the Kanagawa Prefecture to operate an incinerator across the fence line of NAF Atsugi, located in Ayase, Japan. It operated until May 2001, when the facility was closed and dismantled. The SIC was licensed to burn household and industrial waste that included solvents, plastics, and medical waste. Several housing areas and work sites on base were located within several meters of the SIC. For about six months a year, the prevailing winds would blow the incinerator smoke and waste solvent vapors onto the base. The first written record available about the adverse conditions was an article in the base newspaper in 1988.

B. Three environmental sampling events (1988, 1990, and 1994) were conducted in an attempt to identify and assess the pollutant levels in the air on the base. These were:

1988 - Sampling performed and results reported by the U.S. Navy Aircraft Environmental Support Activity. The report was revised in 1989 to include a toxicology assessment of the samples.
1990 - Sampling performed and results reported by the Naval Energy and Environmental Support Activity.
1994 – 1995 Sampling performed and results reported by Naval Facilities Engineering Support Center.

The results of the 1994 report were forwarded as a request for support in a letter from the Commanding Officer, NAF Atsugi, to the former Navy Environmental Health Center (NEHC) in May 1994. NEHC conducted a Human Health Risk Assessment (HHRA) that included a health risk evaluation in 1995, a screening health risk assessment in 1997, and additional environmental sampling and fixed air monitoring between 1997 and 2000. The final HHRA report was reviewed by the National Academy of Sciences and the US Environmental Protection Agency (USEPA) in 2000 and forwarded to the Navy Bureau of Medicine and Surgery (BUMED). The HHRA concluded that there was a slight increase in cancer risk (1 per 10,000 children with 3 years of exposure and 1 per 10,000 adults with 6 years of exposure). In October 2007, NEHC was renamed the Navy and Marine Corps Public Health Center (NMCPHC).

C. In March 2007, NMCPHC was requested by BUMED to submit a study proposal to address concerns about the long-term effects from exposure to the SIC emissions. After reviewing available electronic medical and personnel databases, NMCPHC proposed that a cohort study be conducted with the Atsugi population as the exposed cohort and a comparable, unexposed population as the unexposed cohort. The residents of Commander Fleet Activities Yokosuka (CFAY), Japan, were selected as the unexposed cohort, as they shared many of the same environmental characteristics as Atsugi residents, except for exposure to the SIC.

IV. Sources of potential bias. Bias is defined as any deviation of the study results from the truth. Every effort was made during the design phase of this study to minimize the effects of bias on the results. This section includes a list of potential sources of bias and how they were handled by the study design.

A. Case identification. This study is based on the diagnosis codes used by medical providers to document health conditions when they saw patients. Every medical encounter is documented in the health record using a system of codes called the International Classification of Diseases – 9^{th} Revision, Clinical Modification, (ICD-9). While the ICD-9 codes for cancer are very specific, some acute upper respiratory illnesses and skin conditions may be coded several ways. Where the health condition was not clearly defined (e.g., upper respiratory illness), a broader case definition was used for the study to ensure maximum capture of potential cases.

Bias affects a study when one disease is systematically diagnosed differently in one of the study cohorts. The frequency of miscoding should be random in both cohorts and would therefore have a minimal effect on the study comparison estimates due to the study population size.

B. Environmental awareness. The Commanding Officer, NAF Atsugi, used several methods to keep the base population aware of the health hazards associated with the chemicals in the incinerator smoke. In a population that is highly aware of the health effects of air pollution and unsure of the exposure levels that increase their risks, it would be expected (and understandable) that they might seek medical care earlier and more frequently than those unaware of their environmental conditions or the health effects of exposure (Osterberg, 2007). The SIC emissions provided the Atsugi residents with a very visual reminder that they were being exposed. The effect of this heightened awareness may cause the frequency of medical visits in the Atsugi cohort to be higher than the Yokosuka cohort.

