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ASSESSMENT OF TEXAS MEDICAL PROVIDERS CONCERNING RABIES VACCINES

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Abstract: Rabies is an important zoonotic disease in Texas and thousands of people each year either request or require rabies prophylaxis because they have ‘high risk’ jobs or are exposed to the disease. After experiencing difficulty in receiving rabies prophylaxis from physicians, we conducted a survey of Texas medical providers to assess their knowledge of rabies vaccine procedures and their experience with rabies vaccines. Most providers in Texas (>95% of 297) rarely saw patients for rabies prophylaxis; therefore, providers have minimal, if any, experience with the procedures of acquiring and administering the vaccine. Providers varied greatly in their responses to our questions of where to acquire the vaccine, how and where to administer the vaccine, and where to acquire information about the vaccine. State and local health departments should target medical clinics and physician associations as outlets to disseminate information regarding rabies, rabies prophylaxis, and treatment.

Key words: medical providers, physicians, prophylaxis, rabies, survey, Texas, vaccine

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INTRODUCTION

Rabies is an important zoonotic viral disease in the United States that causes an acute encephalitis, which if left untreated, has a prognosis that is almost always fatal. Epizootics of rabies have been reported in raccoons (*Procyon lotor*) along the Atlantic coastal states (Hanlon et al. 1989), in red fox (*Vulpes vulpes*) from northeastern states (Johnston et al. 1988), in striped skunks (*Mephitis mephitis*) from central states (Rupprecht et al. 1996), in coyotes (*Canis latans*) in southern Texas (Farry et al. 1998a, b), in gray fox (*Urocyon cinerargenteus*) in central Texas (Steelman et al. 2000), and in bats sporadically throughout the continental United States (Rupprecht et al. 1996).

Human exposure to rabies has occurred in each epizootic. Every year

approximately 16,000 - 39,000 people in the United States receive post-exposure rabies prophylaxis (Krebs et al. 1998). In addition, pre-exposure rabies vaccinations should be offered to persons in high-risk groups, such as veterinarians, animal handlers, wildlife biologists, etc. Pre and post-exposure rabies prophylaxis is routinely available with a physician's prescription. However, knowledge of physicians as to the process to acquire rabies vaccine (i.e., pre and post exposure) is uncertain. We became involved in this issue when we had difficulty in acquiring pre-exposure rabies vaccine for ourselves and employees. Medical providers we contacted in Texas either denied services, were hesitant, or unsure how to acquire rabies prophylaxis. Therefore, our objectives were to compare knowledge of medical providers concerning

rabies vaccines between physicians whose practice was located within and outside historic Oral Rabies Vaccination Program (ORVP) baiting zones in Texas, and to compare knowledge of medical providers concerning rabies vaccine between small and large cities within Texas. Houston, Dallas/Ft.Worth, and Austin contain large concentrations of skunk and bat rabies endemic in those populations and for which ORVP is not available. Due to mass media, we have included them inside the rabies zone, although no bait has ever been placed there. Our hypothesis was that medical providers whose practices occurred within the rabies ORVP zones would potentially have more requests for pre and post-exposure rabies vaccines; therefore, would be more familiar with procedures for acquiring and administering rabies prophylaxis.

METHODS

Medical providers were contacted throughout Texas and either the physician or nurse was interviewed concerning their knowledge of rabies prophylaxis and post exposure vaccine. Since many insurance companies require an initial visit to a primary care physician, medical providers surveyed were limited to those in family practice. Medical providers were placed into one of four categories: either within or outside the rabies endemic zone and either in a small (<60,000 population) or large (>100,000 population) city. Rabies endemic zone was defined as areas that occurred within the historic bait drop zones for coyotes, gray foxes, and skunks in Texas (Bradley Hicks, USDA-APHIS-WS, personal communication). Medical providers were randomly selected from the yellow page listings from cities that met our size stipulation. Medical provider selection continued until 10 clinics were interviewed

from each city, unless that city had fewer clinics that were willing to participate. Medical providers that occurred in small cities within the rabies endemic zone included offices in Raymondville/Port Isabelle (N = 7), Junction (N = 10), Fredericksburg (N = 10), Fort Stockton (N = 5), Harlingen (N = 6), Kingsville (N = 10), Kerrville (N = 10), and Stephenville (N = 10); medical providers that occurred in large cities within the rabies endemic zone included offices in McAllen (N = 10), Laredo (N = 10), Austin (N = 10), San Antonio (N = 10), Houston (N = 10), Dallas (N = 10), Ft. Worth (N = 10), Abilene (N = 10), and Corpus Christi (N = 10); medical providers that occurred in small cities outside the rabies endemic zone included offices in Corsicana (N = 9), Galveston (N = 10), San Marcos (N = 10), Lufkin (N = 10), Georgetown (N = 10), Bay City (N = 10), and Victoria (N = 10); medical providers that occurred in large cities outside the endemic rabies zone included offices in Wichita Falls (N = 10), Amarillo (N = 10), Lubbock (N = 10), El Paso (N = 10), Midland (N = 10), Odessa (N = 10), and Waco (N = 10) (Figure 1). Physicians or nurses were asked a series of questions concerning rabies pre-exposure and post exposure vaccines (Table 1), and their responses were recorded.

