disease prevention news

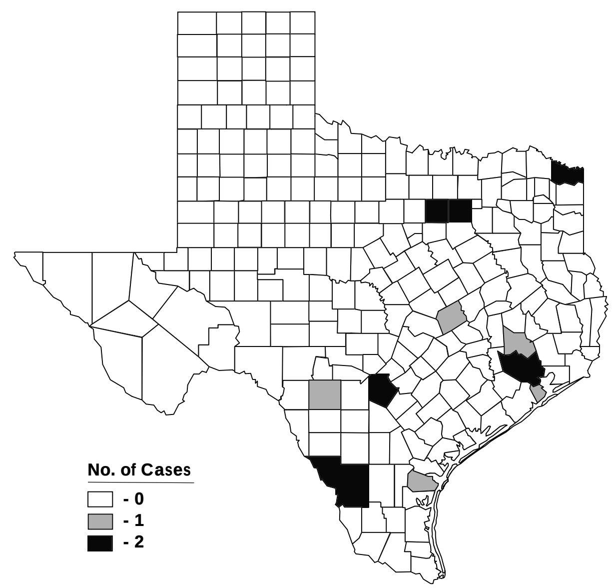
Primary Amebic Meningoencephalitis in Texas, 1983-1996

Five cases of primary amebic meningoencephalitis (PAM) were reported in Texas in 1995. During the previous 12 years (1983-1994), a total of 12 cases were reported from throughout the state (Figure 1) -- with no more than 3 cases reported in any given year (Figure 2). To determine whether these data reflect a true increase or better reporting, death certificates were collected for all individuals who died from 1983 through 1995 as a result of rare or poorly specified types of meningitis or encephalitis. After a review of patient medical records, data analysis indicated an actual increase in the number of PAM cases in 1995.

Primary amebic meningoencephalitis (PAM) is caused by *Naegleria fowleri*, a freshwater ameba. *N. fowleri* is a thermophilic organism that grows best at temperatures around 100°F. Consequently, this disease usually occurs from June through September. Patients usually become infected when swimming in warm, natural bodies of fresh water. Infection is believed to occur when *N. fowleri* in the water goes up the nose, passes through the olfactory apparatus, and invades the gray matter of the central nervous system.

PAM is most commonly diagnosed in young males. It has been proposed that those who become infected have an immunoglobulin A deficiency which would result in a weaker defense at the mucous membrane level. Two to 7 days after exposure to contaminated fresh water, patients develop symptoms similar to those of bacterial meningitis: headache and fever, followed by stiff neck, vomiting, confusion, agitation, paralysis, seizures, coma, and death. A spinal tap usually reveals an elevated white blood cell count (>100 cells/ mm^3) with a high percentage of polymorphonuclear leukocytes (>70%), a depressed glucose level (<50 mg/dL), and an elevated protein level (>60 mg/dL). Most patients die, usually by the seventh day. A few patients have been successfully treated using a combination of intravenous and intrathecal amphotericin B, miconazole, and oral rifampin. Preventive measures focus on keeping water containing *N. fowleri* from being forced up the nose: swimmers are cautioned to avoid deep water diving and to pinch their nostrils closed before jumping in water.

Figure 1. PAM Cases by County, 1983-1996



Another form of amebic meningoencephalitis, granulomatous amebic encephalitis (GAE) is caused by several species of *Acanthamoeba* and *Balamuthia mandrillaris* (leptomyxid ameba).