C. Selection of the comparison group. The best population to use as the comparison group in a cohort study is one that shares all the risk factors for the disease outcomes except the exposure of interest. If the comparison group has some unknown risk for the same study outcome (or is unknowingly prevented from the outcome), then the basis for the comparison will be biased and unreliable. For example, if we were studying the prevalence of influenza in two populations and we were unaware that a significant portion of one population was immunized, the disease rate would be artificially lower in the immunized population. CFAY was selected as the comparison group for the following reasons:

1. Overseas screening. Both populations are required to be screened for the same limiting medical conditions prior to OCONUS transfer. Sometime after 1995, Naval Personnel Command issued guidance to limit the transfer of members with a history of respiratory illness to NAF Atsugi. If this was enforced, then the number of people with pre-existing upper respiratory illness cases located in Atsugi would decrease, potentially lowering the risk for upper respiratory illness in the Atsugi population relative to the Yokosuka population.

2. General environmental conditions. Both bases are located in urban areas of Japan, except that the Atsugi cohort was exposed to the SIC. The regulations for drinking water and food quality were the same for both locations. While CFAY had two municipal waste incinerators on base, they were regulated by Final Governing Standards emission standards and exposure to the emissions would be no different than one would expect in the U.S. (Wilhelm, 1993).

3. Occupational differences. Atsugi, in addition to normal base support operations, had large groups of workers that specialized in aviation support occupations. CFAY had large groups of workers that specialized in fleet support operations or were assigned to ships. Every Navy workplace (shore and afloat) has routine industrial hygiene surveys to characterize and assess the risks for occupational illness and injuries and ensure that workers are not exposed to unacceptable risks. If occupational exposure limits are exceeded, protective measures are required. It is not expected that differences in outcome rates could be attributed to risks associated with the difference in occupational exposures. The study did not expect any differences in exposures of the family members due to the occupations of the sponsor.

4. Misclassification of exposure. Misclassification of exposure is defined for this study as the placement of a study member into the wrong cohort. The determination of the cohorts was based entirely on the location of the service member's assigned command. If a person was assigned to Atsugi but resided elsewhere, then the person (and family members) was placed in the Atsugi cohort. The same was true for the CFAY cohort. Many people remained in that area of Japan for several tours by changing assignments among the various commands. For this study, those that were assigned to Atsugi and CFAY commands were placed solely in the Atsugi cohort. Due to the distance between the commands (more than one hour commute time during the work week), the misclassification of exposure due to the difference between the assigned command and the residence is expected to be very small. Some sponsors were "unaccompanied" and did not bring their family members with them to Japan. The study was unable to distinguish unaccompanied sponsors, and their family members were included in the appropriate population. This was considered to be a non-differential misclassification of exposure and would reduce the risk estimates in both populations.

D. Lost to follow up. Lost to follow up is an epidemiologic concept that means a study member leaves the study before it ends and the chance to observe illness during the missing time is lost. Bias may be introduced into a study if the follow up rates in the populations was significantly different. For instance, if the exposure to the atmosphere in Atsugi influenced a member's decision to leave the military earlier than someone who was not exposed, then the incidence of disease would be lower because there would be less time to observe the illness in the military health care records. The length of service for the active duty members and the length of eligibility for health care in the family members were compared in this study.

V. **Methods**

A. Selection of Health Outcomes

1. This study was designed to describe the incidence of disease in two populations based on environmental exposure to the chemicals identified in the cancer and non-cancer effects models reported in the "U.S. Naval Air Facility Atsugi, Japan Human Health Risk Assessment" (June 2002). Every chemical that contributed at least one percent to the total cancer or non-cancer risk models was included in the study design phase as a potential agent. A focused literature review to determine specific cancer and non-cancer outcomes for the study was conducted. The primary sources of information were the USEPA Technology Transfer Network Air Toxics Web Site (http://www.epa.gov/ttnatw01/hlthef/hapindex.html) and the Integrated Risk Information System (IRIS) (http://www.epa.gov/iris/) websites. Other sources included peer-reviewed literature using the National Library of Medicine search engine, Cancer Epidemiology and Prevention (2nd Edition), and NMCPHC medical staff. Applicable diagnosis codes for all diseases of interest were determined through research and approved by consultation with a subject matter expert. Tables 1 and 2 provide a list of the study chemicals and the health outcomes selected for the study.