Answers of respondents were analyzed using G-tests (Sokal and Rohlf 1981) to compare the mean proportion of categorical responses given between respondents by region (inside or outside the rabies endemic zone), city size (large or small), and interactions of main effects. Statistical tests were considered significant at $P \leq 0.05$. Unless otherwise specified, data were pooled and graphically represented due to non-significant differences between regions and city sizes.

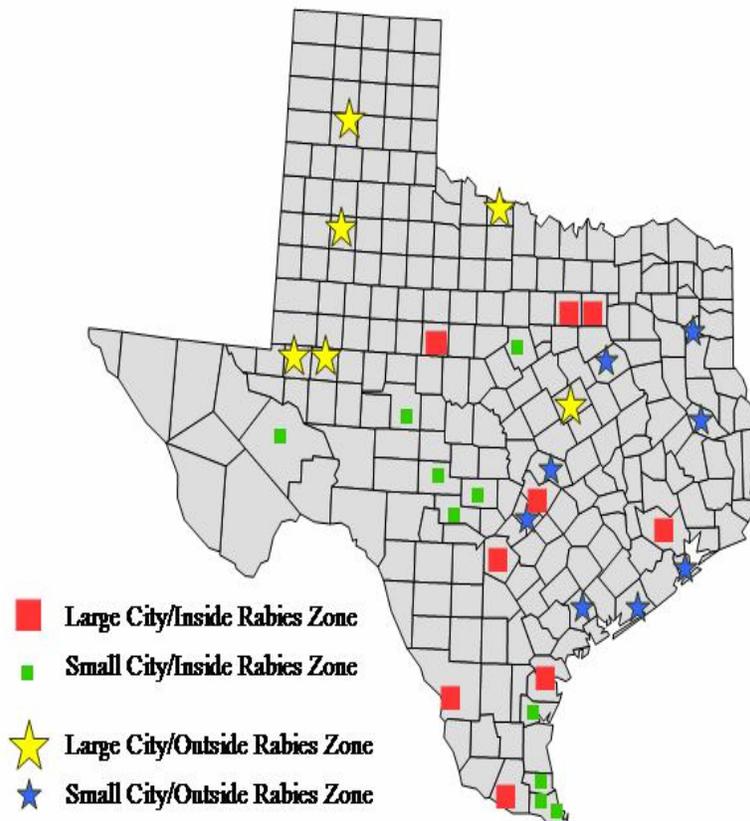


Figure 1. Locations of medical providers who participated in our survey of rabies vaccines. Red stars are cities within the rabies endemic zone; yellow stars are outside the rabies endemic zone; big-sized stars represent large cities (>100,000 population); small-sized stars represent small cities (<60,000 population).

Table 1. Survey questions asked of Texas physicians concerning pre and post exposure rabies vaccines.

| | |
|-----|--|
| 1. | Do you administer pre-exposure rabies vaccine? |
| 2. | Do you administer post exposure rabies vaccine? |
| 3. | Why do you not administer pre-exposure rabies vaccine? |
| 4. | Why do you not administer post exposure rabies vaccine? |
| 5. | Where can a person get pre-exposure rabies vaccine? |
| 6. | Where can a person get post exposure rabies vaccine? |
| 7. | Is the pre-exposure rabies vaccine a single shot or a shot series? |
| 8. | Is the post exposure rabies vaccine a single shot or a shot series? |
| 9. | If a series, how many shots are in the pre-exposure series? |
| 10. | If a series, how many shots are in the post exposure series? |
| 11. | Where on the body are the rabies pre-exposure vaccines given? |
| 12. | Where on the body are the rabies post exposure vaccines given? |
| 13. | What side effects can occur with rabies pre-exposure vaccines? |
| 14. | What side effects can occur with rabies post exposure vaccines? |
| 15. | Are pre-exposure vaccines kept in stock or ordered on an individual basis? |
| 16. | Are post exposure vaccines kept in stock or ordered on an individual basis? |
| 17. | To how many patients did you administer pre-exposure rabies vaccine in the last year? Last 5 years? |
| 18. | To how many patients did you administer post exposure rabies vaccine in the last year? Last 5 years? |
| 19. | Where would one get information about rabies vaccines? |

RESULTS

Three hundred forty-four clinics were contacted, of which 297 medical providers participated in our survey. Of the 47 non-participatory clinics, a greater number ($\chi^2 = 17.1$, $df = 3$, $P < 0.001$) of medical providers were from large cities outside the rabies endemic area (75% of the chi-square value) than the remaining regions and city sizes.

Significant interactions occurred between regions and city sizes ($\chi^2 > 9.3$, $df = 3$, $P < 0.03$) when medical providers were asked how many patients they administered

pre and post exposure rabies vaccine to during the last year and past 5 years. More medical providers from small cities within the rabies endemic area treated more patients with rabies prophylaxis than medical providers from the other regions and city sizes (Figure 2a-d). However, the majority of medical providers (>95%) did not have a history of rabies prophylaxis treatment. Significant differences between region, city size, and interactive effects were not noted ($\chi^2 < 6.0$, $df = 3$, $P > 0.14$) for the remaining questions of our survey.

