LETTERS TO THE EDITOR

I enjoyed reading Vol 1 No 1 of NMSR. You are onto something good for the Navy and very good for the Prev Med community. We will circulate this to our command, place it in the library, and encourage the staff to send you information to consider for inclusion into future issues. Please keep up the good work.

In the Global Surveillance of Emerging Disease section please make a correction to the NHRC homepage address. Address should read: http://pc176.nhrc.navy.mil/disease.

J. T. Coyne
CAPT, MSC, USN
Executive Officer
NHRC

I appreciated the numerous timely reports in the latest NMSR. Regarding the GBS case series, however, I fear that reliance on DARs severely underrepresented the occurrence of GBS in our Navy and Marine Corps populations. From DMED, there were 145 reported hospital discharges of Navy and Marine Corps members with GBS (i.e., ICD-9 357.0) from 1990-1997 (see attached file). Hospital discharge data has its limitations, but the 10-fold difference is not trivial. A more detailed look at the hospitalization data, which you may get from AMSA/DMSS, might be in order.

That said—keep up the good work.

CAPT David Trump, MC, USN
Program Director, Prev Med & Surveillance
Office of the Asst Sec of Defense (Health Affairs)

Editor's Note: ICD-9 357.0 is for "Inflammatory and toxic neuropathy." We are unsure of how many GBS cases were included under this code, but we will investigate the matter and try to get back to our readers in our Jan-Mar publication. DMED can be found at http://amsa.army.mil/dmed.

During the surgeon General's Conference, which I attended, I saw the Naval Medical Surveillance Report.

As it is interesting to see how the USN handles problems that we see as well, my request is to add us to the mailing list.

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Views and opinions expressed are not necessarily those of the Department of the Navy

NAVAL DISEASE REPORTING SYSTEM (NDRS)

Medical Event Reports Instruction Released

In compliance with the Presidential Decision Directive NSTC-7, "Emerging Infections," the U.S. Navy and U.S. Marine Corps took significant steps toward a functional electronic surveillance system with the publication of the new instruction, BUMED 6220.12A, Medical Event Reports.

This instruction mandates the Naval Disease Reporting System as the method of reporting disease and other medical conditions of interest. It changes the time period of reporting from yearly to monthly, moving the Services closer to real-time surveillance and analysis. The program has the capacity to report unusual syndromes as well as the 70 Tri-Service Reportable Events, making it a useful tool for surveillance of emerging diseases. The seventy reportable events that were developed in consultation between the Services are accompanied by consistent case definitions (contained within the NDRS program). Also, reportable events traditionally reported, such as animal bites/rabies prophylaxis are included. These events encompass the civilian requirements for reporting, and the NDRS is being used by an increasing number of sites to report conditions to state public health authorities.

This Instruction represents a paradigm shift for epidemiologic surveillance in the U.S. Naval Services. The focus is expanded to include population based aggregate data beyond the mere case report. The data generated by this new reporting method are accessible to analysis by statistical programs and offer epidemiologists a new tool for population-based assessment of readiness. New abilities for quality assurance are built into the program in menu-driven choices in selected fields, making data consistent from site to site. It also allows meaningful aggregation at local, Navy Environmental and Preventive Medicine Units (NEPMUs), Navy Environmental Health Center (NEHC), and DoD levels. Quality assurance is primarily the responsibility of the data entry level, but validation of data will occur, according to the Instruction, at NEPMU and NEHC levels as well. This assures the most meaningful data will be forwarded to the Department of Defense Medical Surveillance System at the Army's Center for Health Promotion and Preventive Medicine. The reportable events data there become part of the Department of Defense database, which draws from inpatient, outpatient, personnel, and deployment data from multiple other sources.

Excerpts from the Upcoming 10-Year Disease Report

For many years, Navy Environmental Health Center (NEHC) has been receiving data on reportable diseases and conditions. This was done through the previous reporting form, the Disease Alert Report (DAR). With the GEIS initiative of 1998, we instituted a new reporting system, the Naval Disease Reporting System (NDRS). We are engaged in a ten-year retrospective review of trends in the U.S. Navy and Marine Corps using data from DARs and the NDRS. These data will be published in booklet form within the next few months. As a preview to the data, we include in this issue of NMSR frequency tables (Tables 1 and 2), and a few graphs (Figures 1-10) indicating Navy and Marine Corps' experience of reportable diseases over the past decade. The tables and figures represent diseases occurring in active duty personnel only. Our hope is that this data will be useful to you. As always, we welcome your comments and suggestions.

Table 1. Disease Frequency, Active Duty Personnel, USN, 1988-1997

Disease	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Total
Amebiasis	5	1	31	17	10	2	1	3	3	1	74
Bites, Non-venomous rabies vax given	54	58	48	44	50	38	37	24	34	53	440
Bites, venomous	1	3	3	3	5	5	2	1	0	3	26
Brucellosis	0	0	1	0	1	0	0	2	0	0	4
Campylobacter	0	0	0	0	4	0	2	1	5	1	13
Chancroid	2	0	0	1	4	32	2	4	1	4	50
Chlamydia	0	0	0	0	0	0	0	0	0	231	231
Coccidioido-mycosis	2	2	1	0	5	10	8	2	9	0	39
Dengue Fever	2	52	5	13	20	1	1	7	1	1	103
E. coli 157 infection	0	0	0	0	0	0	1	0	0	0	1
Encephalitis	0	1	0	0	1	0	0	1	3	4	10
Ehrlichiosis	0	0	0	0	0	0	0	0	0	0	0
Gonorrhea	0	0	0	0	0	0	0	0	0	100	100
Giardiasis	3	14	40	32	27	31	18	8	9	21	203
Gullian-Barre Syndrome	0	1	0	1	0	4	3	1	1	1	12
Hepatitis A	92	117	67	84	44	27	37	24	31	21	544
Hepatitis B	113	117	75	67	57	37	39	27	16	9	557
Hepatitis C	0	14	2	10	2	9	6	7	8	3	61
Legionellosis	1	0	0	1	1	0	1	1	1	1	7
Leishmaniasis	0	0	0	1	1	0	0	1	0	2	5
Leprosy (Hansen's Disease)	2	0	0	0	0	0	0	0	0	0	2
Leptospirosis	0	1	0	0	1	0	0	0	0	1	3
Lyme Disease	2	0	19	5	3	5	2	8	19	9	72
Lympho-granuloma Venereum	0	1	46	30	9	14	9	4	5	3	121
Malaria	8	7	15	5	10	3	6	4	5	6	69
Measles	1	0	8	3	2	1	1	0	0	0	16
Meningitis (viral)	0	27	12	15	29	20	21	25	25	21	195
Meningococcal disease	6	6	3	2	3	2	4	0	1	0	27
Mumps	1	1	50	11	23	13	5	6	1	5	116
Paratyphoid Fever	1	0	0	0	0	0	0	0	0	0	1
Pertussis	0	0	0	0	2	0	0	0	2	0	4
Psittacosis	0	0	1	0	0	0	0	0	1	0	2
Rheumatic Fever	0	1	0	0	0	0	1	0	0	1	3
RMSF	0	1	1	2	0	0	0	2	0	0	6
Rubella	0	0	0	0	1	0	0	0	0	0	1
Salmonellosis	52	8	46	79	66	27	25	24	20	17	364
Schistoso-miasis	0	0	0	0	0	1	0	0	0	0	1
Shigellosis	29	2	17	18	9	10	29	21	9	9	153
Strep, Invasive	0	0	0	0	0	0	0	1	0	0	1
Syphilis	152	17	153	142	109	108	84	64	37	29	895
Toxic Shock Syndrome	0	2	0	0	0	1	2	0	0	3	8
Toxoplasmosis	0	0	1	0	0	0	0	0	0	0	1
Trypanoso-miasis	0	0	0	0	0	0	0	0	0	0	0
Tuberculosis (Pulmonary)	13	2	5	7	10	6	8	8	8	6	73
Typhoid Fever	1	0	3	3	1	0	0	0	0	0	8
Varicella	117	1181	919	767	402	473	234	292	38	15	4438
Total Population	592570	592652	579417	570262	541886	509950	468662	434617	416735	387774	4706751