2. Epidemiologic studies are designed to determine if there is an association between an exposure and a health outcome. The primary source for including a specific health outcome in this study was evidence from published reviews by USEPA that clearly demonstrated an association between environmental exposure and adverse health outcomes in humans. When the USEPA reviews did not exist or were known to be outdated, the International Agency for Research and Cancer (IARC) and a text on the epidemiology of cancer (Schottenfeld, 1996) were consulted to identify studies that showed an association in humans or animals at levels comparable to those found at Atsugi. This investigation was restricted to established exposure-disease associations.

3. Based on the study outcome criteria, several associations were investigated to answer the study question and are defined in this section. Where appropriate, 95% confidence intervals were calculated to determine if the observed ratios were statistically significant.

Table 1. List of study chemicals for cancer risk model, target organs, and potential confounders

Chemicals of concern	Target Organs	Confounders
1,1,2,2-Tetrachloroethane	Liver	Alcohol
1,2-Dibromoethane	Liver	Alcohol
1,3-Butadiene	Lymphosarcoma, reticulosarcoma	Smoking
1,4-Dichlorobenzene	Liver, kidney	Alcohol
1,4-Dioxane	Liver	Alcohol
Acetaldehyde	Nasopharyngeal	Smoking
Acrylonitrile	Lung, colon, prostate	Smoking
Arsenic	Lung, kidney, bladder, skin	Smoking
Benzene	Leukemia	Smoking, exposure to diagnostic radiation
Benzyl Chloride	None for inhalation	
Cadmium	Lung, kidney	Smoking
Carbon Tetrachloride	Liver	Alcohol
Dioxin (Total 2,3,7,8-TCDD toxic equivalents)	Soft tissue sarcomas	Smoking, alcohol
Formaldehyde	Lung, nasopharyngeal	Smoking
Hexachlorobutadiene	Kidney	Smoking
Methylene Chloride	Liver, lung	Alcohol, smoking
Vinyl Chloride	Liver, lung, angiosarcoma	Alcohol, smoking

Table 2. Chemicals of concern, non-cancer risk model, by health concerns

Chemical of concern	Target system
1,2-Dibromoethane	Respiratory, dermal
1,2,4-Trimethylbenzene	Respiratory
Acetaldehyde	Respiratory, dermal, ocular
Acetonitrile	Respiratory
Acrolein	Respiratory, ocular
Aluminum	Respiratory
Formaldehyde	Respiratory, dermal, ocular
PM10	Respiratory

B. Selection of Study Members

1. Data sources. NMCPHC reviewed several sources of data that could place a person in Atsugi during the study period. These included personnel and family member databases, housing records, and medical records. While personnel records and family member files provide a definitive source, it was not always possible to determine that a family member accompanied the service member. Because the study was designed to follow a person as long as they were eligible for healthcare from Department of Defense (DoD) medical treatment facilities, DoD civilians, reservists, contractors, and non-appropriated fund personnel were not included. While DoD and other civilians may have selected to receive their health care at the Atsugi Branch Medical Clinic or US Naval Hospital Yokosuka, once they returned to the US, we could not follow their health conditions. Though they were excluded from the study, the results may be applicable to this population.

2. Active Duty. Personnel files were obtained from the Defense Manpower Data Center (DMDC) for the entire study period for Navy and Marine Corps service members whose service location zip code matched Atsugi or Yokosuka. Quarterly records were combined to create one record indicating the first and last quarter of uninterrupted service in the location of interest. It was possible to have more than one tour of duty in these records and more than one resulting summary record. For service members that were stationed in both Atsugi and Yokosuka, the Yokosuka tour of duty record(s) was excluded from the analysis. This was done to reduce the bias that might result from including an exposed person within the unexposed population. Records were grouped for each individual and a sum of cumulative exposure was calculated. Final records indicated the date of first exposure, the last known record of exposure (latest date of departure from Atsugi or Yokosuka) and cumulative exposure time. Extended periods away from the base (i.e. leave, deployments, and temporary duty assignments) were not accounted in the database.

3. Transient personnel. Transient personnel are military members who were assigned to one of the study locations for less than 6 months. As only quarterly personnel records were available, these populations may not be present in the DMDC active duty personnel files. To ensure that the study populations had a sufficient time at their respective duty stations, six months of cumulative exposure were required for inclusion in this study. If differences in disease risk could be identified, the feasibility to assess the exposure of transient personnel could be reviewed.

