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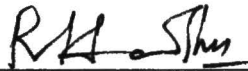
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Perception and knowledge of risk of a bioterrorist attack are important factors in determining public response and anxiety level. A telephone survey of residents of Tarrant County, Texas was conducted to determine public perception regarding Tarrant County's preparedness to respond to an intentional release of the smallpox virus as an act of terrorism. Although a low response rate limits the ability to generalize the findings of this survey, frequency and chi-squared analysis of survey responses revealed a public desire for more information about the county's preparedness, access to smallpox vaccine, and identified a potential gap between objectively measured and public self-assessment of knowledge about bioterrorism and smallpox concepts. Increased efforts toward information dissemination and education of the Tarrant County community are needed to address these concerns.

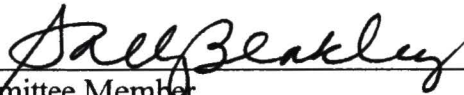
PERCEPTIONS REGARDING TARRANT COUNTY'S PREPAREDNESS
FOR A BIOTERRORISM ATTACK INVOLVING SMALLPOX

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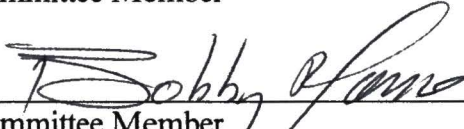
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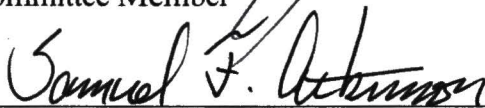
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PERCEPTIONS REGARDING TARRANT COUNTY'S PREPAREDNESS FOR A
BIOTERRORISM ATTACK INVOLVING SMALLPOX

THESIS

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CHAPTER I

INTRODUCTION

September 11, 2001 is a date that will forever live in the memory of any American citizen alive that morning when the United States was shocked into realizing that it, too, was a target of terrorist attack. Within the span of a few hours, a country that had become comfortable under a perceived blanket of security was forced to address serious vulnerabilities in the way its citizens live their daily lives. It has been theorized that the next wave of terrorism against the United States may involve utilizing a biological agent to cause widespread, debilitating illness and casualties. Increasingly, terrorist groups and rogue nations that do not have access to nuclear weapons can acquire the technology and material needed to manufacture biological weapons, which are cheaper and simpler to make. "In some circumstances, biological weapons can be as devastating as nuclear ones - a few kilograms of anthrax can kill as many people as a Hiroshima-size (10 kiloton) nuclear weapon" (Siegrist, 1999). Much has been detailed regarding the efforts of government to strengthen and bolster levels of preparedness for such an attack, but the importance of the public's perception of the effectiveness of this security is important.

The objective of this study is to analyze and evaluate the perceptions of the general population living in Tarrant County, Texas, regarding their understanding of the concepts of bioterrorism, smallpox and its potential use as a weapon of mass destruction, and their confidence in the ability of local government to contain the spread and treat the injured

resulting from an attack in which smallpox is released into the population. The study hypotheses are that:

- I. The public's perception supports the concern that the governmental agencies in Tarrant County are not prepared to respond to a smallpox bioterror attack.
- II. Perceptions regarding the threat of an attack, Tarrant County's preparedness to respond, and the overall understanding of the concepts of bioterrorism and smallpox differ according to age, education, gender, and language spoken most in the home.

A telephone survey of a sample of 81 residents of Tarrant County was conducted utilizing an 18-item questionnaire. The survey was developed to compare knowledge and beliefs regarding bioterrorism among demographic groups based on age, education, gender, language spoken most in the home, status in the household, marital status, and length of residence.

The results of the survey should help to identify strengths and weaknesses in the education of the public regarding Tarrant County's state of preparedness and recent improvements.

CHAPTER II

BACKGROUND AND LITERATURE REVIEW

Much research and background exist for the smallpox virus and bioterrorism. The following discussion will include background regarding smallpox disease pathology and epidemiology, the history of smallpox as a bioterror weapon, current national, state, and local response protocols, and the importance of public perception of local preparedness.

Disease Pathology and Epidemiology

The smallpox virus, known as *Variola major*, is a brick-shaped DNA virus from the genus *orthopox* (a genus which also includes the cowpox and vaccinia viruses), and is the only member of this genus that is communicable by person-to-person contact. Disease pathology begins once an infectious dose of virions (believed to be only a few) become implanted in the oropharyngeal or respiratory mucosa and subsequent migration to lymph nodes. Infection soon spreads to the bloodstream (resulting in an asymptomatic viremia) and multiplies in the bone marrow, spleen, and lymph nodes. A secondary viremia (followed by high fever) results as the virus infects leukocytes and localizes in the small blood vessels of the dermis and beneath the oral and pharyngeal mucosa. From here, the virus infects and destroys cells within these localized tissues (Henderson, 1999).