Table 2. Disease Frequency, Active Duty Personnel, USMC, 1988-1997

Disease	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Total
Amebiasis	0	0	2	1	1	0	3	0	0	0	7
Bites, Non-venomous rabies vax given	8	16	21	25	18	15	6	8	14	47	178
Bites, venomous	3	4	7	7	10	12	7	4	5	5	64
Brucellosis	0	0	0	0	0	0	0	0	0	0	0
Campylobacter	0	0	1	1	3	1	6	0	1	0	13
Chancroid	0	0	1	1	0	1	0	0	0	2	5
Chlamydia	0	0	0	0	0	0	0	0	0	222	222
Coccidioido-mycosis	0	2	0	0	2	0	1	1	1	1	8
Dengue Fever	0	0	0	1	0	0	0	4	0	0	5
E. coli 157 infection	0	0	0	0	0	0	0	0	0	2	2
Encephalitis	0	0	0	2	2	0	0	0	0	1	5
Ehrlichiosis	0	0	0	7	3	0	0	0	1	0	11
Gonorrhea	0	0	0	0	0	0	0	0	0	60	60
Giardiasis	0	2	5	17	7	8	3	2	8	2	54
Gullian-Barre Syndrome	0	0	0	1	1	0	1	0	0	0	3
Hepatitis A	22	32	27	26	3	8	7	4	7	3	139
Hepatitis B	33	35	25	20	23	15	7	6	9	4	177
Hepatitis C	0	2	1	2	2	2	0	0	1	0	10
Legionellosis	0	0	0	0	1	0	0	0	0	0	1
Leishmaniasis	0	0	0	1	1	0	0	1	0	0	3
Leprosy (Hansen's Disease)	0	0	0	0	0	0	0	0	0	0	0
Leptospirosis	0	17	0	0	0	1	3	0	2	5	28
Lyme Disease	0	0	14	27	11	55	4	13	21	8	153
Lympho-granuloma Venereum	0	0	1	1	2	3	6	3	4	8	28
Malaria	45	28	49	12	5	56	9	3	2	5	214
Measles	0	0	0	1	0	1	0	0	0	0	2
Meningitis (viral)	7	7	1	7	7	5	9	8	8	8	67
Meningococcal disease	1	6	1	4	2	0	0	1	1	0	16
Mumps	0	0	6	0	22	5	6	0	2	0	41
Paratyphoid Fever	0	0	0	0	0	0	0	0	0	0	0
Pertussis	0	0	0	0	0	0	0	0	0	0	0
Psittacosis	1	0	1	0	0	0	0	0	0	1	3
Rheumatic Fever	0	0	0	1	0	0	0	0	0	0	1
RMSF	0	0	6	7	6	3	0	0	1	7	30
Rubella	0	0	0	0	0	0	0	0	0	0	0
Salmonellosis	8	4	15	13	6	11	9	7	5	9	87
Schistoso-miasis	0	0	0	0	0	0	0	0	0	0	0
Shigellosis	13	0	0	4	6	12	11	2	2	2	52
Strep, Invasive	0	0	0	0	0	0	0	0	0	0	0
Syphilis	38	1	43	33	65	24	18	8	9	10	249
Toxic Shock Syndrome	0	1	0	0	0	0	0	0	1	0	2
Toxoplasmosis	0	0	0	0	0	0	0	6	0	0	6
Trypanoso-miasis	0	0	0	0	0	0	1	0	0	0	1
Tuberculosis (Pulmonary)	2	0	1	2	4	0	2	1	1	1	14
Typhoid Fever	1	0	0	0	0	0	0	0	0	0	1
Varicella	2	169	317	274	191	60	52	67	11	4	1147
Total Population	197350	196956	196652	194040	184529	178379	174158	174639	174883	171637	1671586

Figure 1. Hepatitis Rates in the Navy, 1988 to 1997

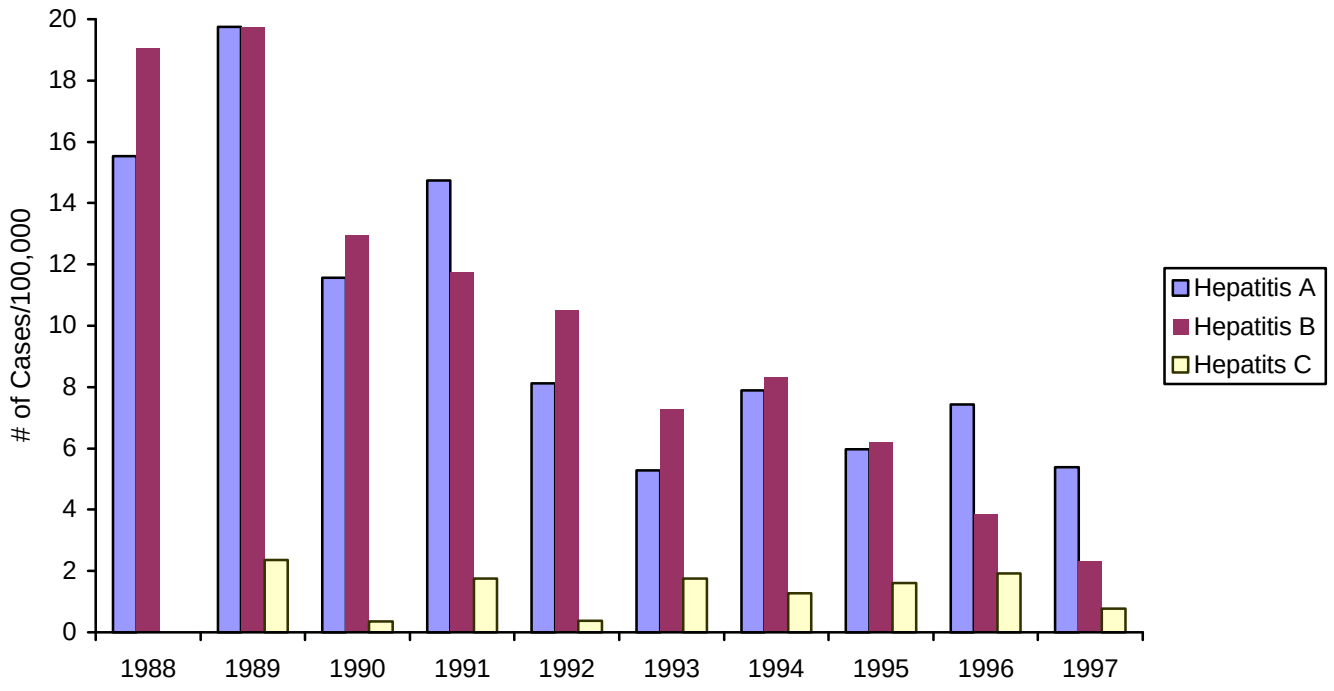


Figure 2. Hepatitis Rates in the Marine Corps, 1988 to 1997

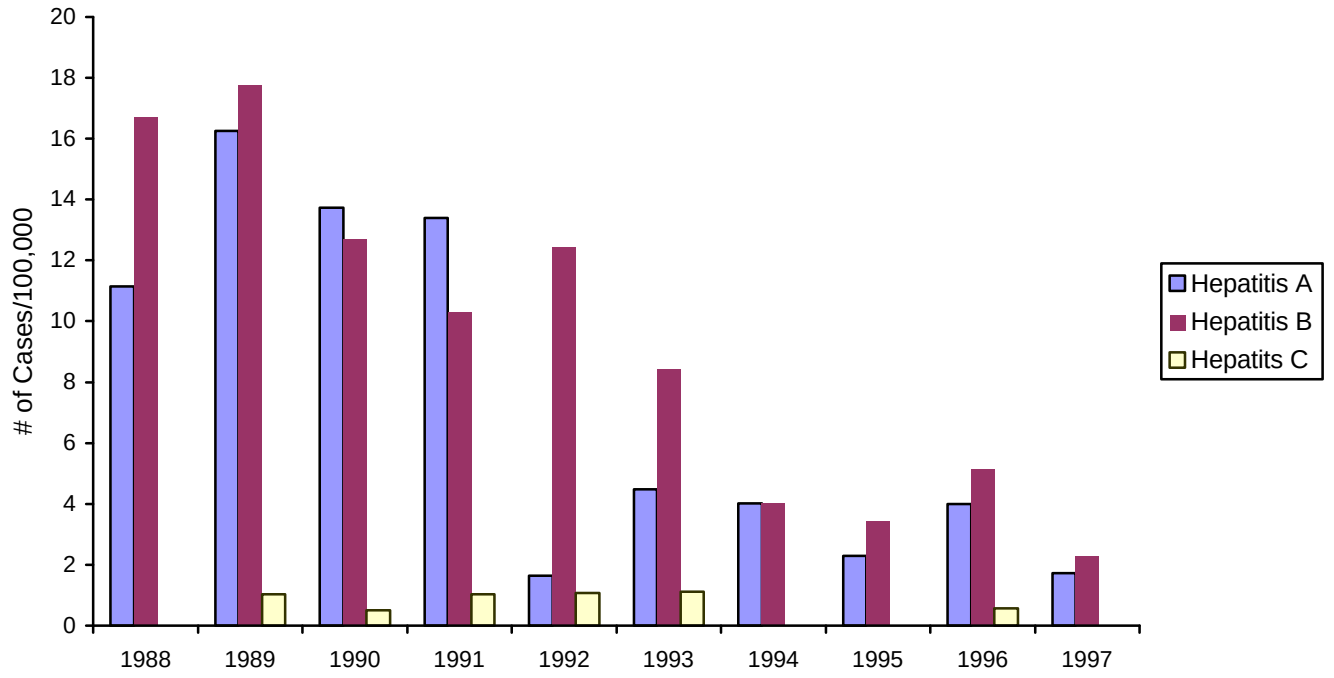


Figure 3. Syphilis Rates, USN/USMC, 1988-1997

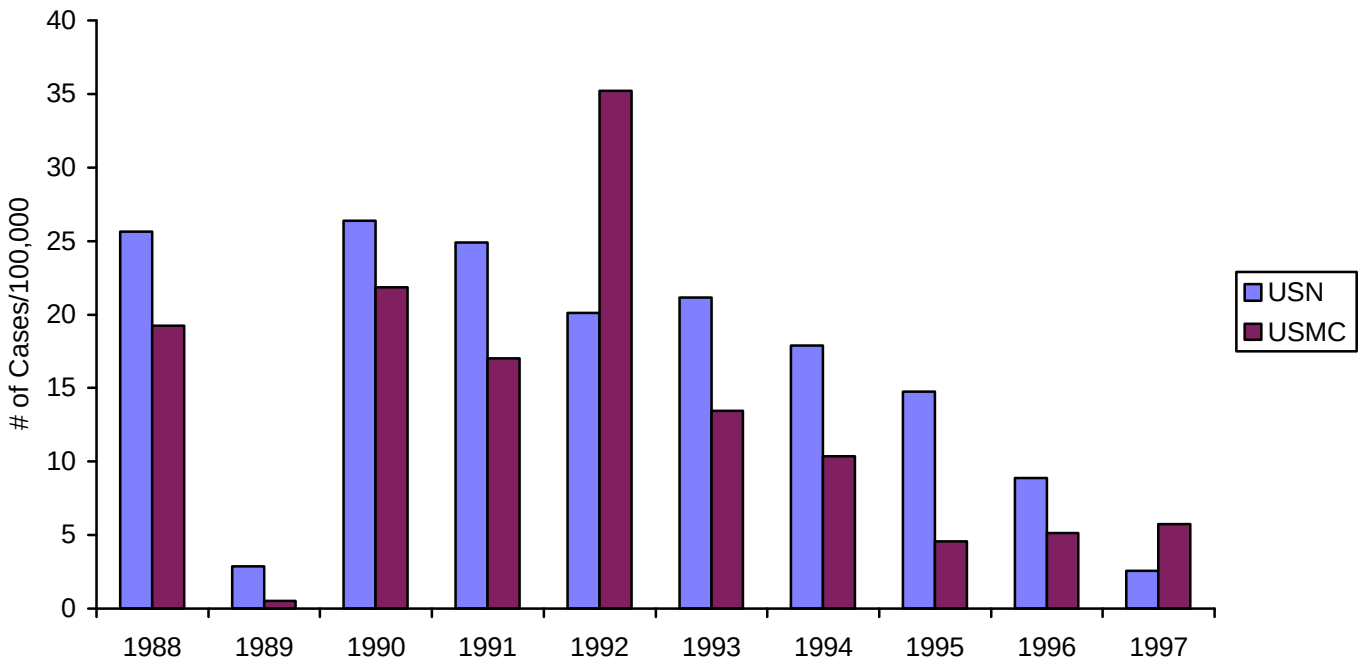


Figure 4. Salmonella, Shigella and Giardia Rates, USN, 1988-1997 (Excludes Outbreaks)