4. Establishing length of exposure and time since first exposure. A list of unique identifiers from all active duty personnel identified through previous steps was matched to the DMDC Length of Service (LOS) data (based on military dates for entering and leaving the service) to assign a date for the end of military service (EOS) and eligibility for healthcare as an active duty member. While on active duty, the primary source for medical care is generally through Military Medical Treatment Facilities (MTFs). Depending on the reason for separation, discharged personnel may or may not be eligible for care at MTFs. While some study subjects (e.g., retirees) were

eligible for health care through the Military Healthcare System (MHS), most were not. To ensure that both populations were treated equally in this study, EOS dates were used to determine when follow-up was stopped for each study participant. These dates were also used to calculate person-time for cancer and non-cancer illnesses. (Person-time is an epidemiologic method used to count the total time a person is included in the study, starting on the day that the person arrived in the study area for the first time and ending when the person left active duty or was still on active duty at the end of the study period, 01 May 2008.) Active duty personnel that did not have a valid LOS file or were still active were given an EOS date of 01 May 2008 to match to the encounter data available. LOS dates were also used to compare the rate at which members left active duty between both populations.

5. Family members. Defense Enrollment Eligibility Reporting System (DEERS) records were used to select the population of family members included in the study. Because these records are not always accurately changed during transition from active duty to non-active duty, all family members were assigned to the same exposure group for the same time period as the sponsor. Family members with a date of birth after the date of sponsor's last assignment to the study area were excluded from this study, as they did not have known direct exposure. Dates indicating the end of military treatment eligibility were also included in these records. These dates were used when they were before the sponsor's EOS date. Additionally, many children are no longer eligible for care after age 21, and were assigned an EOS date on their 21st birthday. If dependent records did not meet either of these criteria, the sponsor's EOS date was applied to the family member record. After all inclusion criteria were applied, a single database of Atsugi and Yokosuka personnel and their family members was compiled. All inclusion and exclusion criteria were equally applied to Atsugi and Yokosuka populations, except members of both populations were included only in the Atsugi population.

C. **Medical Data**

1. Medical data sources. Defense Health Services Systems (formerly Executive Information and Decision Support (EI/DS)) provided medical records for the Department of the Navy (DON) for this study. Medical records were received from MTF-based inpatient and outpatient records and purchased care records reflecting inpatient and outpatient visits. Purchased care records represented medical visits outside the MHS that were reimbursed by the MHS. Data from each source of medical records were not available for the entire study period, as the sources were created or implemented at different times; the specific time period of each database used in the study is provided (Table 3). Records from each of the six databases were formatted to match and combined into one data resource. Health outcomes were recorded as diagnoses using ICD-9. Inpatient outcomes could have up to 20 diagnoses per admission and outpatient outcomes could have up to 4 diagnoses per visit. All fields were searched for ICD-9 codes that matched the relevant outcomes related to the chemicals of interest for this study.

Table 3. Starting dates for medical data files

Patient Status	Type of Care	Start Date
Inpatient	Military Care	Oct-88
	Purchased Care	Oct-93
Outpatient	Military Care	Oct-98
	Purchased Care	Oct-93

2. Linking study participants to medical data. The sponsor identifier from the previously created database of active duty service members in each population was matched to the compiled encounter database. Because patient identifier in the medical data was not as reliable as sponsor identifier, the sponsor identifier was used. Records were classified by exposed and non-exposed populations, and any diagnosis was included, regardless of treatment location. After matching, several criteria were applied to ensure that all records considered were appropriate. The service date for the record must have been after the date of first assignment to the study area. Only patients with possible exposure were included; therefore, the birth date recorded in the medical record must have been before the latest date of last assignment to the study area.