Smallpox incubation periods may range from 10-14 days. The disease first presents as high fever, head and back aches, and fatigue, but later progresses into a rash within 2-3 days (Kortepeter, 1999). This rash affects mainly the face, arms, legs, and back and appears

at the same rate in all locations. The rash initially consists of flat red lesions, called macules, which appear first in the mouth and pharynx. These lesions typically accumulate clear fluid as papules develop. After the fifth day, the clear fluid contained within the papule becomes cloudy and begins to thicken. The resultant pus-filled vesicles become pustular by the seventh day and reach maximum size by the eleventh day of symptomatic disease. Eventually, scabs form over these lesions as the fluid is absorbed. Over the next few days, these still-infectious scabs fall off the skin. Patients are considered infectious from the onset of rash until all of the virus laden scabs have fallen off of the skin (Simpson, 2002).

Diagnosis of smallpox infection is made by using immunological assays performed using patient serum samples and analyzing vesicles, pustules, and scabs removed from the skin. Complications that are sometimes seen as the result of smallpox infection include septicemia (blood stream infection) or bacterial infection of the skin, and corneal ulceration with resultant blindness.

Smallpox virus is typically communicable via saliva droplets, although contaminated clothing or bed linens can also spread the virus. Coughs, sneezes, or other aerosolization of the Variola virus places others at risk of inhaling the organism and contracting smallpox. The ease of transmissibility of this organism makes smallpox a viable and tactical biological weapon due to its potential for release in a large crowded area and large success rate with secondary transmission among household members and attendants (Henderson, 1999). Although Jenner originally used the cowpox virus to vaccinate against smallpox in the 17th century, vaccines composed of vaccinia virus were used to eradicate the disease in the 1970s and comprise the vaccine stockpile that America has today. Wyerth

Laboratories produced the U.S. vaccine, known as Dryvax. Although individuals who were vaccinated with Dryvax before 1980 most likely have minimal protection against smallpox infection, immunization with the same vaccine today can stimulate T-cell and interferon- γ response and thus confer immunity with 5-10 fold dilution of the original stock (Frey, 2002)

History of Smallpox as a Bioterror Weapon

Although the concept of biological war has recently become a widespread concern due to genetic and weapons technology, terrorism or warfare in which a living organism is used to accomplish an end result dates back at least to the 6th century, B.C., when Assyrians poisoned the wells of their enemies with rye ergot. In 1346, the Tartar army hurled its plague-ridden dead over the walls of the city of Kaffa and eventually forced the surrender of the defenders of that city. More specifically, smallpox has been involved both intentionally and accidentally during times of war and conquest. English general, Sir Jeffrey Amherst, and Captain Ecuyer gave smallpox-laden blankets to Indians loyal to the French during the French and Indian War in 1767. This biological attack resulted in the decimation of the tribal population in the Ohio River Valley and led to a successful British attack on Fort Carillon (Christopher, 1997).

Smallpox was one of the most serious diseases in both Europe and America in the 16th and 17th centuries. Introduction of smallpox to the Americas in the 16th century resulted in the widespread depletion of native populations in North America. When introduced by Cortes' army in 1520, smallpox led to the destruction of the Mexican Aztec population. The death of Queen Anne's only child resulted in an effort to inoculate the entire population of England in order to avoid having a disease influence lines of royal succession. This

inoculation most certainly contributed to England's population growth in the 18th and 19th centuries (Kennedy, 2002).

As the 20th century began and the world's understanding of microbiology increased, world leaders recognized a need to prevent the use of these agents as an act of war. As scientists learned more about the properties, efficient production, and optimal conditions critical to the survival of microorganisms, the potential for intentional use for the devastation of millions of people became increasingly apparent.

In 1925, the Geneva Protocol for the Prohibition of the Use of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare was introduced to prevent the use of chemicals or microorganisms in warfare. This agreement did not, however, prevent many countries from researching and developing biological weapons. Many countries, including Belgium, Canada, Italy, The Netherlands, Poland, and the U.S.S.R., ratified the agreement stipulating retaliation clauses and immediately began building biological weapons programs (Christopher, 1997). The United States did not ratify this agreement until 1975, three years after a later revision was introduced. In essence, the agreement prevented only a "first strike" use of biological weapons. Weapons programs could be built and retaliation for an actual or perceived attack was not prohibited. Even an unintentional release may have resulted in an escalation of deployment of biological weapons could induce public fear.