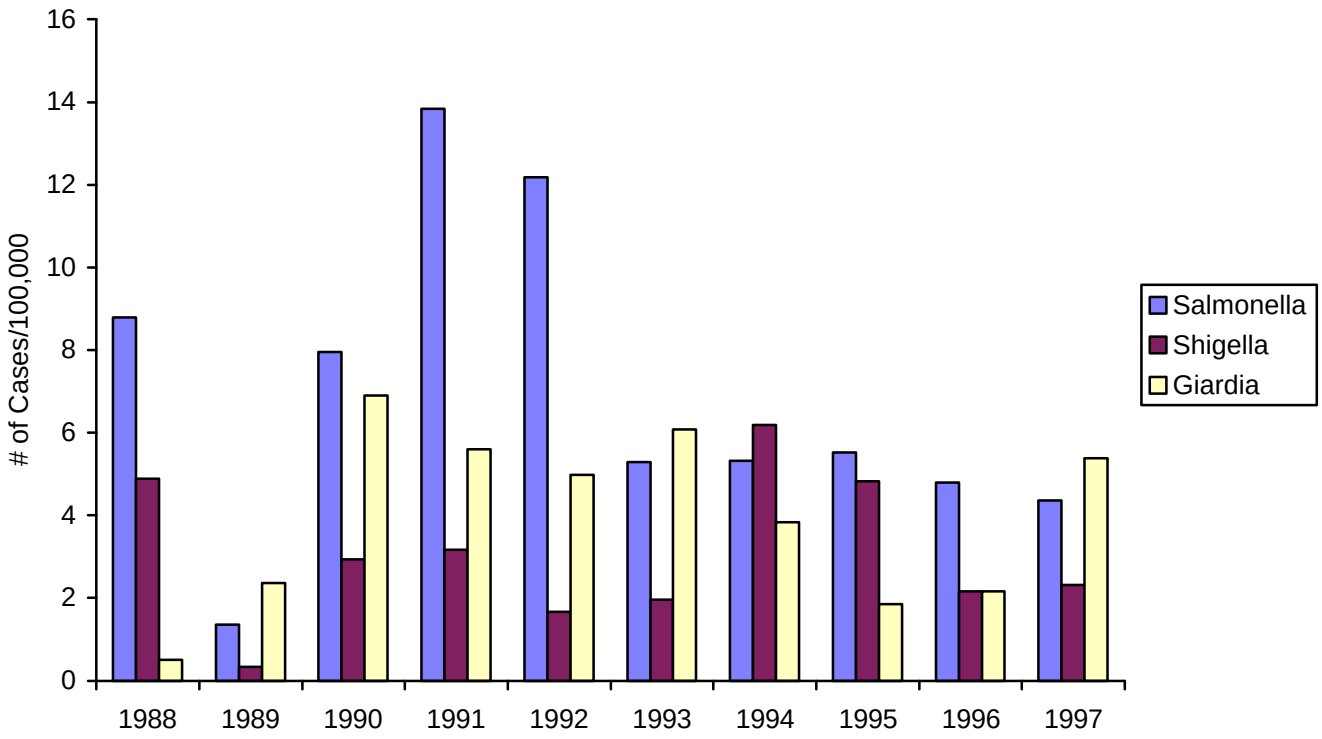


Figure 5. Salmonella, Shigella and Giardia Rates, USMC, 1988-1997, (Excludes Outbreaks)