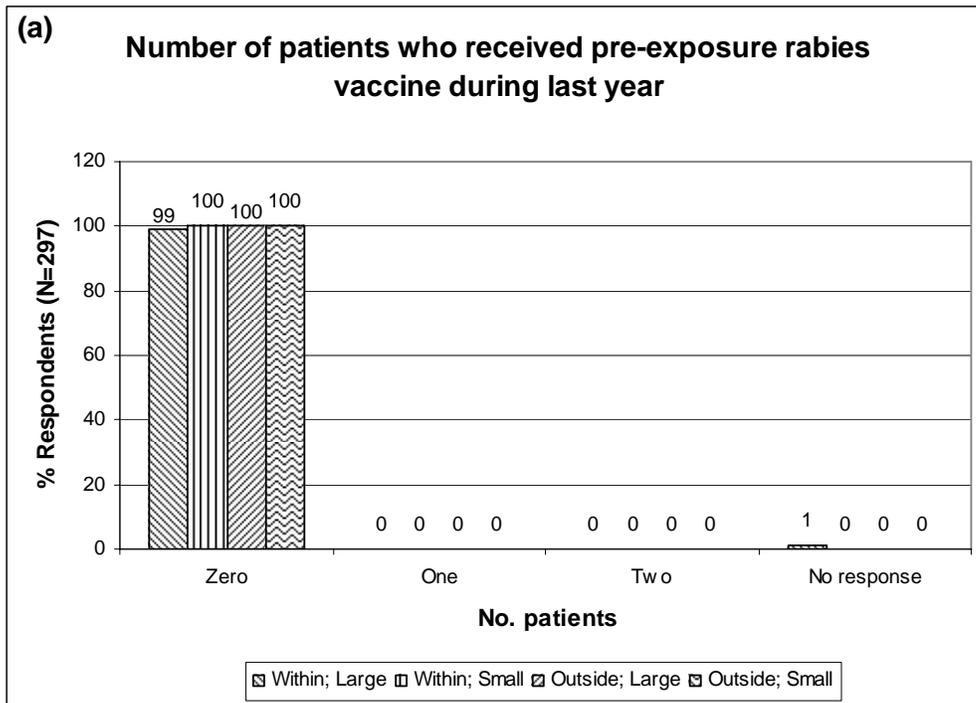


Figure 2(a). Percent of respondents (N=297) who stated that they treated patients with pre-exposure rabies prophylaxis during the last year. No differences were observed between respondents within and outside rabies endemic zone, city size, or interactive effects.

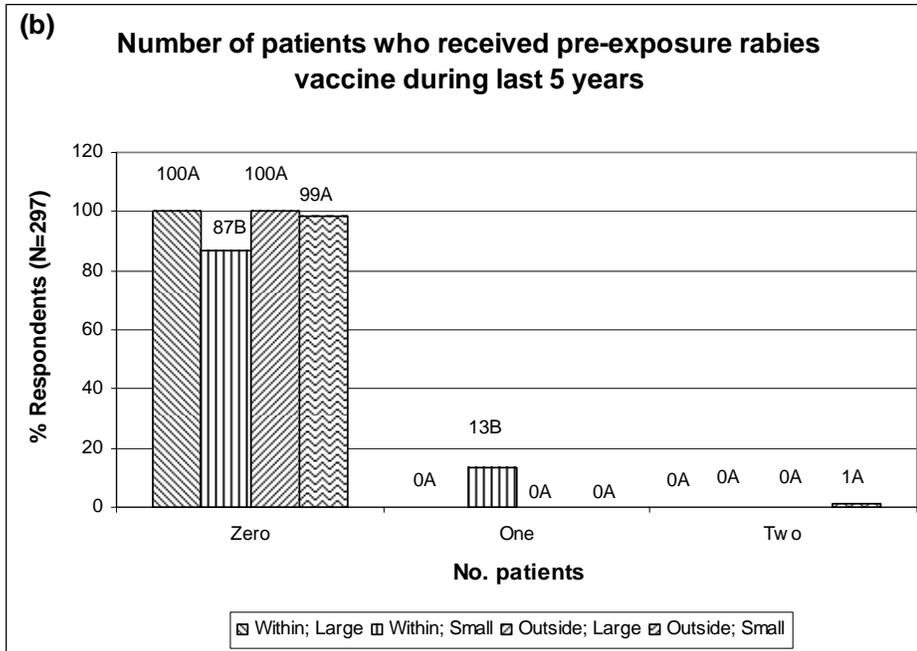


Figure 2(b). Percent of respondents (N=297) who stated that they treated patients with pre-exposure rabies prophylaxis during the last 5 years. The same capital letter within each category for patient number is not different ($P > 0.05$).