3. Health outcome exclusions and categories. In order to maintain statistical integrity, calculations were not performed on any category where less than 5 cases were found in either population (Greenland, 1996). Analysis was divided into two different portions, cancer and non-cancer diagnoses, and each was calculated separately.

a. Cancer outcomes. Each person included in the study was only eligible for each cancer type one time, typically called the “incident case.” Subsequent diagnoses of the same cancer were excluded because it was not possible to distinguish between recurrent and new cancers after the incident case. It was possible for a person to be included in more than one cancer category, but only once for each specific category. For purposes of this study, primary and secondary malignant cancer diagnoses were included. When possible, diagnoses for cancers with uncertain behavior were included; this was limited to the specific location of those diagnoses.

There were three latency models created for this study. The typical latency for cancers from exposure levels like those observed in Atsugi is approximately 20-30 years, meaning it would take approximately 20-30 years for disease to occur as a result of exposure. To provide a very conservative estimate of the cancer risk, this study used a 15-year latency model to ensure that people that may be more susceptible to the effects of the exposures were included in the analysis (Aschengrau, 1998). Therefore, in the primary analysis model, there must have been a lapse of 15 years between first known exposure and first known diagnosis. A second latency model was created to assess the possibility of the chemicals as cancer promoters, which theoretically might result in cancer as early as five years post-exposure (Aschengrau, 1998). This 5-year latency model would mean that the chemical did not cause the disease process; rather, the cancer process was accelerated by the chemical exposure. Analyses were completed with both latency periods applied to the date of first diagnosis. The cause and the time at which the disease process starts of leukemia is unknown, especially in young children. A 1-year latency model was used for leukemia, meaning that a diagnosis of leukemia had to be at least one year after arrival in Japan for it to be included in the study.

Risk ratios and confidence intervals were calculated using the case counts and population estimates. In the risk ratio calculations, Atsugi was considered the population at risk and was used in the numerator. A calculated ratio that was greater than 1 would indicate an increased risk for Atsugi residents. Table 4 details the diagnosis codes used to find cancer cases from the medical data.

Table 4. Types of cancer included in the study by diagnosis code

Cancer Type	Diagnosis Code(s) (ICD-9-CM)
Bladder	188, 236.7, 239.4
Colon	153 (excluding 153.5)
Kidney	189.0, 189.1, 236.91
Leukemia	203.1, 204-207
Liver	155.0, 235.3, 239.0
Lung	162, 235.3, 239.0
Lymphosarcoma	200.1
Nasopharyngeal	147
Prostate	185, 236.5
Reticulosarcoma	200
Soft tissue sarcomas	170.0 - 170.2, 171.0 - 171.9, 164.1

b. Non-cancer outcomes. Three broad areas of non-cancer adverse health effects were identified: respiratory, dermal and ocular (Table 5). Central nervous system, liver and kidney damage were not included for their non-cancer effects because the available literature was felt to be inadequate regarding the very low levels reported in the NMCPHC 2002 HHRA; most existing studies addressed much higher occupational levels of exposure. Each diagnosis, not each visit, of a non-cancer illness was counted in the study once, as it was possible for one person to have multiple visits for each disease or illness of interest.

Non-cancer diagnoses were evaluated in two ways: while a person was living in Japan and any time after first assignment to the study area. For disease analysis while a person was living in Japan, the medical visit must have occurred during the exposure period. To investigate if exposure to the incinerator pollution had a long-term impact on health, the cohorts were followed until the sponsor left active duty. To be counted in this analysis, a medical visit any time since the date of first assignment to the study area was counted, regardless of the location where the medical visit occurred. Rates per one thousand person-years since the date of first assignment to the study area were calculated using person-time estimates as previously described. For analysis purposes, rate comparisons were performed.

Table 5. Non-cancer outcomes by diagnosis code

Disease Type	Diagnosis Code(s) (ICD-9-CM)
Dermal	691-692 (excluding 691.0)
Ocular	372 (excluding 372.2 and 372.4)
Respiratory	473, 476-478, 493

VI. Results.

A. Population Description. Population estimates are provided in Table 6.

Table 6. Overall study population estimates

	Population	Active duty	Family Members	Total
Overall During Study	Atsugi	5,635	11,169	16,804
	Yokosuka	15,633	28,348	43,981
Eligible for Care at end of Study	Atsugi	1,345	3,159	4,504
	Yokosuka	3,099	7,079	10,178

1. Active duty. There were 5,635 active duty service members identified in Atsugi during the study period (1985-2001). There were 15,633 active duty service members identified in Yokosuka during the same time period. At the end of the study (May 1, 2008) there were 1,345 (23.9%) personnel still on active duty service that were former residents of Atsugi and 3,099 (19.8%) remaining from Yokosuka. The mean LOS after first assignment to the study area for Atsugi active duty service members (8.7 years) was slightly higher than that of Yokosuka residents (7.7 years). Both populations were in their respective locations for, on average, about the same length of time: 2.4 years (Atsugi) and 2.2 years (Yokosuka) .