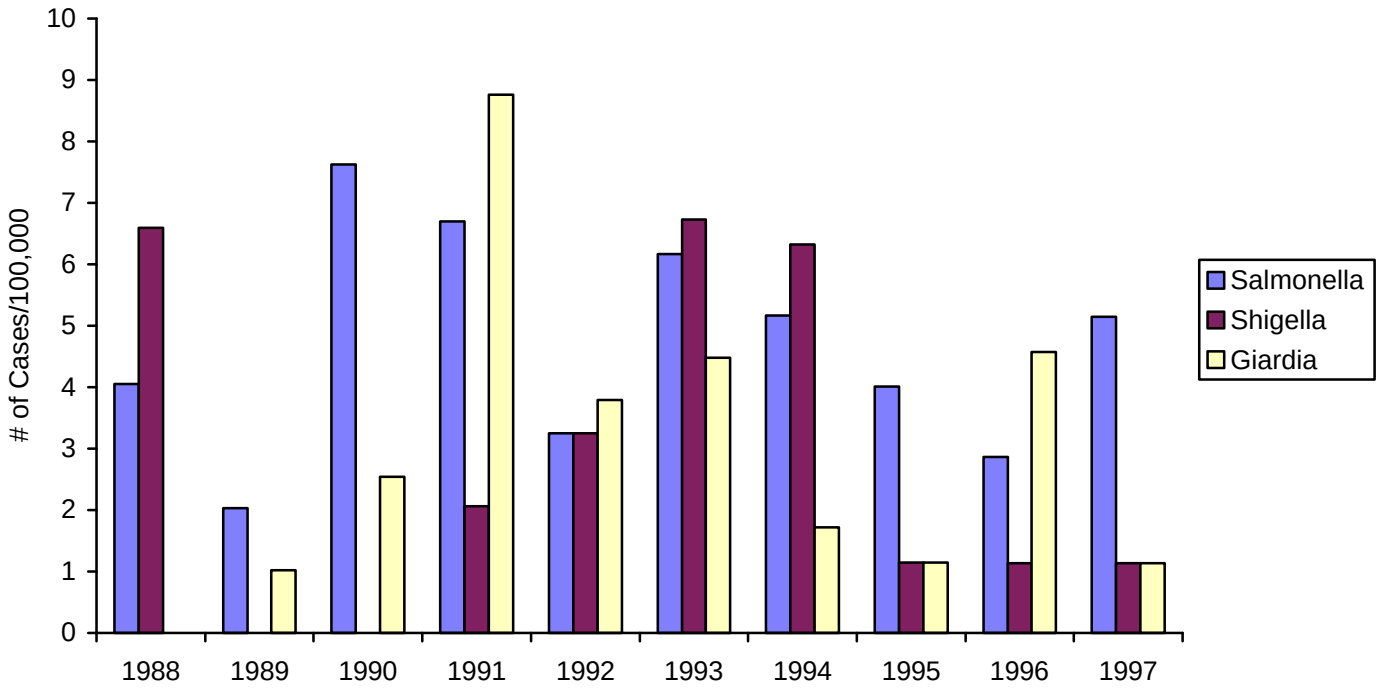


Figure 6. Varicella Rates, USN/USMC, 1988-1997

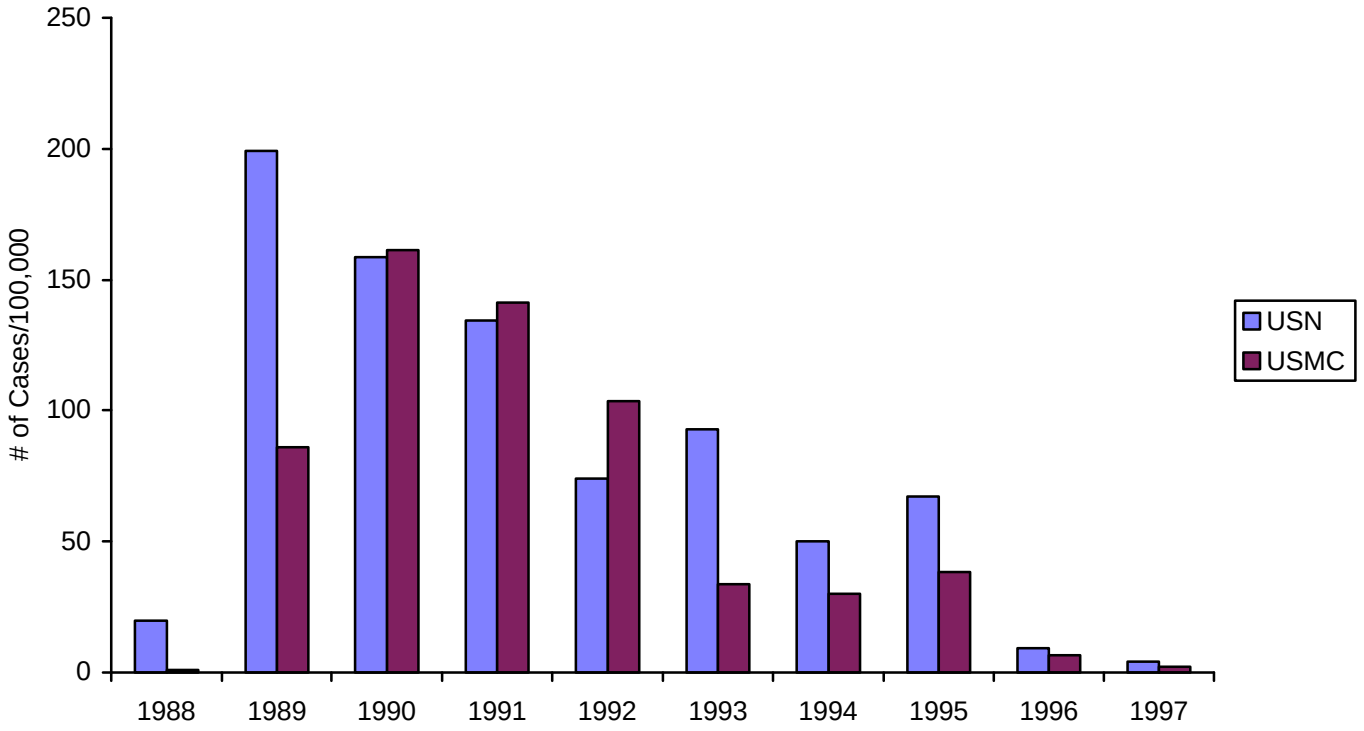


Figure 7. Malaria (all types) Rates, USN/USMC, 1988-1997

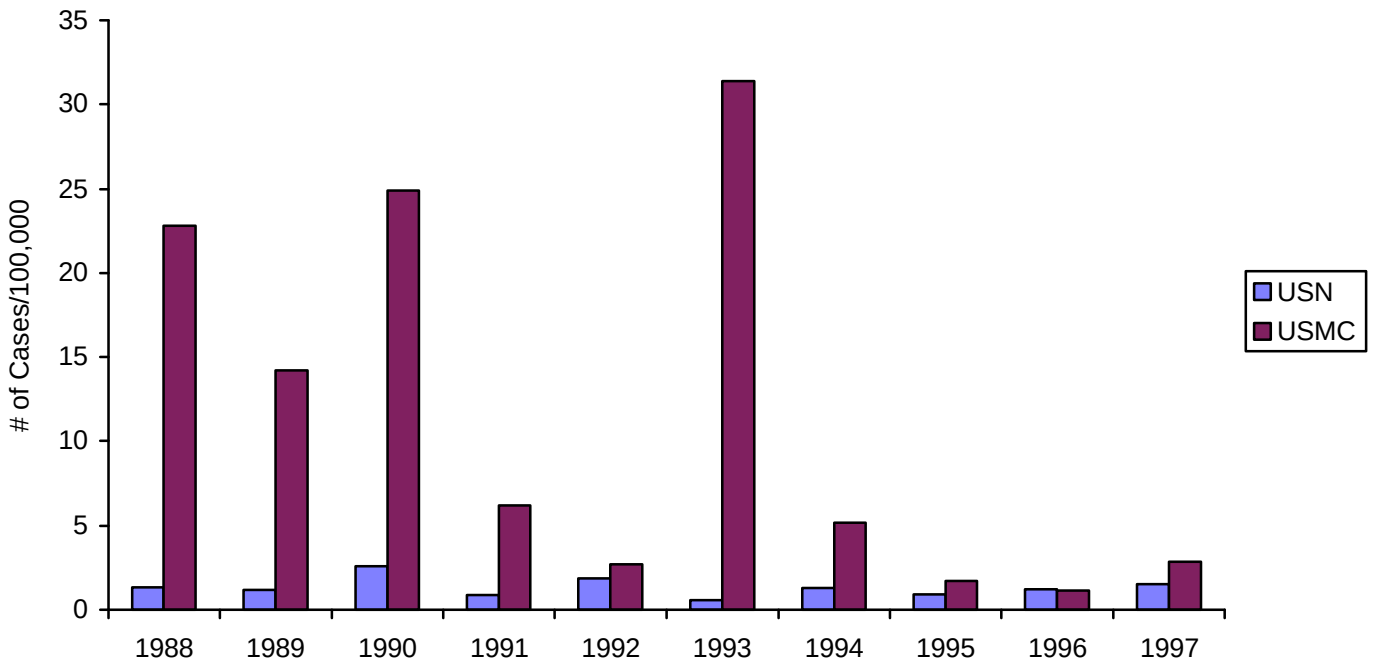


Figure 8. Lyme Disease Rates, USN/USMC, 1988-1997

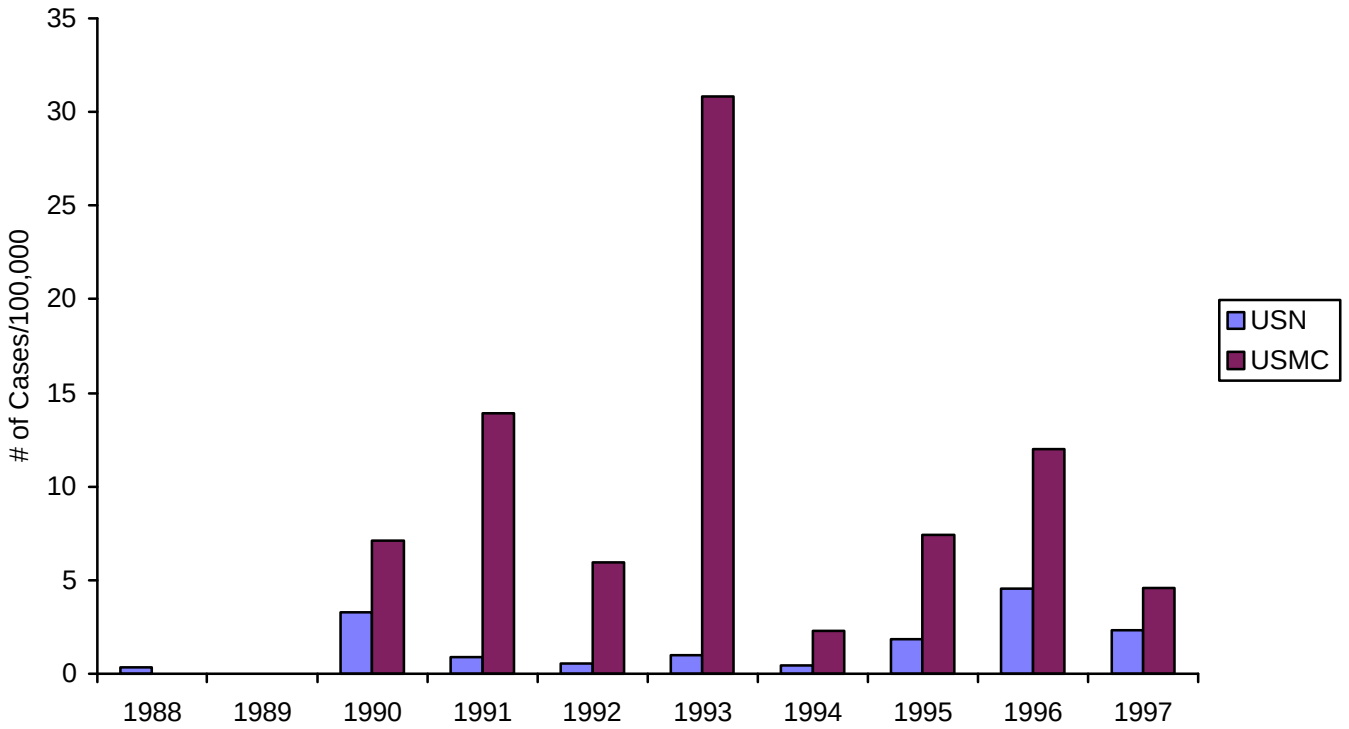


Figure 9. Bites, Rabies Prophylaxis Needed, Rates, USN/USMC, 1988-1997

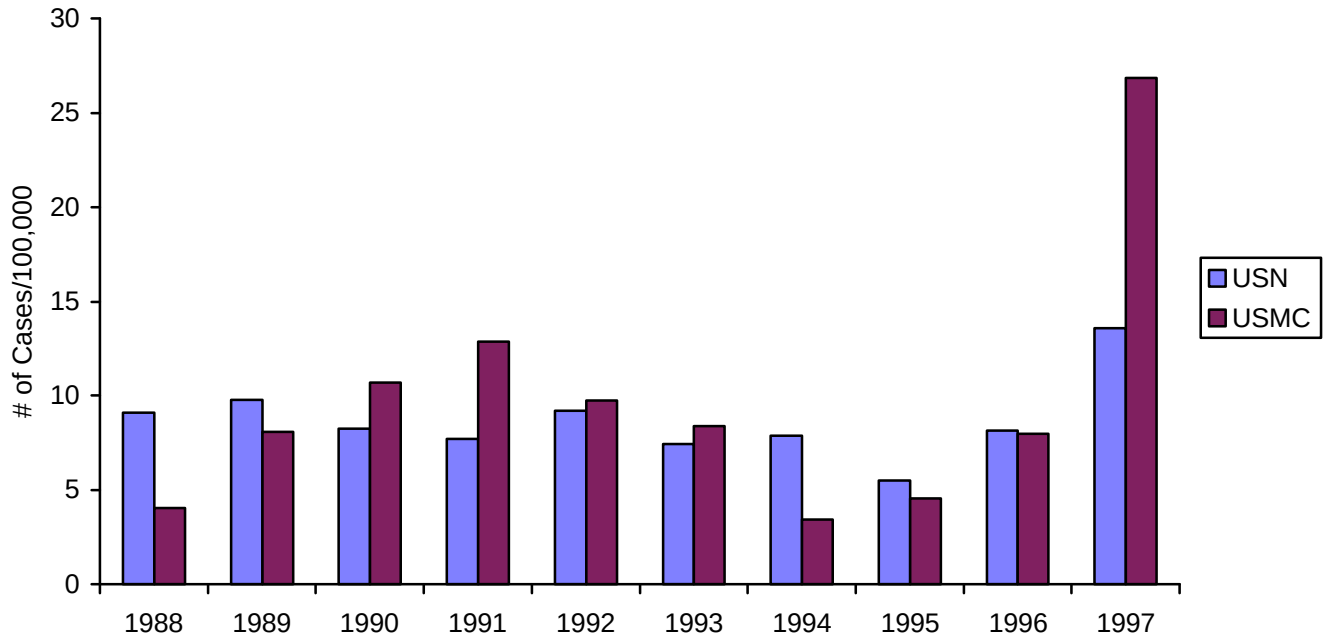
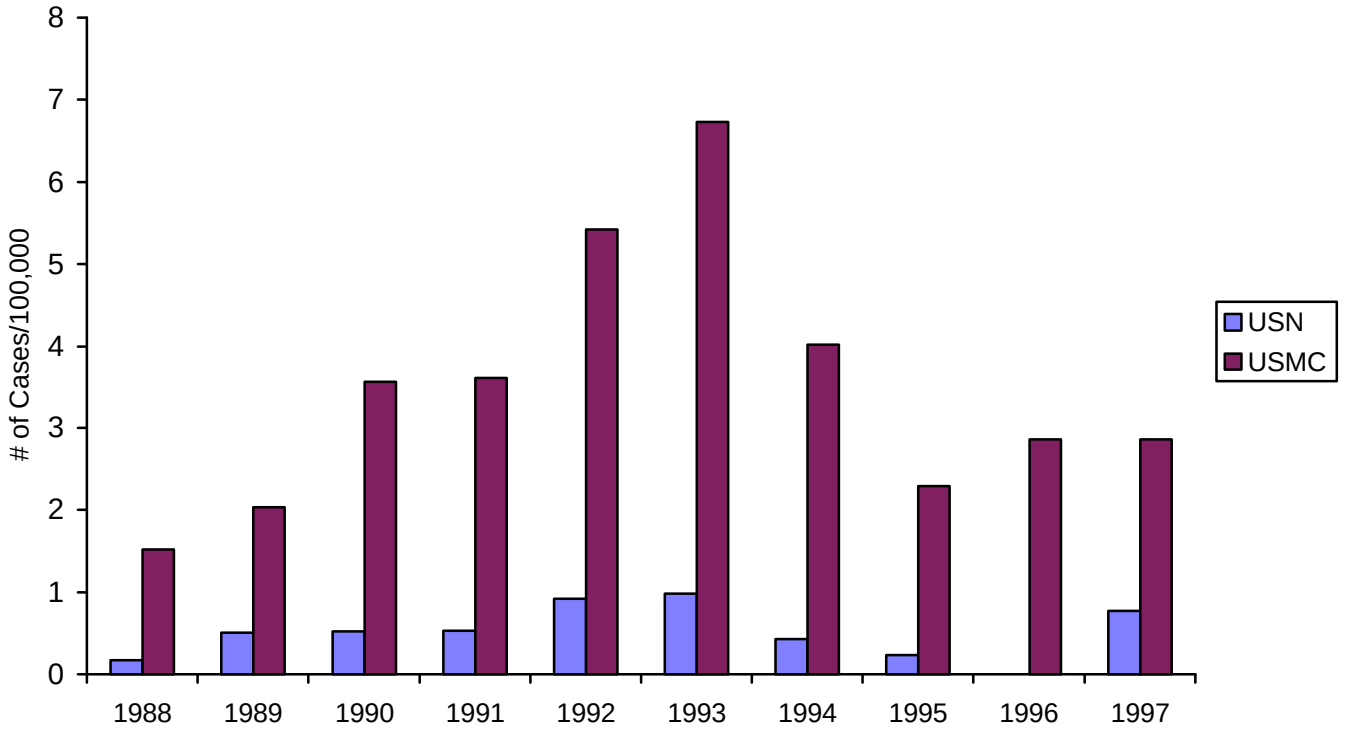


Figure 10. Venomous Bites Rate, USN/USMC, 1988-1997



GLOBAL SURVEILLANCE OF EMERGING DISEASES

The Air Force Global Emerging Infections Surveillance and ResponseSystem (GEIS)

Major Laura Trent, USAF, FS, Epidemiological Services Branch, Brooks AFB

The Air Force Global Emerging Infections Surveillance and Response System (GEIS) is an integral part of the newly designated Force Health Protection and Surveillance Branch located at Brooks AFB TX. This initiative expands long standing programs such as reportable event surveillance and Project Gargle, the sentinel site influenza surveillance program. Expansion opportunities include development of molecular epidemiology capabilities, real-time deployment health data analysis, and automated assessment of clinical laboratory data. Consultative capabilities in emerging infections, tropical and travel medicine as well as outbreak response remain a key element of the Air Force GEIS activities.

The Centers for Disease Control (CDC) utilizes the information obtained through Project Gargle in determining the composition for the annual influenza vaccine. New technologies under development in our Molecular Epidemiology section will soon be utilized in the deployed setting for the rapid identification of biological agents through PCR techniques.

Project Gargle 1997-98 Laboratory Summary Report

Major Laura Trent, USAF, FS, Epidemiological Services Branch, Brooks AFB

From 1 October 97-31 May 98, a total of 2,194 specimens were received in the virology laboratory at Brooks AFB and processed as Project Gargle specimens (Table 3). From the 19 sentinel sites, 1,662 samples were submitted. In addition, there were 347 respiratory specimens from non-sentinel AF sites which are included in this report. In cooperation with the Army and the Navy, collection materials were sent to Cairo, Indonesia, Nepal, Peru, Saudi Arabia, and Thailand in an attempt to establish surveillance there. 185 samples were collected over the season from these areas show graphically influenza isolated from submitted specimens for the last two seasons, respectively.

Every season is unique and the challenge of a surveillance program is to detect the current virus and predict which virus will predominate in the following year. In both the 1996-97 season and the 1997-98 season, 78% of the isolates were identified as influenza (Figures 11 and 12). Last year, 65% of the isolates were influenza A and 15% were influenza B. In contrast, the 97/98 season has been overwhelmingly an influenza A year. From the 19 sentinel sites, only 2 influenza B's were recovered all season (0.4% of all positives), and both of those were collected in March at Sheppard AFB (Texas).

The World Health Organization (WHO) Collaborating Center for Surveillance, Epidemiology and Control of Influenza at the Centers for Disease Control and Prevention (CDC) reported that 99% of the influenza A isolates in the 1996-97 season had been antigenically characterized as A/Wuhan/359/95-like. The A/Wuhan strain was used in the 96/97 vaccine and was selected as the H3N2 component of the 97/98 vaccine due to its overwhelming predominance. A/Sydney/05/97, an antigenically distinct influenza A(H3N2) strain, was first reported by CDC in June 1997; too late for vaccine consideration. Of the isolates submitted by us that have been antigenically characterized by CDC this year, 91% have been the A/Sydney H3N2 subtype.

The first influenza isolate of the 97/98 season was submitted from Andersen AFB, Guam in September. In October and November, the only flus recovered were from Guam, but in December there were positive submissions from 8 of the 19 sentinel sites.