Although smallpox was never developed as a biological weapon by the United States, in 1942 the War Reserve Service began an offensive biological warfare program at Ft. Detrick, Maryland, with testing sites in Mississippi and Utah and a production facility at

Terra Haute, Indiana. This program produced primarily anthrax, botulism toxin, and tularemia. (Perkins, 1999) This weapons program resulted in the production of approximately 5,000 anthrax bombs (Perkins, 1999). Beginning during the Korean War and through 1968, the United States expanded its biological weapons program to include covert human-subject experiments in which scientists aerosolized the supposedly non-pathogenic bacterium *S. marcescens* at locations in New York City and San Francisco to examine the effects that solar and climatic conditions had on airborne bacteria. One such experiment resulted in an outbreak of urinary tract infections at Stanford University (Perkins, 1999). Worldwide concern (which affected U.S. relations with other nations and with its own citizens) regarding the United States' bioweapons program and its potential use of such weapons continued to rise throughout the 20th century. The U.S. failure to ratify the 1925 Geneva Convention and collaboration with Japanese "Unit 731" bioweapons scientists captured during World War II fueled these concerns.

After several years during the 1940s and 1950s in which many countries conducted research involving the weaponization of biological agents, the 1972 Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological and Toxin Weapons and on Their Destruction prohibited the stockpiling or possession of agents or delivery systems. The 1972 Biological Weapons Convention agreement cited the uncontrollable nature of a biological attack, and reasoned that an attack on one country would surely have ripple effects throughout the world due to expanding inter-country travel habits. One hundred three nations ratified the convention, including the United States in 1975, after

President Richard Nixon had terminated the U.S. bioweapons program by executive order in 1969 and 1970 (Perkins, 1999).

Current Status of Bioterrorism Preparedness and Protocol for Response to an Attack

Although the 1972 Biological Weapons Convention outlawed research on and development of biological weapons, multiple nations have admitted to having stockpiles of anthrax, smallpox, and aflatoxin that are ready for use as weapons. Possible perpetrators of a bioterrorism event include a wide spectrum of state, organization and individual profiles, from activists interested in influencing the political climate of a region to “rogue states” who are more interested in massive casualties that are similar to those seen in the wake of a nuclear weapon deployment. Advantages of the use of smallpox in this type of unconventional warfare are that massive damage can be done to a country or region without causing damage to infrastructure, and with little to no way to trace the source of an attack (Siegrist, 1999).

Ken Alibek, a former director of the U.S.S.R.’s biological weapons program and recent defector to the United States, has disclosed that the U.S.S.R. was involved in bulk production of smallpox and its adaptation for use in bombs and Intercontinental Ballistic Missiles during the 1980s (Henderson, 1999). It is unclear what nation is now in control of or has access to this stockpile of bioweapons, but it is likely that non-Russian countries with motive may have gained access due to the fragmentation of the Soviet empire and a lack of financial support for these laboratories in current-day Russia. Iraq, a country which is known to have experimented extensively with the camelpox virus, may be the next target in the continuing war against terrorism. If Iraq (or terrorist organizations associated with Iraq) is in

possession of such weapons, a pre-emptive attack against the United States or its allies using biological agents is possible.

Smallpox may make a tactically attractive weapon for bioterrorists due to its potential for rapidly destroying troops and/or citizens, and the disruption of production and distribution of equipment. The smallpox vaccine is abundant enough that terrorists could be vaccinated against the organism they are releasing. According to the Johns Hopkins Center for Civilian Biodefense Studies, smallpox is capable of a “maximum credible terrorist event,” indicating that smallpox is a virulent and lethal organism that can be weaponized and made stable in an aerosol form (Kortepeter, 1999). The World Health Organization has expressed concern that smallpox could be freeze-dried to preserve virulence for long periods of time. At the 1999 39th *Interscience Conference on Antimicrobial Agents and Chemotherapy*, Dr. Michael Osterholm, a leader in infectious epidemiology, stated that there 453 known storehouses in 67 nations holding agents of bioterrorism.

An attack on the American population would result in not only physical decimation of the target population, but drastic psychological effects, and likely widespread panic (“Should We,” 2001); Smallpox makes a particularly deadly and demoralizing weapon in that medical personnel can only treat the symptoms of smallpox, not the disease itself.