2. Family members. There were 11,169 family members of active duty service members associated with Atsugi identified in available electronic records (1990-2001). There were 28,348 family members identified in Yokosuka during the same time period. At the end of the study (May 1, 2008), there were 3,159 (28.3%) family members from Atsugi active in the DEERS system and 7,079 (25.0%) from Yokosuka (Table 1). The mean length of dependency after first assignment to the study area for Atsugi family members (10.0 years) was similar to that of Yokosuka family members (9.5 years). Both dependent populations were in their respective locations for, on average, about the same length of time: 3.1 years (Atsugi) and 2.7 years (Yokosuka).

3. Person-time at risk. Person-time was calculated from the personnel and family member data sources as described in Section V.B. above. Based on the model selected, the person-time at risk was adjusted to account for the latency period. For example, for the 5-year latency model, person-time at risk did not start until the person passed the 5-year anniversary of their assignment in the study area. The person-time at risk, adjusted for the latency period, was used to provide the denominator for calculating the relative rates for each model (Table 7).

Table 7. Person-year estimates for Atsugi and Yokosuka

	Population	Active duty	Family Members	Total
Cancer: 1 Year Latency	Atsugi	42,542	10,796	53,338
	Yokosuka	103,283	25,325	128,608
Cancer: 5 Year Latency	Atsugi	23,718	4,164	27,882
	Yokosuka	54,326	9,639	63,965
Cancer: 15 Year Latency	Atsugi	2,517	61	2,578
	Yokosuka	5,338	119	5,457

B. Cancers. The results of the cancer analysis should be interpreted carefully as they only apply to this study. These calculated rates are not comparable to the cancer incidence rates published by the National Cancer Institute Surveillance Epidemiology and End Results because they have been adjusted for the latency period for each model.

1. 1-Year Latency Model (leukemia diagnoses only). The minimum requirement of five cases was not found in the active duty or dependent populations to support valid statistical analysis.

2. 5-Year Latency Model (Table 8). Statistical analysis was only possible for lung cancer and liver cancer diagnoses because the minimum 5-case requirement was not met for the other cancers. Yokosuka residents had a higher incidence lung cancer diagnoses, and Astugi residents had higher incidence of liver cancer diagnoses, but the differences were not statistically significant.

Table 8. 5-year latency model, all DON beneficiaries

	Atsugi		**Yokosuka**			
Disease	**Count**	**Incidence / 1000 person-years**	**Count**	**Incidence/ 1000 person-years**	**Incidence Ratio**	**CI (95%)**
Liver	9	0.32	15	0.23	1.38	0.60, 3.14
Lung	5	0.18	17	0.27	0.67	0.25, 1.83

3. 15-Year Latency Model. The minimum requirement of five cases for any of the cancer categories was not found in the active duty or dependent populations to support valid statistical analysis.

C. Non-Cancer Diseases. The tables in this section are divided based on the source of the medical visit data. When the visit rate ratios were significantly different between the populations at a more detailed level, those were reported in addition to the summary tables. For example, purchased care is used by family members more than active members and sub-analyses were conducted to determine if the purchased care visit rates were significantly different.

1. Respiratory. During exposure, the rate of ambulatory visits per 1,000 person-years was higher in Yokosuka family members than their counterparts in Atsugi. There were too few ambulatory visits in the active duty Atsugi population to do a valid comparison. Yokosuka residents had higher percentages in all categories considered, except for purchased care for family members during their time in Japan (Table 9). Within the family member sub-analysis for in-patient visits, the rate ratio (RR) for Atsugi family members hospitalized in Japanese hospitals for respiratory complaints while living in Atsugi was 80% higher than the Yokosuka family members, but this difference was not statistically significant at a p=0.05 level due to a very small number of visits in the analysis. Because Atsugi did not have DOD inpatient medical facilities on base and Yokosuka did, it is expected that Atsugi would use off-base hospitals for emergency care more frequently.