During December and January, an outbreak was identified at Sheppard AFB when 25% of those samples were positive for influenza A. Isolation rates peaked in January and February when influenza A was recovered from 32% of the 997 specimens submitted from all sites in this two month time frame.

Besides the outbreak at Sheppard AFB, influenza A was isolated from 42% of the specimens collected from January through March in Hawaii. Forty-four isolates from the Pearl Harbor Naval Station were sent to CDC for antigenic characterization. The vaccination status was known for the majority of those individuals and the results of this epidemiological study were summarized in the 20 March 98 issue of MMWR (http://www.cdc.gov/ncidod/diseases/flu/fluvirus.htm) and the NMSR Vol 1 No 2. The virus was determined to be A/Sydney/05/97(H3N2)]. This study helped prove that the A/Wuhan/H3N2 component of the vaccine was minimally protective. These same isolates were sent for molecular studies in Dr. Vito Del Vecchio's lab at the University of Scranton.

Overall, nearly 27% of the submitted specimens were positive for a respiratory virus (Figure 14). The program is designed for influenza A and B detection, but adenovirus, an important respiratory pathogen in the military community, is also recovered. The parainfluenza viruses (P1, P2, P3), enteroviruses (Entero), and herpes simplex virus (Hsv) are also often detected and are reported. Demographic information was collected on most of the positive submissions. The average patient age was 24 years (2 mo - 88 yrs) and 56% were active duty individuals. Based on collection information provided, the average time in transit for a specimen was 5.1 days. Most samples were shipped via FedEx with other laboratory specimens in a very timely manner, but some of the more remote sites held the swabs and sent them in batches. There was viral recovery in samples from Peru that had been collected 2 months before we received them in the lab! Disregarding those samples, the average specimen reached this laboratory 3.9 days after collection. The initial culture test is performed after 48 hours of incubation. Of those specimens reported as influenza, 71% were identified and reported in an average of 2.6 days. There were 37 specimens (7%) that did not show evidence of influenza until the last test on day 10. It took an average of 4.1 days to report any virus present. A culture is held and tested 10 days before a final negative report is issued.

As has been true in past years, we have not detected a significant problem with respiratory adenovirus in the Air Force recruit population. Six percent (6/102) of the submissions throughout the season from Lackland AFB were positive for adenovirus and all of these were typed to be either 4 or 7. Serotyping of adenoviruses from other locations is not routinely done.

The season ended with receipt of 44 specimens collected from three remote clinics and shipped to San Antonio from Bangkok. The clinics were run by the Army and located at the River Kwai Christian Hospital on the Thai-Burmese border; at a clinic for expatriates (non-Nepalese civilians) living in Kathmandu, Nepal; and at a clinic for local civilian and military Nepalese. Twenty-two influenza isolates from this geographically significant area are now at CDC for antigenic characterization and at the University of Scranton for nucleotide sequencing. Earlier in the season, samples were received that had been collected by Navy personnel at clinics in Peru and Argentina.

There are tremendous challenges in collecting, storing and shipping samples from these remote sites. The system worked because of the coordinated efforts of many individuals. These viruses provide information from areas of the world that are not well covered by WHO and they contribute significantly to the value of our program. Sites in Bolivia and Brazil are currently being established. This will have future importance since CDC has announced that WHO will be holding a conference in September to determine vaccine composition for the Southern Hemisphere. It will be the first time a

separate vaccine will be considered for this area of the world.