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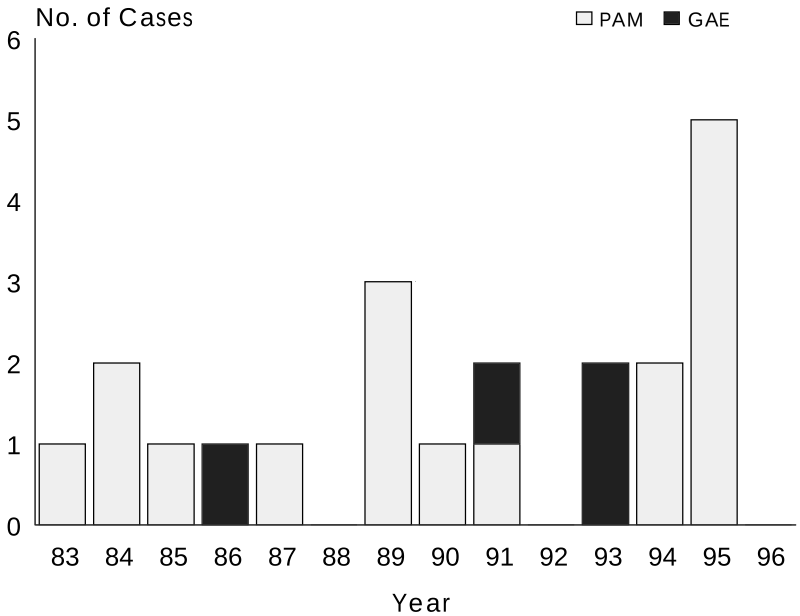
GAE, which has an insidious onset and a protracted course lasting weeks to months, is characterized by mental status abnormalities, seizures, fever, headache, and hemiparesis. Four cases of meningoencephalitis due to leptomyxid amebae were reported in Texas from 1983 through 1996 (Figure 2).

Figure 2. PAM and GAE Cases, 1983-1996



Methods and Materials

Death certificates dated 1983 through 1994 for patients aged 4 years through 15 years and coded with one of 11 ICD9 codes were obtained from the Texas Department of Health (TDH) Bureau of Vital Statistics (Table 1). When a death certificate was coded for meningitis, encephalitis, or myelitis of unspecified cause, a letter requesting all pertinent documents regarding the patient (i.e., history and physical data, laboratory reports, discharge summaries and autopsy findings) was sent to the hospital in which the patient died. Data regarding symptomatology, date of death, duration of illness, final diagnosis, and hematology and cerebrospinal fluid (CSF) test results were abstracted from these medical records. Data were abstracted from the death certificates of the remaining patients. All data were analyzed using EpiInfo.

Results and Discussion

From 1983 through 1994, death certificates for 58 patients were coded with one of the pertinent ICD9 codes (Table 1). After the death certificates were reviewed, medical records were requested for 30 of the 58 patients. Information for 29 of the 30 patients was received; the medical record for 1 patient was not located. Review of all death certificates and 29 medical charts revealed that 16 of the 58 patient diagnoses were amebic encephalitis/meningoencephalitis, 12 were PAM, and 4 were GAE. Death certificates mentioned amebic encephalitis/meningoencephalitis for only 9 of the 16 patients. In a couple of cases, amebic encephalitis/meningoencephalitis was mentioned as the cause of death, but the wrong ICD9 codes were assigned (323.8 or 323.9 instead of 136.2) (Table 1). In the other cases, the causes of death were incorrectly listed as suppurative necrotizing meningoencephalitis, meningitis, meningitis/encephalitis, and brain stem encephalitis, and the corresponding ICD9 codes were assigned.

Eighteen of the remaining 42 death certificates were for patients who died from May to September. Twelve of the 18 patients were ruled out as potential amebic meningoencephalitis patients because they had pre-existing conditions such as chronic postmeningitis syndrome. Medical records for 3 of the other 6 patients who died during May-September showed CSF lab results considered atypical of PAM.

For the last 3 patients, insufficient data were available for definitive confirmation of PAM. Suppurative necrotizing meningoencephalitis was listed as the cause of death for one of the remaining patients. Pathologically, PAM can

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present as suppurative necrotizing meningoencephalitis. It is common for *N. fowleri* to destroy the olfactory bulbs and cause a purulent exudate at the base of the brain. Cardiorespiratory arrest resulting from meningitis due to an unspecified bacterium was listed as the cause of death for the second patient. Acute lobar pneumonitis secondary to meningitis of unknown etiology was listed as the cause of death for the third patient. This information indicates that the first patient is likely to have had PAM, and the other two probably did not.

The average number of PAM cases per year from 1983 through 1996 was 1 (Figure 2). The 3 patients discussed above died in 1983, 1986, and 1989, respectively. If all 3 had actually had PAM, the average number of cases from 1983 through 1994 would have been 1.25. Thus, using an expected value 1.25 cases per year, the 5 cases reported in 1995 represented a true increase (Fishers Exact Test, p = 0.009). The next highest number of PAM cases occurred in 1989 when 3 cases were diagnosed (4 if patient 3 had PAM).

An increased number of cases in given years might be explained by changes in environmental conditions. For instance, hot dry conditions might increase the concentration of *N. fowleri* by facilitating the growth of amebae and causing bodies of water to shrink due to evaporation. However, when hot and extremely dry conditions prevailed in Texas in 1996, not a single case of PAM was reported. Therefore, other factors are involved.