Table 9. Medical visits for respiratory complaints

Respiratory			Atsugi		Yokosuka			
			Number of Medical Visits	Visit Rate per 1,000 Person-Years	Number of Medical Visits	Visit Rate per 1,000 Person-Years	Visit Rate Ratio	CI (95%)
Active Duty	During Exposure	Ambulatory	-	-	101	3.77	-	-, -
		In-Patient	25	1.39	112	2.16	0.64	0.42, 0.99
	Since First Exposure	Ambulatory	644	11.44	2417	17.43	0.66	0.60, 0.72
		In-Patient	72	0.92	272	1.40	0.65	0.50, 0.85
Family Members	During Exposure	Ambulatory	253	68.60	987	93.50	0.73	0.64, 0.84
		In-Patient	84	10.40	273	11.84	0.88	0.69, 1.12
	Since First Exposure	Ambulatory	3001	243.53	8265	282.53	0.86	0.83, 0.89
		In-Patient	185	9.34	642	13.87	0.67	0.57, 0.79

- Less than 5 medical encounters; rates not calculated

2. Dermal. Atsugi residents had a higher visit rate for dermal complaints than Yokosuka residents in almost all categories, though none was statistically significant (Table 10). When comparing total visits for dermal complaints between the Atsugi and Yokosuka populations across all categories, the Atsugi residents had a significantly increased visit rate ratio (RR: 1.08, CI 95% 1.01, 1.15). As part of the sub-level analysis, the visit rate for Atsugi family members was significantly higher for inpatient visits (RR: 4.53, CI 95% 1.48, 13.83) while residing in Atsugi and for Atsugi active duty members for ambulatory treatment outside the MHS (RR: 2.48, CI 95% 1.29, 4.76).

Table 10. Medical visits for dermal complaints

Dermal			Atsugi Number of Medical Visits	Atsugi Visit Rate per 1,000 Person-Years	Yokosuka Number of Medical Visits	Yokosuka Visit Rate per 1,000 Person-Years	Visit Rate Ratio	CI (95%)
Active Duty	During Exposure	Ambulatory	6	0.65	12	0.45	1.45	0.54, 3.87
		In-Patient	-	-	5	0.10	-	-, -
	Since First Exposure	Ambulatory	198	3.52	423	3.05	1.15	0.97, 1.36
		In-Patient	5	0.06	11	0.06	1.12	0.39, 3.23
Family Members	During Exposure	Ambulatory	114	30.91	329	31.17	0.99	0.80, 1.22
		In-Patient	8	0.99	9	0.39	2.54	0.98, 6.58
	Since First Exposure	Ambulatory	993	80.58	2317	79.20	1.02	0.95, 1.09
		In-Patient	11	0.56	23	0.50	1.12	0.54, 2.29

- Less than 5 medical encounters; rates not calculated

3. Ocular. Yokosuka residents had greater visit rates for ocular conditions per 1,000 person-years when compared to Atsugi residents in all categories (Table 11). None of the primary and sub-level analyses revealed any significant differences.

Table 11. Medical visits for ocular complaints

Ocular			Atsugi Number of Medical Visits	Atsugi Visit Rate per 1,000 Person-Years	Yokosuka Number of Medical Visits	Yokosuka Visit Rate per 1,000 Person-Years	Visit Rate Ratio	CI (95%)
Active Duty	During Exposure	Ambulatory	7	0.76	26	0.97	0.78	0.34, 1.80
		In-Patient	-	-	9	0.17	-	-, -
	Since First Exposure	Ambulatory	222	3.94	736	5.31	0.74	0.64, 0.86
		In-Patient	5	0.06	26	0.13	0.48	0.18, 1.24
Family Members	During Exposure	Ambulatory	61	16.54	202	19.14	0.86	0.65, 1.15
		In-Patient	-	-	17	0.74	-	-, -
	Since First Exposure	Ambulatory	466	37.82	1199	40.99	0.92	0.83, 1.02
		In-Patient	6	0.30	30	0.65	0.47	0.19, 1.12

- Less than 5 medical encounters; rates not calculated

VII. Discussion.

A. Overall. The study found a significantly higher risk for dermal complaints, a non-cancer effect, in the Atsugi population when compared to the Yokosuka population. No other area of the analysis found significant differences in disease and illness incidence or health complaints.