A very exciting addition to the Project Gargle program this year was the molecular sequencing work that was done by Dr. Vito DelVecchio, et al. This work was supported by a Cooperative Research and Development Agreement between Brooks AFB and the University of Scranton. In this study, 138 influenza A isolates that had been received between January 1996 and February 1998 in the Project Gargle program were examined. Cases were matched with the Air Force Reportable Event Surveillance System (AFRESS) database to obtain demographics and case histories. The antigenic drift in these viruses was studied. Nucleotide sequencing and deduced amino acid analysis was performed on the antibody-binding region of the hemagglutinin gene. A dendogram representing genetic relatedness was compared with available epidemiological information to identify case clustering. One probable cluster and four definite clusters were identified. One of these was the Sheppard AFB outbreak from this season. Twenty-two cases were studied. As was shown in other studies, there was a slight genetic drift across time. There were three outliers within this cluster based on location, two of which had a documented travel history prior to the outbreak.

The use of genetic techniques to identify related strains of influenza virus when linked with available patient epidemiological data significantly enhances our ability to identify clusters and demonstrates worldwide mobility of these viruses. This capability enhances the likelihood of projecting future outbreaks and addressing appropriate and timely interventions. The molecular surveillance data is being shared with CDC and will be utilized for the first time to determine the composition of influenza vaccines.

Project Gargle has been in existence since 1976, and through this program the value of the military mandated vaccine program has been supported, numerous outbreaks have been detected in a timely manner, and there have been important contributions to WHO for vaccine composition. Influenza has long been at the top of the list of emerging infectious organisms of concern for potential to cause significant global morbidity and mortality. Because of this, the Global Emerging Infections Surveillance and Response System (GEIS) is now working to make Project Gargle a triservice program. (www.ha.osd.mil/geis) There is every indication that our coordinated efforts will further enhance the surveillance network and contribute to an even better program.

Table 3. Project Gargle Specimen, 1997-98 Season

Base	# Sent	Flu A	Flu B	Adeno	P1	P2	P3	Entero	Hsv	% Isol.	% Flu
Andersen (Guam)	77	18		1	2		1	3	2	35.1%	23.4%
Andrews (Wash D.C.)	58	7								12.1%	12.1%
Elmendorf (Anchorage)	149	42			4	4			4	36.2%	28.2%
Hawaii	121	51							2	43.8%	42.1%
Howard (Panama)	2									0.0%	0.0%
Incirlik (Turkey)	33	6		1						21.2%	18.2%
Kadena (Okinawa)	132	26		1	3				1	23.5%	19.7%
Kunsan (Korea)	56	17							1	32.1%	30.4%
Lackland (San Antonio)	102	9		6	1				1	16.7%	8.8%
Lakenheath(England)	14	9			1					71.4%	64.0%
Maxwell (Alabama)	80	4		4					2	12.5%	5.0%
McGuire (New Jersey)	195	38		4		3			8	27.2%	19.5%
Misawa (Japan)	14	4								28.6%	28.6%
Osan (Korea)	40	4		1	1				1	17.5%	10.0%
Ramstein (Germany)	70	22							1	32.9%	31.4%
Sheppard (TX)	257	52	2	6	3			1	5	26.8%	21.0%
Travis (San Francisco)	188	53		6	1				7	35.6%	28.2%
USAF Academy	25	6		2	1					36.0%	24.0%
Yokota (Japan)	49	17			1				4	44.9%	34.7%
Non-sentinel sites	347	42		11	1		1	1	5	17.6%	12.1%
Cairo											
Indonesia											
Nepal	29	20	1	1						75.9%	69.0%
Peru	141	2		2			1	1	1	5.0%	1.4%
Saudi Arabia(KAS)											
Thailand	15		1	2	1					20.0%	6.7%
Totals:											
Sentinel sites	1662	385	2	32	18	7	1	4	39	29.4%	23.3%
Nonsentinel sites	347	42	0	11	1	0	1	1	5	17.6%	12.1%
Special sites	185	22	2	5	1	0	1	1	1	5.0%	1.4%
Total Rec'd	2194										
Total Positive	556	449	2	45	19	7	3	6	45		
% Positive	25.9%	20.5%	0.1%	2.1%	0.9%	0.3%	0.1%	0.3%	2.1%		
% of isolates		80.8%	0.4%	8.1%	3.4%	1.3%	0.5%	1.1%	8.1%		

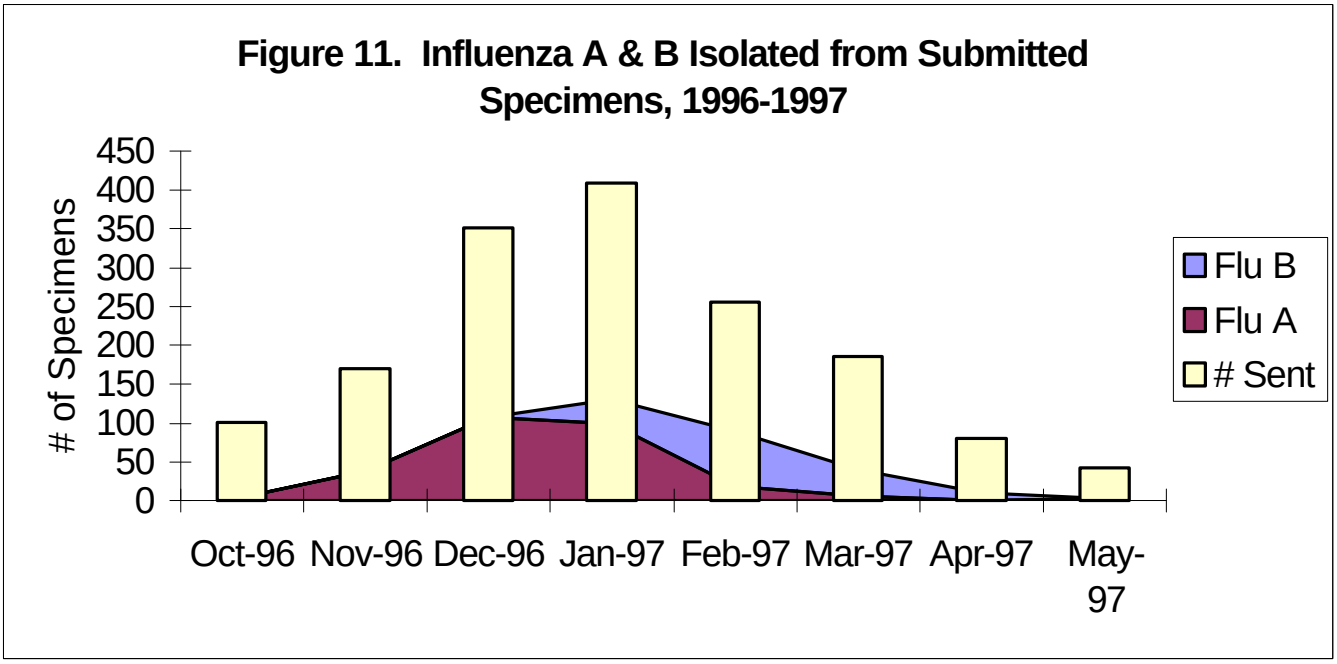


Figure 11. Influenza A & B Isolated from Submitted Specimens, 1996-1997
# of Specimens
450
400
350
300
250
200
150
100
50
0
Oct-96
Nov-96
Dec-96
Jan-97
Feb-97
Mar-97
Apr-97
May-97
Flu B
Flu A
Sent

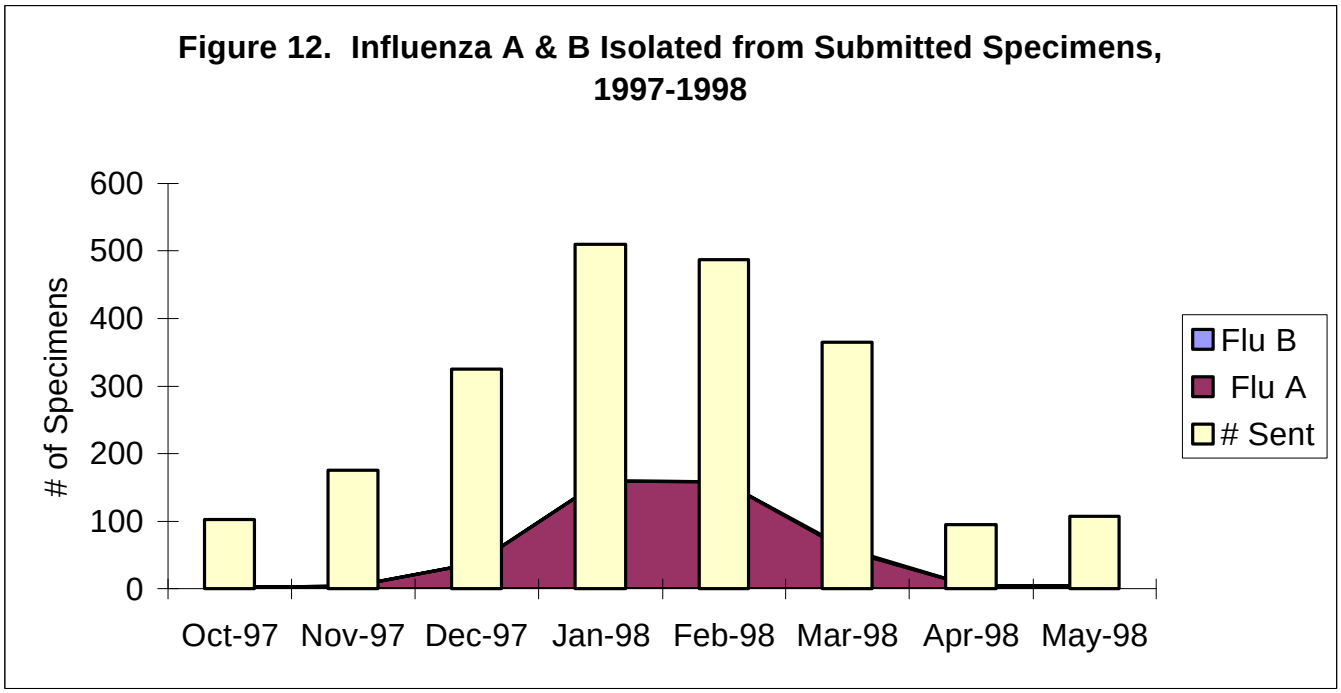


Figure 12. Influenza A & B Isolated from Submitted Specimens, 1997-1998
# of Specimens
600
500
400
300
200
100
0
Oct-97
Nov-97
Dec-97
Jan-98
Feb-98
Mar-98
Apr-98
May-98
Flu B
Flu A
Sent