Extensive TDH Laboratory testing over many years has confirmed that these species of amebae are ubiquitous in fresh water lakes, ponds, and rivers. The July 10, 1995, issue of DPN (Vol.55, No. 14) contains more detailed information about laboratory procedures and a description of health department surveillance for PAM conducted in the past. These efforts have shown that the most effective prevention efforts are focused on public education regarding personal precautions and proper swimming pool maintenance. (See companion article.)

For further medical information contact Dr. Kate Hendricks at (512) 458-7676.

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Table 1.

ICD9 Code	Condition
006.5	Amebic brain abscess
006.9	Amebiasis, unspecified
123.1	Cysticercosis
136.2	Specific infections by free-living ameba
320.8	Meningitis due to other specified bacteria
320.9	Meningitis due to unspecified bacteria
321.2	Meningitis due to viruses not elsewhere classified
321.8	Meningitis in bact. infection classified elsewhere
322.9	Meningitis, unspecified
323.8	Other causes of encephalitis or myelitis
323.9	Unspecified cause of encephalitis or myelitis

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Prevention of Infections Associated with Water Recreation

The most serious infection associated with water recreation is PAM.

Swimmer's ear, or acute diffuse otitis externa, is a mild infection commonly associated with water recreation, especially during hot, humid weather. Another mild infection, swimmer's itch, is a schistosomal dermatitis that occurs when humans swim in water containing snails infected with cercariae. Water related infections that are much less common include *Vibrio vulnificus* skin infections and sepsis, which occur through exposure of a wound to seawater. *V. vulnificus*, which is part of the normal marine flora, reaches infectious thresholds easily during warmer months.

Swallowing water puts swimmers at risk of ingesting enteric pathogens. Outbreaks of enteric diseases associated with swimming have been documented. For instance, giardiasis outbreaks have been associated with infant and toddler swim classes and also with a water slide pool.

The most serious infection associated with water recreation is primary amebic meningoencephalitis (PAM). It is caused by *Naegleria fowleri*, a ubiquitous free-living ameba. While the likelihood of exposure to *Naegleria* is high, the risk of infection is low. However, since PAM is almost always fatal, it is advisable to reduce the risk of infection as much as possible.

Natural bodies of water, especially those that are stagnant or polluted, are the most likely source of infection.

Personal Precautions

The following personal precautions are easy to follow and should substantially reduce the risk of water related illness. The first 4 preventive actions listed are especially important to protect against PAM and GAE. The first 5 are protective against most water-related infections and are recommended for persons of all ages and health conditions. Individuals who tend to get ear or eye infections may benefit from using ear plugs or swim goggles. The last 3 recommendations are especially important for keeping potential sources of infection out of recreational water.

- Never swim in stagnant or polluted water.
- Hold your nose or use plugs when jumping into water.
- Swim in properly maintained pools whenever possible.
- Wash open skin cuts and abrasions with clean water and soap.
- Avoid swallowing water when swimming.
- Use ear plugs as needed.
- Use swim goggles or masks as needed.
- Shower before using swimming pools.
- Take young children to the restroom frequently.
- Make sure every child who is not toilet trained is wearing a swim suit (or rubber pants) over diapers designed to prevent leakage. Check diaper at least every 10 minutes.

Although it is impractical to monitor natural bodies of water, all public swimming pools and spas must adhere to established standards of cleanliness and chemical treatment. Stringent pool maintenance does not guarantee total eradication of all potentially harmful organism, but it does help control many species of infectious organisms.

Swimming Pool and Spa Maintenance

The information below provides general guidelines for proper maintenance of pools and spas to prevent water-related infections. However, anyone responsible for maintaining pools over an extended time is advised to obtain more comprehensive information/training. (See the resources listed at the end of the bibliography.)

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Chlorination. For all swimming pools and spas not located in a single family residence, state law requires a continuous free chlorine residual of at least 1 ppm and 2 ppm, respectively. For control of both *Naegleria* and its food sources, up to 3 ppm is recommended for swimming pools and 5 ppm for spas. The higher concentrations are advisable during periods of heavy use.