1. Cancer. None of the types of cancer considered as possibly associated with exposure to the SIC pollution had significantly different risk ratios between the populations.

2. Non-cancer effects. This study found that medical visits for dermal complaints showed a statistically significant difference between the residents of Atsugi and Yokosuka. Medical visits for dermal complaints were significantly increased in the

Atsugi population while they were stationed in Japan and after they left, indicating a possible long-term dermal affect from exposure to the SIC pollution.

D. Study limitations.

1. Most cancers take 20-30 years to develop from first exposure and there has not been sufficient time since the beginning of SIC operations to observe such cancers in the Atsugi population.

2. For cancers with a shorter latency, the relatively small size of the Atsugi population limited the ability to find cases. Most cancer rates are reported as cases per 100,000 person-years at risk for being diagnosed with cancer. There were about 181,000 person-years in the Atsugi and Yokosuka populations combined and relatively few cases of cancer were found over the entire study period.

3. The study was limited by the total number of person-years to detect cancer in the population due to how soon service members or dependents leave the military health care system after a tour in Japan. Except for pediatric, brain and blood cell cancers, cancer is generally found in people older than 50. Most of the study population left the service or MTF system before age 50.

4. Medical data for all persons in the study were not consistently available over the entire study period. Outpatient medical visits were not routinely recorded for visits in Japan until 1999. While that limited the depth of analysis while the SIC was in operation, the study was able to follow medical visits for study members until May 2008. Thus, the analysis of acute effects that occurred early in the study period was limited.

5. The original study was designed to allow investigation of a relationship based on the location of the residence with respect to the distance from the SIC. Because the number of cases was so small for most disease categories, statistical analysis was not appropriate.

APPENDIX I
Literature Review

Aschengrau A, Paulu C, Ozonoff D. Tetrachloroethylene-contaminated drinking water and the risk of breast cancer. Environmental Health Perspectives 106(Suppl 4) :947-953 1998.

Greenland, S. Commentary: Modeling and Variable Selection in Epidemiologic Analysis. American Journal of Public Health, Vol. 79(3), 1989.

International Agency for Research on Cancer, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans (located at: http://monographs.iarc.fr).

Osterberg K, Persson R, Karlson B, Carlsson Eek F, Ørbæk P. Personality, mental distress, and subjective health complaints among persons with environmental annoyance. Human & Experimental Toxicology. Vol 26: 231-241, 2007.

Ries LAG, Melbert D, Krapcho M, Stinchcomb DG, Howlader N, Horner MJ, Mariotto A, Miller BA, Feuer EJ, Altekruse SF, Lewis DR, Clegg L, Eisner MP, Reichman M, Edwards BK (eds). SEER Cancer Statistics Review, 1975-2005, National Cancer Institute. Bethesda, MD, http://seer.cancer.gov/csr/1975_2005/, based on November 2007 SEER data submission, posted to the SEER web site, 2008.

Schottenfeld D, Fraumeni JF Jr, eds. Cancer Epidemiology and Prevention, 2nd ed. New York: Oxford University Press, 1996.

United States Environmental Protection Agency, Toxicological profiles for study chemicals were obtained from the U.S. Environmental Protection Agency Integrated Risk Information System (IRIS) (located at http://www.epa.gov/iris/).

United States Environmental Protection Agency, The Health Effects Notebook for Hazardous Air Pollutants (located at http://www.epa.gov/ttnatw01/hlthef/hapindex.html).

Whilhelm, W.B. Municipal waste incinerator, Public Works Center, Yokosuka, Japan: Evaluation and recommendations. Report from the Department of Civil Engineering, Environmental Engineering and Science Program, University of Illinois at Urbana-Champaign. April 1993.