OUTBREAKS

An Egg-Associated Outbreak of *Salmonella virchow* Among U.S. Army Troops Stationed in Dhahran, Saudi Arabia

Submitted by LT Dorina Maris, MSC, USN, Naval Medical Research Institute, Bethesda, MD, on work performed by MAJ David Twillie, MC, USA and ARCENT-KSA staff, the JTF-SWA Theater Medical Surveillance Team (Lt Col Robert Johnson, MC, USAF; CDR Richard L. Haberberger, MSC, USN; MAJ Steven R.Hinten, BSC, USAF; LT Maris; SSgt Karl J. Giese,USAF; HM1 Ron Finnegan, USN), staff from King Abdul Aziz Air Base Ministry of Defense and Aviation (MODA) Hospital, Saudi Arabia, and staff from Foodborne Diseases Branch, Centers for Disease Control and Prevention

Southwest Asia is the largest operational theater for our military. An outbreak of *Salmonella virchow* occurred between 23 September and 4 October, 1997 among U.S. Army troops deployed to Eagletown, Dhahran, Saudi Arabia in support of Operation Southern Watch. Up until the outbreak the historical mean of diarrhea cases seen at the clinic was less than two per week. When 112 soldiers assigned to eight separate units reported gastrointestinal illness within less than a week -- attack rates varying between 5% and 43%, the joint task force theater surgeon (JTF-SWA/SG) tasked the Theater Medical Surveillance Team assigned to Southwest Asia (TMST) to conduct a standard epidemiologic investigation. TMST members obtained investigative protocol approval, gathered photographs, environmental samples and inspection records from the only dining facility on site, examined clinic records, subcultured the isolates obtained at the local Saudi hospital from one blood and ten stool specimens, and facilitated the screening of 35 food handlers for carrier state.

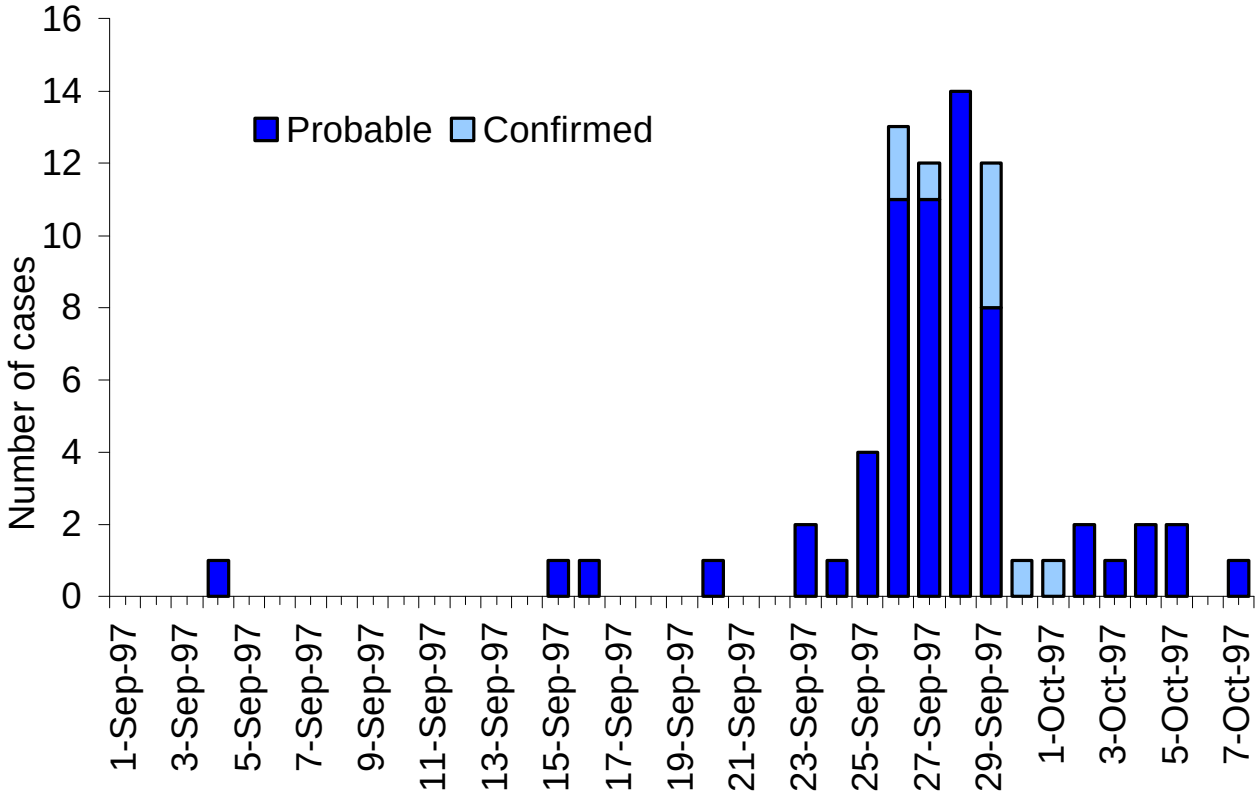
A confirmed case of salmonellosis was defined as isolation of *Salmonella spp*. from a clinical sample obtained from symptomatic Eagletown personnel. A probable case was defined as either one of the following scenarios: (1) loose stools for two or more consecutive days; (2) a combination of two or more symptoms, at least one being GI related (constipation, abdominal cramps, vomiting, nausea, headache, malaise, fever). Following a case-control study design, information was collected during four sessions from 49 ill and 37 not ill individuals, and was subsequently entered and analyzed using Epi Info version 6.04b.

Illness in 91 individuals met the probable or confirmed case definition and the epidemic curve suggested a common-source outbreak (Figure 13). Symptoms of the ill individuals included diarrhea (94%) with 54% reporting more than 10 loose stool episodes, abdominal cramps (85%), fever (56%), headache (52%), vomiting (43%), malaise (26%), and chills (25%). Duration of illness ranged from 1 to 14 days, although 66% were ill for only 3 days.

Salmonella Group C1 was recovered from 10 specimens submitted to the local Saudi hospital, nine from stool, one from blood. The septicemic patient was hospitalized due to symptoms suggestive of meningitis. In addition, one Army sargeant responsible for supervising local food handlers turned out positive for *Salmonella C1*.

Survey responses revealed that the epidemic was most likely triggered by the consumption of undercooked, contaminated eggs served at the military dining facility. Food-specific odds ratios for 39 cases and 32 controls who ate at least one breakfast meal on September 25th or 26th are given in Table 4. Furthermore, scrambled eggs seemed to be more closely associated with illness than were hard boiled eggs (OR = 3.3, $P<0.10$); this data along with Table 5 suggest a dose-response effect between illness and eggs. Direct observations and discussions with individuals identified food service sanitation deficiencies.

Figure 13. Epidemic Curve: Cases by Onset Date



Environmental cultures yielded no enteric pathogens. All Salmonella isolates were subsequently serotyped at the CDC as *Salmonella virchow*. All were resistant to tetracycline and trimethoprim sulfamethoxazole, but susceptible to chloramphenicol, gentamycin, ciprofloxacin, augmentin, cefuroxime, and ceftriaxone.

A foodborne epidemic caused by *Salmonella virchow* is of particular concern because this serotype is one of the few non-typhoid *Salmonella spp.* associated with increasingly more invasive disease in humans around the world.[1, 2] The spectrum of illness surprisingly includes foodborne meningism,[3] systemic infection due to a lactose-fermenting strain,[4] and uncommonly frequent abscess formation even in the absence of a recent history of gastrointestinal illness.[5, 6] Furthermore, the strain is reportedly acquiring multiple drug resistance.[7] Finally, *Salmonella* Group C1 may be the most prevalent serogroup found in contaminated animal feed in the Persian Gulf region.[8, 9]

This event raises several force protection issues and our experience suggests that existing outbreak investigation protocols and clinical microbiology protocols could be improved.

Table 4. Breakfast Food Odds Ratio Based on Survey Responses From 39 Cases and 32 Controls Who Ate at Least One Breakfast Meal on September 25th or September 26th, Eagletown, Dhahran, Kingdom of Saudi Arabia

	Cases		Controls				
Food Items	**Ate Item**	**Did NOT Eat Item**	**Ate Item**	**Did NOT Eat Item**	**OR**	**95% exact CI**	**P Value**
Eggs	**38**	**1**	**25**	**7**	**10.6**	**1.2 - 491.8**	**0.019***
French Toast	24	15	10	22	3.5	1.2 - 10.7	0.012
Sausage	16	23	6	26	3.0	0.9 - 10.9	0.045

* Fisher's exact two-tailed P, else Mantel-Haenszel P

Table 5. Association Between Scrambled Egg Dose and Development of Signs/Symptoms Within 72 Hours of the Breakfast Meal, Given That at Least One Dose Was Consumed on September 25th or 26th

Cumulative number of times one reported eating scrambled eggs	Cases	Controls
0	0	6
2	1	0
3	16	5
Chi square for linear trend =		**10.7**
P =		**0.001**

Lessons Learned

Force Protection Issues

1. The implementation of broad spectrum preventive protocols at the onset of a foodborne epidemic is the single most important factor responsible for minimizing the impact of an outbreak.
2. Thorough periodic review of food storage and preparation practices, especially for foods at high risk for contamination with Salmonella (e.g. eggs, poultry, and meat products) goes a long way towards prevention.
3. For USDA and the FDA guidelines towards minimizing morbidity and mortality associated with the consumption of *Salmonella* infected whole shell eggs, see reference (10) and
4. Because eggs for all troops stationed in Southwest Asia are purchased from local vendors, implicating eggs in this outbreak raises food safety concerns regarding so-called “non-approved” sources. It has been suggested that in dining facilities serving large numbers of people, most egg-associated salmonellosis may be prevented by using pasteurized, rather than fresh eggs.[10]
5. In this epidemic, we found one food services supervisor harboring *Salmonella* Group C1. Both contractor and military food handlers should be encouraged to voluntarily report suspected illness, without fear of reprisal.
6. Extended follow-up of known cases of this outbreak may help document onset of possible insidious complications, as well as drug resistance patterns for this unusual pathogen.