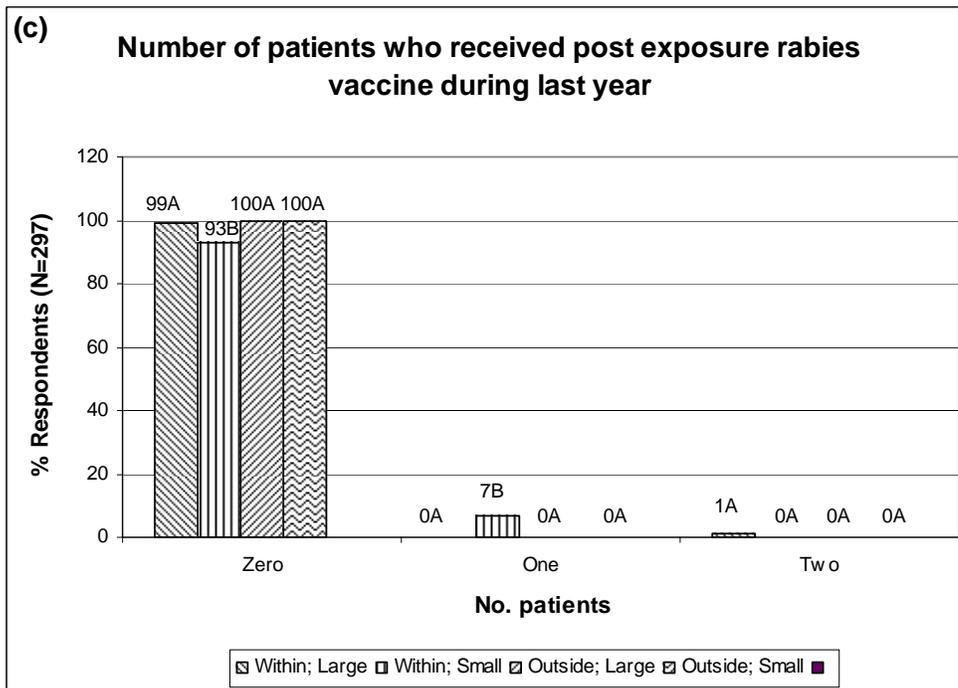


Figure 2(c). Percent of respondents (N=297) who stated that they treated patients with post exposure rabies vaccine during the last year. The same capital letter within each category for patient number is not different ($P > 0.05$).

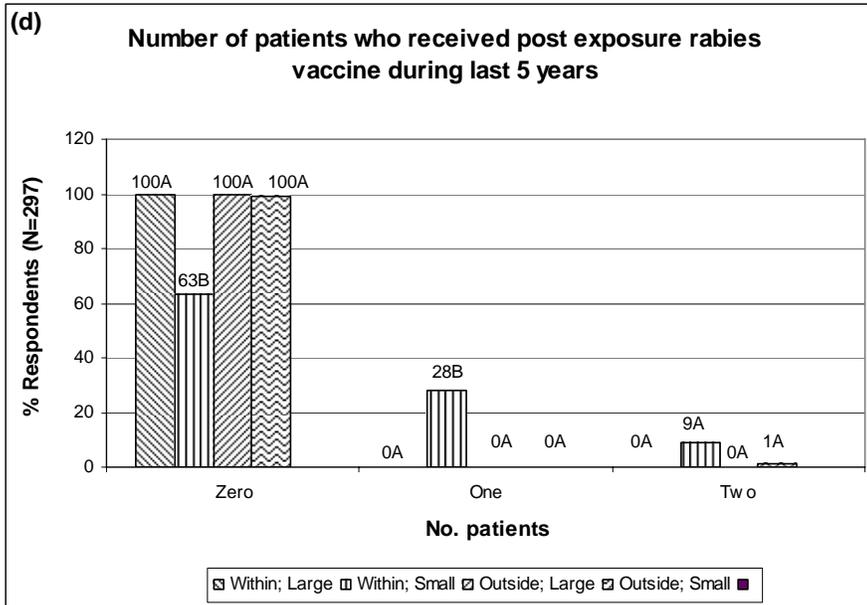


Figure 2(d). Percent of respondents (N=297) who stated that they treated patients with post exposure rabies vaccine during the last 5 years. The same capital letter within each category for patient number is not different ($P > 0.05$).

In general, medical providers had varied responses to our questions. Nearly 70% of the 297 medical providers stated that they would provide post exposure rabies vaccine to patients; however, only 52% responded that they also would administer the pre-exposure prophylaxis. Answers varied as to why medical providers (N = 143) did not administer pre-exposure prophylaxis (Figure 3), but the majority of medical providers that would not give post exposure vaccines (58% of 92) stated that they had no authority to administer the vaccine (Figure 3). Of the same medical providers who would not administer rabies prophylaxis, when asked where a person could acquire rabies vaccines, the majority of providers responded that patients should go to county health offices (41.8% of 143) and hospitals (66.3% of 92) for pre-exposure and post exposure rabies vaccines, respectively (Figure 4). Of the medical providers who did provide rabies vaccines to their patients, only 1 of 154 providers maintained the pre-exposure vaccine in stock while the vast majority of providers

ordered the vaccine on an ‘as needed’ basis. All medical providers who were willing to provide post exposure vaccine to their patients (N = 205) ordered the vaccine on an ‘as needed’ basis. When asked if the pre-exposure rabies vaccines was a single injection or a series of injections, 33.3% and 48.1% of the medical providers said the vaccine was a single shot and shot series, respectfully, while the remaining providers either did not know or chose to not respond to the question. When the same question was posed concerning the post exposure vaccine, 0% and 81.8% of the medical providers said the vaccine was a single shot and shot series, respectfully, while the remaining 18.2% of the providers did not know or chose to not answer the question. Of the medical providers who responded that rabies prophylaxis was a series of injections, 23.9%, 24.2% and 51.9% of the providers (N = 143) stated that the pre-exposure vaccine was a series of 2-5 shots, 6-9 shots, and ‘did not know’, respectfully, while 0.7%, 31.0%, and 68.3% of the providers (N = 243) stated that the post

exposure vaccine was a series of 2-5 shots, 6-9 shots, and 'did not know', respectfully. The majority of medical providers believed that pre-exposure vaccines are administered in the arm of patients, while the stomach was considered the injection site of choice for post exposure shots by more providers (Figure 5). Responses by medical providers concerning the side effects of pre and post

exposure vaccines varied widely (Figure 6). Lastly, when asked where a person should go to acquire information about rabies vaccines, 18.2% responded their family physician, 60.3% said the county health department, 21.4% said the state health department, and 0.4% of the 297 medical providers responded that they did not know.