Although recent progress has been made in reducing the United States’ vulnerability to an attack involving a biological agent, these strides have been made mostly at the federal level. The National Disaster Medical System has voluntary access to 100,000 hospital beds across the country should local hospitals become overwhelmed with the victims of a large-scale attack. These beds are not, however, all equipped with supportive equipment needed

for treating smallpox victims (Siegrist, 1999). The Centers for Disease Control and Prevention (CDC) has also recommended that hospitals identify a group of healthcare workers (including emergency room personnel and infectious disease specialists) that would be hospital based should a case be identified and provide care 24 hours a day. The Centers for Disease Control has stockpiled between 5 and 7 million doses of a smallpox vaccine that, if given within four days of infection, can reduce the severity of, or altogether prevent, symptoms of smallpox. The CDC has reportedly purchased more doses of this vaccine in an effort to further bolster this emergency supply (Siegrist, 1999). Implementation of a CDC recommended pre-emptive vaccination plan of hospital workers (mainly 100 emergency room workers and first responders for each of the 5,100 hospitals in the nation that could handle smallpox) began in January, 2003. According to the CDC, states have requested more than 66,000 doses of the vaccine ("Smallpox Vaccine," 2003). U.S. government has entered into a contract with OraVax for the production of a new form of the smallpox vaccine (produced in live cell cultures) that will deliver 40 million doses in 2004 and continue until 2020. Research is also being conducted on the antiviral drug, cidofovir, for oral use in treating this disease (LeDuc, 2001).

Were a bioterrorism attack involving smallpox to occur in Tarrant County, Emergency Medical Technicians (EMT) and hospital personnel would most likely be the "first responders"- the front line of detection and defense should such an attack occur. Unless preceded by a catastrophic or violent event, initial exposure to the virus as a result of an attack would be unnoticed and uneventful, - e.g., breathing in aerosolized smallpox in a crowded area like a shopping mall or train station. Victims would most likely only realize

they were exposed when they begin to exhibit the later symptoms of the disease. As victims report to private physicians, hospitals, or are visited by EMTs with initial symptoms similar to chickenpox or influenza, the ability of first responders to correctly identify and distinguish smallpox disease from similar afflictions is critical. Initial smallpox symptoms are similar to other diseases involving fever, such as influenza. Several characteristics may allow first responders to distinguish smallpox from chickenpox symptoms. Chickenpox lesions are usually prominent on the trunk and successive groups of lesions develop over several days, whereas smallpox lesions are usually more prominent on the face and extremities and develop at the same time (Ward, 2001). Testing blood and lesion material can confirm initial suspicions. Once smallpox disease is suspected, isolation from the rest of the hospital population is needed until affirmative diagnosis has been made. Once diagnosis has been made, local public health authorities must be notified per the "Health and Safety Code, Chapter 81, Control of Communicable Disease" (Hathaway, 2002). According to Dr. Bobby Jones, Tarrant County Epidemiology Manager, many hospitals have specialized response teams consisting of staff experienced with various different aspects of dealing with patients who have contracted smallpox. These response teams would work with patients and with local, state, and federal staff responding to a crisis (personal communication, November 21, 2002).

At that point the local public health department (either Fort Worth or Tarrant County, depending on the location of the patient) would become involved in active surveillance for further occurrence of the disease, in addition to responding to the currently diagnosed case(s). The Centers for Disease Control and Prevention have recently released recommendations

regarding a ring vaccination strategy to be used by local health departments. According to this strategy, those in need and those most likely to come down with disease (such as first responders and hospital personnel) are subjected to mandatory vaccinations by public health staff (coordinated by the epidemiology manager/local public health officer), with a mass vaccination strategy in which up to one million of those who are in need or at risk may be vaccinated on a voluntary basis in regions where a smallpox case is identified. Vaccination efforts of first responders have also recently gotten underway in Tarrant County. Voluntary vaccination of up to 2,400 Tarrant County public health and hospital response team members began during early March 2003 (Tarrant County Public Health Department, 2003). These vaccination efforts are an important step in strengthening the Tarrant County medical community's ability to respond to a smallpox bioterrorist attack.

Epidemiologists from the Tarrant County or City of Fort Worth investigate and confirm cases, contacts, and exposures to quickly determine commonalities in identifying an outbreak source, and controlling the spread of the disease by isolating and treating those exposed to the initial cases (Hathaway, 2002). Simpson (2002) recommends investigating contacts and exposures out to two degrees of separation (primary and secondary exposures) from each initial case.