Outbreak Investigation Protocols

1. Our experience suggests that conducting in depth interview with outlier survey responders may quickly uncover the index case (if any) and may eliminate ambivalent results regarding the source or the mechanism of transmission of the epidemic.
2. Likewise, focused trace backs of the food batches most likely implicated (in this instance, eggs) help clarify the source and mechanism of an epidemic.
3. Because not all enteric pathogens induce diarrhea, yet all will produce some form of gastrointestinal sign and/or symptom, adopting a broader case definition at the onset of a suspected foodborne illness (e.g. constipation and nausea, or abdominal cramps and fever) may provide a more timely trigger for an investigation.
4. Familiarity with CDC's software Epi Info is a valuable asset in deployed settings.

Clinical Microbiology Protocols

1. Since some strains of *S. virchow* are lactose positive and given the high prevalence of *Salmonella* Group C1 in the Gulf region, screening stools simply for nonlactose fermenters may be an inadequate method for detecting enteric pathogens in patients suspected of acquiring their illness in Southwest Asia. Therefore, identification schema from enteric sources should include isolation of morphologically distinct lactose positive colonies onto nutrient agar plates and subsequent screening for H_2S production using TSI slants. (Note: Besides *S. virchow*, two other possible but rare enteric pathogens initially presenting as lactose positive on MacConkey agar plates are *Aeromonas spp.* and *Plesiomonas shigelloides*, both of which are also oxidase positive).[11]
2. The importance of specimen labeling can never be over-emphasized in facilitating appropriate follow-up, yet it is often over-looked.
3. Isolates from suspected outbreaks should be saved onto nutrient agar slants and sent to the CDC for serotyping and further characterization. Multiple importation permits from deployed settings can be obtained from the CDC in 1 to 10 days (see http://www.cdc.gov/od/ohs/biosfty/imprtper.htm).

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Review of Published Outbreaks on Cruise Ships, 1988-1997

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Outbreaks of infectious diseases that occur on cruise ships are of interest to the U.S. Navy. They are the closest approximation of the living and working environment of the Navy. Outbreaks aboard cruise ships have a high potential of spreading due to the crowded living conditions, shared sanitary facilities, and shared food sources. These same conditions occur on U.S. Navy vessels. The main difference between cruise ship and Navy outbreaks are the cycles of transmission to new people. A cruise ship generally has the same people on for a limited time, usually 3-15 days. A U.S. Navy vessel often has six-month deployments with only minor changes in passengers.

Cruise ships often have crews from many different countries with many different endemic diseases and vaccination policies. Crews aboard U.S. Navy vessels are generally from the United States and have received vaccinations required by the Navy. An estimated four million people travel aboard North American cruise ships each year.[1] There are approximately 5,000 personnel on board each of 12 active carriers in the fleet (60,000 people per year).

It is believed that under-reporting of cases on cruise ships is a major problem. Many passengers do not report their illness to the medical department aboard due to fees that may be incurred. Many crewmembers on cruise ships do not report illness due to fear of retribution. The U.S. Navy vessel has free medical for all personnel aboard and so under-reporting is minimized. Tables 6 and 7 describe some of the outbreaks that have occurred on cruise ships and aircraft carriers over the last 11 years.

Table 6. Published Cruise Ship Outbreaks and Number Ill, 1988-1997

Outbreak Agent	Year	Passengers Total	Passengers Reported Ill	Crew Total	Crew Reported Ill
Small Round Structured Virus (SRSV)	1988	1173	237	752	28
Shigellosis	1989	818	72	518	12
Norwalk	1990	527	217	306	28
Legionnaires	1994 (3 cruises)	4500	50	688	0
SRSV	1995 (4 cruises)	4400	378	400	~30
Rubella	1997 (2 cruises)	10,400	Unknown	1285	23

Table 7. Reported Outbreaks on United States Aircraft Carriers, 1991-1997

Year	Ship	Cases Reported	Diagnosis	Diagnosis Status
1991	CVN	44	Food Poisoning	Presumptive
1991	CV	14	Food Poisoning	Presumptive
1991	CV	550	Gastroenteritis	Unconfirmed
1993	CV	23	Food Poisoning	Confirmed
1994	CV	222	Food Poisoning	Confirmed
1994	CV	100	Gastroenteritis	Unconfirmed
1996	CVN	815	Gastroenteritis	Confirmed
1996	CVN	238	Gastroenteritis	Presumptive

Personnel aboard US Navy ships must be aware of the possibility of outbreaks. The close living quarters, limited space, and shared sanitary facilities make the ship a perfect place for an outbreak. Personnel must be vigilant to ensure the cleanliness of the ship, that personal hygiene practices are followed, and that all personnel are current on their vaccines.

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1. "Rubella Among Crew Members of Commercial Cruise Ships—Florida, 1997." *JAMA*; 279:348-350, 1998

U.S. Navy Studies on Diarrheal Disease in Operational Environments

Outbreaks are important to the military. As evidence of this, readers are referred to the published literature of US Navy studies of diarrheal diseases in operational environments. Since 1979, there have been at least 34 articles published in 15 peer-reviewed journals. Navy scientists from 10 institutions have published studies on this topic. These scientists have been distributed world-wide and have been associated with U.S. Naval Medical Research Unit No. 2 (formerly Taipei, Republic of China, now Jakarta, Indonesia), Naval Medical Research Institute (Bethesda, MD), U.S. Naval Medical Research Unit No. 3 (Cairo, Egypt), U.S. Naval Medical Research Institute Detachment (Lima, Peru), Walter Reed Army Institute of Research (Washington, DC), Armed Forces Research Institute of Medical Sciences (Bangkok, Thailand), U.S. Army Medical Research Unit (Brazil), U.S. Navy Environmental and Preventive Medicine Unit No 7 (Naples and Sigonella, Italy), and the U.S. Navy Environmental and Preventive Medicine Unit No. 6 (Pearl Harbor, Hawaii).

A listing of the ten most recent articles provides a sense of the scope and depth of this literature:

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ENVIRONMENTAL DATA

Pediatric Lead Poisoning Prevention (PLPP) Program

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Military pediatric lead poisoning prevention programs were established in response to studies showing an association between low-level lead exposure and child development. Following ASD/Health Affairs and ASD/Production and Logistics memo of November 1992, BUMEDINST 6200.14 provides guidance on medical screening to all Navy-sponsored health care facilities that evaluate and treat children. This guidance is based on the 1991 CDC publication "Preventing Lead Poisoning in Young Children." In conjunction with the Navy PLPP, Naval Facilities Engineering Command provides lead-based paint risk assessment of DoD housing and related structures.

When the program was started, the main features of medical screening were the following:

1. Questionnaires administered for children 6 years of age and younger starting at the one-year well baby check-up, then updated annually.
2. Blood lead testing of all children at the one-year well baby check-up and on children categorized as high risk by questionnaire.

Navy Medical Treatment Facilities (MTFs) report the results of screening blood lead tests to the Navy Environmental Health Center (NEHC). Screening tests may be done on capillary or venous blood. If capillary blood tests show levels at or above 10 μg/dl, confirmatory tests must be done on venous blood. The screening tests reported to NEHC for levels at or above 10 μg/dl are the results of the venous tests.

Data from the Navy and the other services have shown that elevated blood lead levels are not a significant problem among military dependents. In June 1995, ASD/Health Affairs modified policy and allowed commanding officers of MTFs to suspend the requirement for universal blood lead screening of infants considered low risk by questionnaire if analysis of local community data showed that the percentage of children found not to have elevated blood lead levels was greater than or equal to 98% (an elevated blood lead level is defined as greater than or equal to 10 μg/dl). More than half of Navy MTFs report that they have suspended universal blood lead screening of low risk children.

Conclusion: Elevated blood lead levels are not a significant problem among Navy dependents (Table 8). Even in children considered high risk by questionnaire, most have blood lead levels below 10 μg/dl (Table 9). Place of residence is not a significant factor for having elevated blood lead levels at or above 20 μg/dl (Table 10).

Table 8. Blood Lead Levels FY 1994-1997

Blood Lead Levels (μg/dl)	Number	Percent
<10	47,092	98.13
10-19	829	1.73
20-44	64	0.13
45-69	5	0.01
>70	0	100.00

Table 9. Blood Lead Levels FY 1995-1997 According to Risk (Risk Determined by Questionnaire)

Blood Lead Levels (μg/dl)	High Risk	Low Risk
<10	9944 (96.53%)	14557 (98.90%)
10-19	326 (3.17%)	154 (1.05%)
20-44	28 (0.27%)	7 (0.05%)
45-69	3 (0.03%)	0 (0.00%)
>70	0 (0.00%)	0 (0.00%)
Total	10301 (100%)	14718 (100%)

Table 10. Blood Lead Levels FY 1995-1997 According to Residence (on or off base)

Blood Lead Levels (μg/dl)	On Base	Off Base
<10	14193(98.27%)	15824 (97.92%)
10-19	226 (1.56%)	317 (1.96%)
20-44	22 (0.15%)	17 (0.11%)
45-69	2 (0.01%)	2 (0.01%)
>70	14443 (99.99%)	16160 (100%)