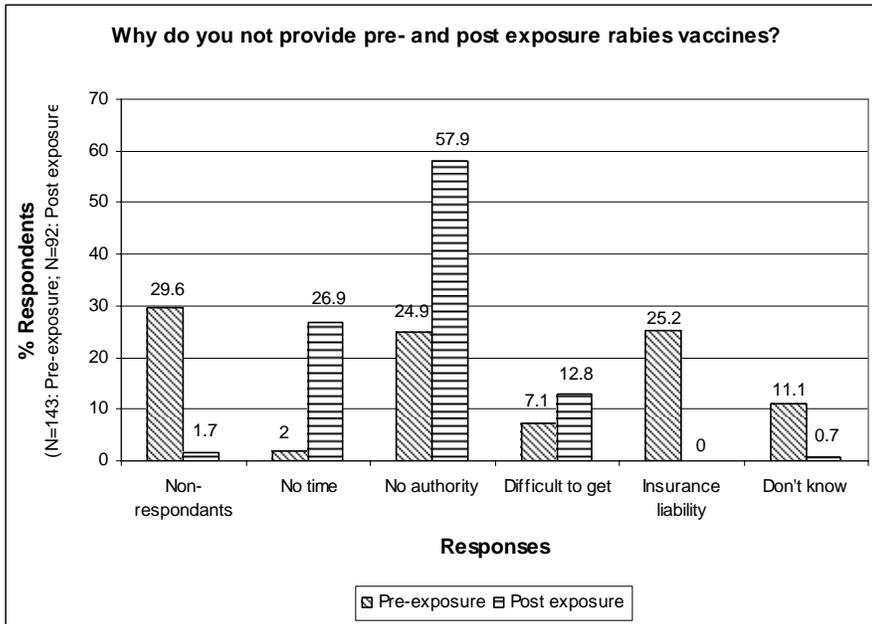


Figure 3. Reasons given why certain medical providers did not provide pre and post exposure rabies vaccines to their patients.

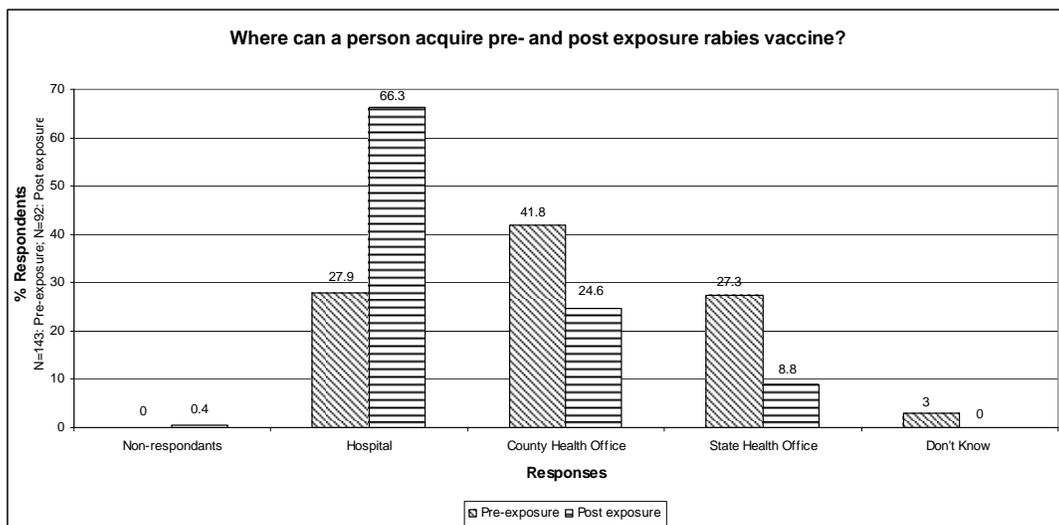


Figure 4. Places suggested by medical providers who would not provide pre and post exposure vaccines to their patients as to where the patients could acquire the rabies vaccine.