The responding public health department then communicates with, and coordinates response from local (Department of Public Safety), state (Texas Department of Health), and federal (Centers for Disease Control and Prevention, Federal Bureau of Investigation) agencies. The Federal Bureau of Investigation is the designated agency for the overall management of a bioterrorism attack and must be notified of any cases of smallpox within the

United States. The responding public health department then focuses its attention to informing the public about the situation by communicating with media outlets and organizing public relations activities.

In 2002, Tarrant County Public Health Department received a \$1.6 million U.S. Department of Health and Human Services grant to help expand bioterrorism preparedness and strengthen the local public health infrastructure. Areas in which preparedness and response ability will be improved are: 1) better preparedness assessments, 2) enhanced surveillance and epidemiology capability, 3) a public health laboratory upgrade, 4) use of a "Health Alert Network" with improved communications, 5) dissemination of health information, and 6) increased education for health department staff and community partners (Tarrant County Public Health Department, 2002). Tarrant County Public Health has already begun work on implementing the use of the "Health Alert Network," a closed computer network that ties together 200 community hospitals, 64 local health departments, the Texas Department of Health, and the Centers for Disease Control to facilitate better communication and information sharing (Tarrant County Public Health Department, 2002). Efforts to educate school district nurses about their role in responding to bioterrorism emergencies and reduce myths and misinformation about mass casualty attacks have already begun as well (Tarrant County Public Health Department, 2003).

Importance of Public Perception

The United States population has seen its government become engaged and send sons and daughters to fight in wars that the public has understood were necessary to stop foreign aggression and preserve their way of life. The events of September 11th have also raised the

levels of anxiety and fear among U.S. citizens that potential battlegrounds for such wars may include America. Gray (2002) reports that as a result of recent terrorist attacks, fear of terrorism may cause people to engage in activities that create greater dangers for themselves and others. Studies have demonstrated that substantially fewer individuals traveled via airplane, more purchased handguns, and more began taking ciprofloxacin prophylactically to protect against anthrax during the May 2001 – May 2002 time period. Although the likelihood that an individual would be exposed to anthrax or find himself on a hijacked airplane is statistically negligible, fear of these possibilities has caused many Americans to alter their behavior unnecessarily (Gray, 2002). Terrorism has also been shown to elicit varied emotional responses from the public. In a Pew Research Center poll taken between October 1-3, 2001 to measure emotional response to the September 11 attacks, 59 percent of respondents said they had experienced depression, 31 percent had difficulty concentrating, 23 percent suffered insomnia, and 87 percent felt angry (Gray, 2002).

A major factor that may contribute to public fear might be the potential of weapons for which immediate effects cannot be physically seen. “The idea of infection caused by invisible agents is frightening. It touches a deep human concern about the risk of being destroyed by a powerful, evil, imperceptible force. These beliefs activate emotions that are extremely difficult to direct with the tools of reason” (Halloway, 1997).

In the absence of effective education from governmental agencies regarding regional and county preparedness, Americans may receive their information about the concepts of bioterrorism from less reliable sources, including media. Rotz et al. (2002) recently reviewed newspaper articles, radio and television transcripts (looking for keywords involving

“smallpox” and “bioterrorism”) and reported that public anxiety, perception and awareness of the smallpox virus was among the highest for any bioterror agent.

Results from a national telephone survey of 1006 U.S. adults conducted by Blendon et al. (2003) have shown a lack of public knowledge about smallpox and the vaccine used to prevent the disease. The majority of respondents in Blendon’s survey did not have correct knowledge regarding smallpox case prevalence, spread, treatment, survival likelihood, and vaccine efficacy. Gray (2002) explains that individual responses to risks (such as the threat of bioterrorism involving smallpox) are affective responses that apply an individual’s emotions, values, and instincts to perceived risk. As a result, fears do not always match rationally with facts about a risk. By educating the public about some of the basic facts regarding smallpox and bioterrorism, public health officials can help people with their fears and encourage rational responses (Gray, 2002). Sandhu (1999) states that a critical goal of a health department is to “disseminate the knowledge base of disaster epidemiology to the community at large.” In Tarrant County, with a population of 1.4 million people (Tarrant County, 2003), the challenge to educate the public is one that will require much effort and dedication in undertaking.