Superchlorination is the term for adding an extra large dose (usually 8 to 10 ppm) of chlorine to the water. Superchlorinated swimming pool water is inhospitable to the trophozoite stage of *N. fowleri*. In general, weekly superchlorination (or "shocking") not only improves pathogen control, but also reduces eye irritation and foul odor.

Water Filtration. A water filtration system must be of the proper design and capacity to effectively reduce the number of bacteria and other contaminants in pool water. The more popular filtration systems for swimming pools, designed primarily for the removal of large particulates such as debris, are not adequate for filtering out bacteria or most parasites.

Although they are the least efficient, **sand filters** are probably the most widely used due to the relatively low expense and low maintenance required. Age of the sand and proper chemical balance of the water greatly affect sand filter efficiency: straining capacity ranges from about 25 microns to 60 microns.

In addition to the proper size sand as recommended by the manufacture, filtration effacacy is improved by allowing filter to run to completion, based on the highest head pressure recommended by the manufacturer. This procedure is recommended because the ability for filters to remove particles is increased as finer particles are deposited on the filter. Filters should not be backwashed on any routine schedule, but rather on an as needed basis in regards to maximum pressure as recommended by the manufacturer.

Cartridge, or **pleated-paper,** filters also are popular. The filtering capability of this type of filter ranges from 5 to 20 microns. Unlike sand, these filters can become more efficient with age as the pores get clogged and thus smaller.

Although capable of removing *Naegleria* and its food sources, **diatomaceous earth (DE)** filters are not as popular due to the laborious effort required to back-flush and clean this type of system. DE filters operate at peak effeciency when clean.

All filtration equipment must be inspected and maintained regularly to ensure optimum functioning. Even though most filtration systems cannot remove bacteria or most parasites, properly maintained systems can help create an aqueous environment that is unfavorable to the growth or survival of infectious organisms.

State law requires a continuous free chlorine residual of at least 1ppm for swimming pools. . .

pH Level. The acceptable pH range for swimming pool water is 7.2 to 7.8, with the optimal level for control of organisms at the lower end. Irritation of skin and eyes of pool users is common at pH levels below 7.2, and the antimicrobial effect of chlorine is diminished at pH levels above 7.6.

Water Temperature. *Naegleria* is a thermophilic organism. Trophozoites thrive at water temperatures above 100°F, but do not multiply at temperatures below 40°F. Pool water that is maintained at temperatures below 80°F is suboptimal for the growth of *Naegleria* as well as algae. Since most pools and spas are kept at temperatures above 80°F, adequate chemical treatment and filtration is especially important.

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Pool Area. The area surrounding the pool should be constructed and tended so as to minimize the amount of dirt entering the water. Overhanging structures and vegetation that allow dust, plant debris, and other contaminants to be blown or washed into pool water should be removed. Cracks and other defects in the pool floor, walls, or deck favor the growth of potentially harmful organisms and should be repaired.

Further information is available from the general sanitation office of your local health department, the National Swimming Pool Foundation at (210) 525-1227, the TDH Infectious Disease Epidemiology and Surveillance Division at (512) 458-7676, and the TDH General Sanitation Division Central office in Austin at (512) 834-6635.

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A Training Course in Swimming Pool Operation. Austin: Texas Department of Health; Stock No. 2-103, 1986[3].

Williams K. Aquatic Facility Operator Manual. Illinois: National Recreation and Park Association, 1991[4].

The following footnotes provide current contact information for those who wish to obtain selected materials.