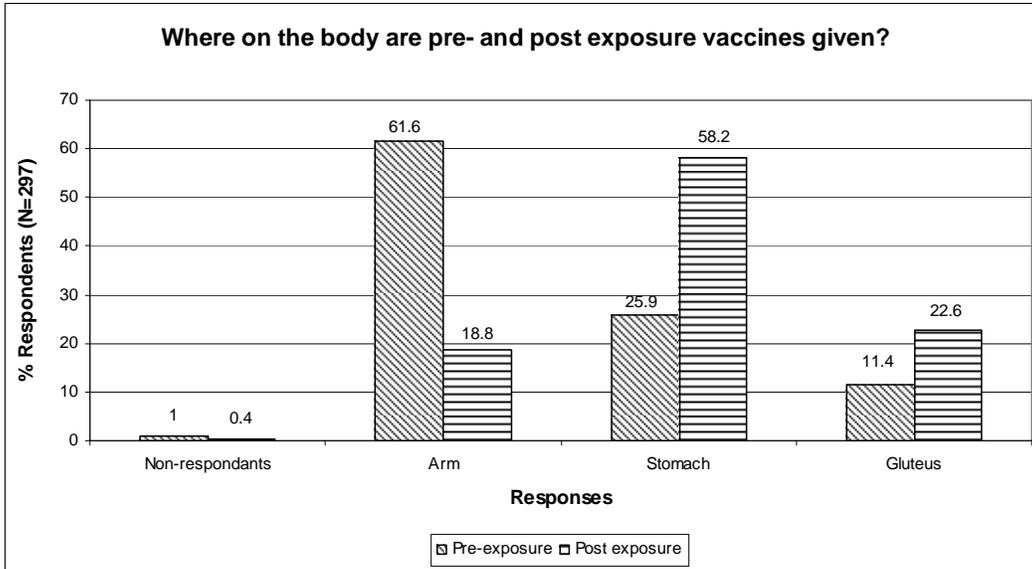


Figure 5. Injection site locations suggested by medical providers as to where on the body pre and post exposure rabies vaccines should be given.

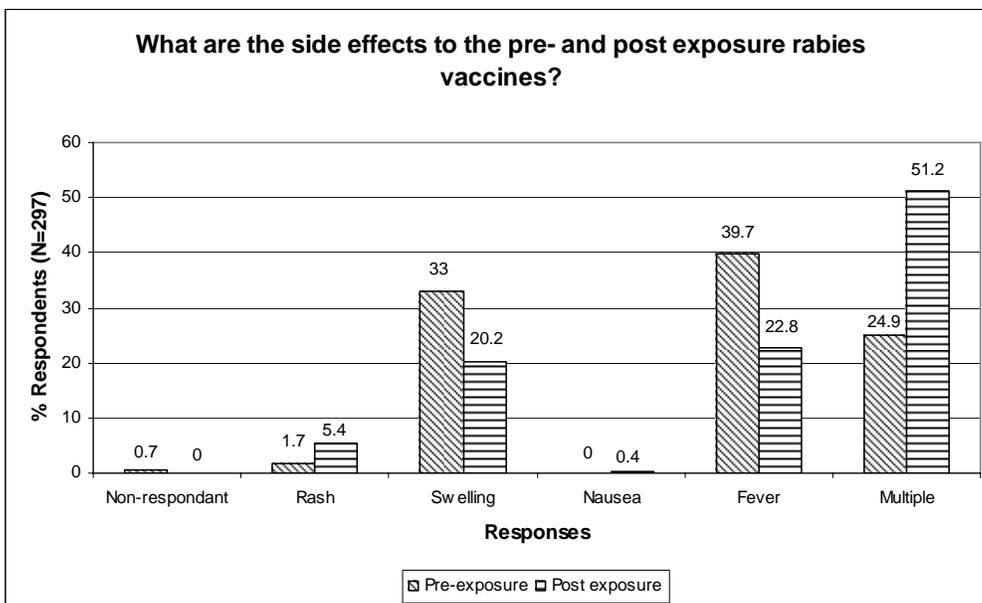


Figure 6. Side effects suggested by medical providers that can potentially occur after pre and post exposure rabies vaccines are given.

DISCUSSION

Despite its rarity in our modern culture, rabies still invokes a deep fear. Since antiquity, rabies has been one of the most feared diseases (Jackson 2002). Many of these fears were played out before our eyes as some of our movie and television heroes fought the good fight before

succumbing to rabies, usually occurring during western-themed genre. Even Roy Rogers died of rabies in his last movie role as a predator trapper on a large Texas ranch. Little wonder then that many envision rabid dogs in rural areas when considering rabies. This ingrained lesson may be partially responsible for our observance of statistical

significance regarding the number of physicians from small cities/within the established rabies zones willing to give pre and post exposure vaccinations to residents, when compared to all other groups. Other reasons might include expanded media coverage of rabies due to rabies control activities occurring within and around their town, observed economic boosts to the local economy as rabies control activities are conducted in their area, and recognition by local doctors of zoonotic disease concerns present within the vicinity. Additionally, enhanced awareness of wildlife and wildlife issues by residents of small cities, typically more tied to the land as compared to large, metropolitan areas, may create a very small, but continuous demand for rabies treatment. Figure 3 depicts this small, but steady demand as observed in the number of shots given across all categories in the last 5 years.

Pre-Exposure Vaccination

The World Health Organization (WHO 2002) states that pre-exposure rabies vaccination should be given to groups of persons at high risk of exposure to live rabies virus, including laboratory staff, veterinarians, animal handlers, wildlife officers, and others who's hobbies may expose them to rabies. Pre-exposure prophylaxis is beneficial for the following reasons: 1) the need for rabies immune globulin is eliminated, 2) post-exposure vaccine regimen is reduced from five to two doses, 3) protection against rabies is possible if post-exposure treatment (PET) is delayed, 4) protection against inadvertent exposure to rabies is possible, and 5) the cost of PET is reduced (Briggs 2002). In spite of these easily obtained findings, roughly half of all respondents indicated that they did not offer pre-exposure prophylaxis. Reasons given were unexpected at best and totally confusing at worst. Of those

providers not offering pre-exposure treatment, insurance liability (25.2%) and the lack of authority to give these shots (24.9%) were cited as the leading reasons, with difficulty in getting vaccine coming in third (7.1%).

Liability is a concern when providing most any service, especially if the service is considered an elective procedure. Given that rabies exposure is sometimes achieved without the awareness of the individual, classifying pre-exposure vaccination as "elective", and thereby not readily available, could prove fatal to those with any risk for exposure. As with all prescription drugs available legally in the US, rabies vaccine is manufactured under FDA regulations and given FDA approval as safe when used as directed. Briggs (2002) reported that while allergic reactions have been reported after booster vaccination, a maintenance requirement for maintaining pre-exposure protection, no serious or lasting medical conditions developed. All have been treated successfully with antihistamines, epinephrine, and steroids. Exactly why medical facilities would look at rabies vaccine differently from any other prophylaxes, such as tetanus vaccine, is unclear and needs to be further studied within the legal arena.

More puzzling is the feeling that medical providers did not have the authority to give pre-exposure rabies vaccine. As a prescription drug, only doctors can prescribe it. Many medical providers cited the need to contact local and state health department officials for assistance. After calling a small random sample of county health departments, several said that they could assist in administering the shot series. However, no department had a doctor on staff to prescribe the shot series, thus leaving the first essential step of prescribing the vaccination to doctors. All county and state health officials expressed surprise at the "no

authority” response and restated their role as a support role, not the leading force in controlling disease at the ground level.

Difficulty in obtaining the vaccine was identified as a reason not to offer the vaccination series. In reality, pre-exposure vaccine is kept in stock and available at all state health regional offices and many county health offices across the state (Tom Sidwa, Texas Dept. of Health personal communication 2005). Additionally, vaccine can be ordered from the manufacturer directly by toll free numbers supplied by state health officials and listed on the Centers for Disease Control (CDC) website (www.cdc.gov/ncidod/dvrd/rabies/professional/professi.htm). CDC also offers a 24 hours a day/7 days a week information line for physicians, nurses, pharmacists, veterinarians, and other health officials that have questions about rabies and rabies prophylaxis.

Post-Exposure Treatment

Rabies is a unique neurologic infection that can be prevented by PET, at least when the vaccine is administered to patients within a reasonable period of time after a rabies exposure (Lafon 2002). However, nearly one-third of our respondents did not offer PET. A shocking 60% felt they had no authority to administer the treatment regimen followed by an equally shocking response by 26.9% that they did not have time. These attitudes are not particularly helpful to someone that has been exposed to rabies, a potentially fatal disease.

As stated earlier, it is difficult to understand exactly how doctors came to believe they have no authority to prescribe a vaccine to combat a medical condition. Whether this is specific to rabies or extends to other diseases is unknown. However, it is particularly troubling given the urgent need for medical care. Both WHO (2002) and

CDC (2005) state that rabies vaccine therapy should be initiated as soon as possible, following exposure. Furthermore, WHO considers PET to constitute an emergency situation. While emergency care and initial shots can be initiated at most hospital emergency rooms, it is important to note that rabies vaccines are very expensive. CDC (2003) estimated the cost of a course of rabies immune globulin and five doses of vaccine given over a 4 week period typically exceeds \$1000. Wound care, tetanus shot, and any additional antibiotics needed are in addition to this figure. Added costs associated with emergency room care could quickly and easily exceed an individual’s available funds. Given rabies’ life threatening potential, health care is a necessity and availability of treatment at one’s primary health care facility could help substantially reduce the associated financial burden.

Every potential rabies exposure should be evaluated on a case-by-case basis, considering the epidemiology of the area, species involved, type of contact between victim and suspected rabid animal (provoked vs. unprovoked), and the anatomical location and severity of exposure (Briggs 2002). Need for medical treatment or non-treatment could then be evaluated from these results. While this procedure may take some time away from the usual stream of common ailments, it can not be stressed enough of the potential death of a patient exposed to rabies. Of our respondents surveyed who did not treat patients possibly exposed to rabies, 26.9% claimed they did not have time to treat them. Although not specially asked as to the meaning of the statement, it is assumed that the amount of time researching necessary procedures and vaccine procurement would seriously hamper their ability to provide health care for all patients. Recognition and utilization of associated consulting staff at

local and/or state health departments, as well as CDC's rabies support hotline, would greatly reduce the time burden possibly felt by uninformed health care providers.

The percentage of providers who did not treat rabies exposures seem consistent with the number of providers that gave incorrect answers to how rabies vaccinations are given. Results in Figure 5 showed that while most providers understood rabies treatments (pre and post-exposure) were given as a series of shots, most were confused as to where the shots were given. Older vaccines were given in a variety of locations, including the stomach region. In 1980, a new vaccine was licensed by FDA for use in rabies treatment in the US (Vodopija and Clark 2000). Currently, all vaccine is given in the deltoid region of the arm for adults and can be administered in the thigh area for children. Our results indicated that over half (58.2%) believed that PET was still given in the stomach, while 22.6% believed them to be given in the gluteus. WHO (2002) stated that neither the pre nor post-exposure shots should ever be given in the gluteal region and Briggs (2002) added that shots in the gluteal area may lead to lower antibody levels and failure of PET. Ironically, a recent San Antonio new story told of a south Texas child, exposed to a rabid animal, as facing a series of shots in the stomach (Gary Nunley, USDA-APHIS-WS, personal communication 2005). Even after 25 years, the perceived discomfort of shots in the stomach is apparently hard to remove from the American psyche.