1. Mosby Yearbook, Inc., 11830 Westline Industrial Dr., St. Louis, MO 63146, (800) 426-4545

2. National Swimming Pool Foundation, 10803 Gulfdale, Ste. 300, San Antonio, TX 78216, (210) 525-1227

3. TDH Audiovisual Library, 1100 W. 49th St., Austin, TX 78756, (512) 458-7260

4. National Recreation and Parks Association, 650 W. Higgins Rd., Hoffman Estates, IL 60195, (708) 843-7529x5

May/Jun 1997

Bimonthly Statistical Summary of Selected Reportable Diseas

	HHSC Region											Selected Texas Counties							
Selected Diseases/Conditions	1	2	3	4	5	6	7	8	9	10	11	Bexar	Dallas	El Paso	Harris	Hidalgo	Nueces	Tarrant	Travis
Sexually Transmitted Diseases[2]																			
Syphilis, primary and secondary	*1	*0	*29	*11	*1	*28	*4	*5	*0	*0	*1	*5	27	*0	*22	*0	*0	*2	1
Congenital Syphilis	*0	*0	*1	*0	*0	*14	*1	*1	*0	*0	*1	*1	1	*0	*14	*1	*0	*0	0
Resistant Neisseria gonorrhoeae	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	*0	0	*0	*0	*0	*0	*0	0
Enteric Diseases																			
Salmonellosis	5	7	10	4	2	29	33	7	5	15	9	3	2	15	25	1	3	3	20
Shigellosis	10	6	2	8	1	32	45	4	5	2	20	3	2	2	14	6	6	0	21
Hepatitis A	9	4	38	18	0	29	15	33	16	9	145	10	18	7	25	83	6	13	12
Campylobacteriosis	9	0	5	4	4	6	40	5	2	4	9	4	3	4	3	4	4	2	34
Bacterial Infections																			
H. influenzae, invasive	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meningococcal, invasive	0	0	4	1	0	0	0	0	0	0	1	0	2	0	0	0	1	1	0
Lyme disease	0	0	7	0	0	0	1	0	0	0	0	0	1	0	0	0	0	6	0
Vibrio species	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Other Conditions																			
AIDS[4]	12	4	142	10	19	290	58	49	5	28	29	45	49	27	266	3	8	76	34
Hepatitis B	3	2	12	0	1	9	5	3	4	1	9	2	5	0	6	0	6	2	4
Adult elevated blood lead levels	0	0	10	10	0	2	0	5	0	0	0	3	5	0	2	0	0	1	0
Animal rabies - total	5	3	0	13	0	4	4	8	2	4	4	3	0	4	3	1	0	0	0
Animal rabies - dogs and cats	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tuberculosis Disease[2]																			
Children (0-14 years)	2	0	0	0	0	13	1	0	0	1	3	0	0	1	12	1	0	0	1
Adults (>14 years)	0	2	81	13	3	134	30	25	1	16	31	15	61	15	98	8	5	13	16
Injuries[2]																			
Spinal Cord Injuries	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^

1. Cumulative to this month. 2. Data for the STD's, Tuberculosis, and spinal cord injuries are provided by date of report, rather than date of onset. 3. Voluntary reporting. 4. Al include reported cases from Texas Department of Corrections, which are not included in the regional and county totals. *Data incomplete. ^Number Breakdown Unavailabl

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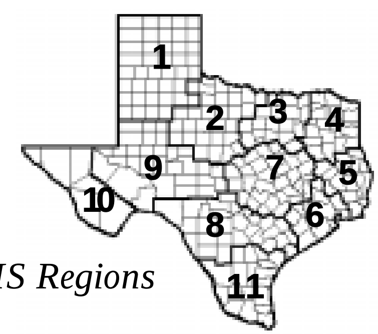
1996 POPULATION ESTIMATES

HHSC REGIONS							
1	760,526	4	947,431	7	1,902,211	10	722,076
2	532,854	5	683,583	8	1,983,995	11	1,574,446
3	4,968,610	6	4,325,854	9	548,963		
STATEWIDE TOTAL 18,950,549							

SELECTED TEXAS COUNTIES			
Bexar	1,308,092	Hidalgo	475,917
Dallas	2,053,859	Nueces	313,907
El Paso	694,878	Tarrant	1,390,298
Harris	3,099,066	Travis	620,718



DHHS Regions

Disease Prevention News (ISSN 1068-7920) is a biweekly publication of the Texas Department of Health, Public Health Professional Education, 1100 West 49th Street, Austin, TX 78756-3199, (512) 458-7677. Periodical postage paid at Austin, TX.
http://www.tdh.state.tx.us/phpep/dpnhome.htm
TDH Healthy Texans BBS: (800) 858-5833

POSTMASTER: Send address changes to Disease Prevention News, 1100 West 49th Street, Austin, TX 78756-3199.

Vaccine-Preventable Disease Update
Reported cases with onset from 5/1/97-6/30/97

Condition	County	Number of Cases	Date of Onset	Condition	County	Number of Cases	Date of Onset
Mumps	Bexar	1	5/10	**Mumps**	Harris	1	6/12
		1	5/13		Reeves	1	5/1
	El Paso	1	5/2		Tarrant	1	5/6

YTD	**Measles**	**Mumps**	**Pertussis**	**Rubella**	**Tetanus**
	4	**22**	**16**	**3**	**2**