Lastly, when asked where one should go to get information about rabies vaccines, 81.7 % indicated that either state or county health departments could provide this information. Only 18.2% respondents felt one could get information from their family physician. Consistent with our findings, family doctors may indeed be the last place

one should attempt to get information about this important disease. To resolve confusion, information packets need to be developed and distributed to family physicians. Aided by a quick reference, medical personnel could cut their research time significantly, disseminate correct information to the patient, and be guided by experts when making important rabies treatment decisions. To spare expense, hard copies could be distributed periodically, with the Texas Department of Health's website serving as the appropriate place to get up to date information between hard copy printings. Information sharing between health officials and physicians is paramount to adequately protecting Texas residents from this rare, but ever present disease.

CONCLUSION

Rabies is endemic in several wildlife species in Texas, making human exposure a rare, but real threat to human life. Many residents, not educated in the disease, its prevention, and/or its treatment, are dependent on their medical providers to provide swift and complete medical treatment. Unfortunately, our survey indicated that many primary care medical personnel throughout Texas are equally deficient in their knowledge of the virus, resulting in a serious reduction of treatment outlets for exposure cases. A state-wide educational program, targeted at medical providers, needs to be implemented to increase awareness of rabies prophylactic procedures and treatment.

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LITERATURE CITED

- BRIGGS, D.J. 2002. Public health management of humans at risk. Pages 401-428 in A.C. Jackson and W.H. Wunner, editors. Rabies. Academic Press, An Elsevier Science Imprint, San Diego, CA, USA.
- CENTERS FOR DISEASE CONTROL AND PREVENTION. 2003. About rabies: Cost of rabies prevention. Website: www.cdc.gov/ncidod/dvrd/rabies/introduction/intro.htm.
- _____. 2005. Rabies questions and answers. Website: www.cdc.gov/ncidod/dvrd/rabies/ques&ans/q&a.htm.
- FARRY, S.C., S.E. HENKE, S.L. BEASOM, AND M.G. FEARNEYHOUGH. 1998a. Efficacy of bait distributional strategies to deliver canine rabies vaccines to coyotes in southern Texas. *Journal of Wildlife Diseases* 34:23-32.
- _____, _____, A.M. ANDERSON, AND M.G. FEARNEYHOUGH. 1998b. Responses of captive and free-ranging coyotes to simulated oral rabies vaccine baits. *Journal of Wildlife Diseases* 34:13-22.
- HANLON, C.L., D.E. HAYES, A.N. HAMIR, D.E. SNYDER, S. JENKINS, C.P. HABLE, AND C.E. RUPPRECHT. 1989. Proposed field evaluation of a rabies recombinant vaccine for raccoons (*Procyon lotor*): Site selection, target species characteristics, and placebo baiting trials. *Journal of Wildlife Diseases* 25:555-567.
- JACKSON, A.C. 2002. Human disease. Pages 219-244 in A.C. Jackson and W.H. Wunner, editors. Rabies. Academic Press, An Elsevier Science Imprint, San Diego, CA, USA.
- JOHNSTON, D.H., D.R. VOIGHT, C.D. MACINNES, P. BACHMAN, K.F. LAWSON, AND C.E. RUPPRECHT. 1988. An aerial baiting system for the distribution of attenuated or recombinant rabies vaccines for foxes, raccoons, and skunks. *Review of Infectious Diseases* 10:S660-S664.
- KREBS, J.W., S.C. LONG-MARIN, AND J.E. CHILDS. 1998. Causes, costs and estimates of rabies postexposure prophylaxis treatments in the United States. *Journal of Public Health Management Practice* 4:57-63.
- LAFON, M. 2002. Immunology. Pages 351-369 in A.C. Jackson and W.H. Wunner, editors. Rabies. Academic Press, An Elsevier Science Imprint, San Diego, CA, USA.
- RUPPRECHT, C.E., J.S. SMITH, J. KREBS, M. NIEZGODA, AND J.E. CHILDS. 1996. Current issues in rabies prevention in the United States: Health dilemmas, public coffers, private interests. *Public Health Reports* 3:400-407.
- SOKAL, R.R., AND F.J. ROHLF. 1981. Introduction to biostatistics. W. H. Freeman and Company. San Francisco, CA, USA.
- STEELMAN, H.G., S.E. HENKE, AND G.M. MOORE. 2000. Bait delivery for oral rabies vaccine to gray foxes. *Journal of Wildlife Diseases* 36:744-751.
- VODOPIJA, I., AND H.F. CLARK. 2000. Human vaccination against rabies. Pages 571-595 in G.M. Baer, editor. *The Natural History of Rabies*. CRC Press, Inc., Boca Raton, FL, USA.
- WORLD HEALTH ORGANIZATION. 2002. Current WHO guide for rabies pre and post-exposure treatment in humans. Website: www.who.int/rabies/en/WHO_guide_rabies_pre_post_exp_treat_humans.pdf.