CHAPTER III

METHODS

To assess public perception regarding Tarrant County's preparedness for a smallpox bioterrorism attack an 18 question survey was developed to gather information from Tarrant County residents (Appendix A). The survey data will allow the following hypotheses to be examined:

- I. The public's perception is that Tarrant County is not prepared to respond to a smallpox bioterror attack.
- II. The public's perception regarding the threat of an attack and Tarrant County's preparedness to respond and the level of understanding of the concepts of bioterrorism and smallpox differ according to age, education, gender, and language spoken most in the home.

Participants were selected for telephone interview by randomly selecting telephone numbers from the August 2001 Southwestern Bell Greater Fort Worth White Pages directory. Directory page numbers and record number on a page were chosen by use of a random numbers table (Daniel, 1999). A random starting point was chosen from the random numbers table. Starting with the number located at that point, the first four numbers recorded were used to choose a page in the telephone directory (random numbers 1-987 were valid as there were 987 pages in the directory). The three numbers that immediately followed were used to

locate a directory record and phone number on the page (random numbers 1-500 were valid as each page contained at most 500 records). The selection of 300 numbers was completed before any telephone interviews were begun on July 20, 2002.

Attempts were made to reach a respondent for 300 numbers initially selected at random between July 20 and October 15, 2002. Interviews were conducted primarily on Mondays-Thursdays from 5pm-6pm, and on Sundays from 3pm-6pm. From the initial group of 300 telephone numbers selected, the following results resulted:

Table 1

Outcomes for Sample of Telephone Numbers (n=300)

Result	Frequency	Percent
Completed Interview	42	14
Contacted but Declined to Interview	82	27.3
Never Answered Phone (after 3 attempts)	97	32.3
Non-Working Number	79	26.3
<i>Total</i>	<i>300</i>	<i>100</i>

For each of the 178 either non-working or non-responsive numbers, initially observed, substitutions were selected, using the random selection method described above, and calls were continued until a total number of 300 residents were contacted and offered an opportunity to be interviewed. This was achieved on November 14, 2002, after an additional 324 numbers were selected.

Answers chosen by survey participants were coded (numbered according to answer unless a continuous value was provided, i.e. years of education, year of birth) and entered

into a Microsoft Access database using the Epi Info 2000 statistical analysis program (Centers for Disease Control and Prevention 2000). Frequencies were produced for responses for all questions on the survey instrument.

Chi square analysis was performed for comparison of demographics and responses to central outcome questions. If P-values for the comparisons were less than .05, a significant degree of dependence was observed. The chi square value, χ^2 , and corresponding p-values were computed using the EpiInfo program.

CHAPTER IV

RESULTS

A total of 81 (16.9%) Tarrant County residents agreed to participate in the telephone survey. The 81 completed interviews were the result of the following total attempts to contact residents:

Table 2

Results of Total Sampling, Including Substitutions

Result	Frequency	Percent
Completed Interview	81	13
Contacted but Declined to Interview	219	35.1
Did Not Answer	179	28.7
Non-Working Number	145	23.2
<i>Total</i>	<i>624</i>	<i>100</i>

Respondent Demographic Frequencies

Response frequencies were calculated for all questions in the survey. The demographic frequencies observed for the respondent population is presented in Table 3. Out of 81 participants, 54 were female (66.7%), 53 (65.4%) were either married or in a partnership, and 52 (64.2%) had completed at least one year of a college education. Seventy-nine respondents (97.5%) spoke English most in their homes.

Table 3

Demographic Frequencies for Respondents (n = 81)

Respondent Characteristic	Frequency	Percent
Gender		
Male	27	33.3%
Female	54	66.7%
Length of Residence in Current Neighborhood		
Less than 1 year	9	11.1%
1-2 years	13	16.0%
3-5 years	21	25.9%
5-10 years	13	16.0%
Longer than 10 years	25	30.9%
Age		
18-34	23	28.4%
35-54	30	37.0%
>55	28	34.6%
Marital Status		
Married/in a partnership	53	65.4%
Single/divorced/widowed	28	34.6%
Head of Household		
Yes	43	53.1%
No	38	46.9%

(Table 3 cont.)

Demographic Frequencies for Respondents (n = 81)

Respondent Characteristic	Frequency	Percent
Language Spoken Most in Home		
English	79	97.5%
Spanish	2	2.5%
Level of Education		
High school grad or some high school	29	35.8%
College grad or some college	43	53.1%
Graduate degree or some grad work	9	11.1%

Survey Outcome Question Frequencies

Of 81 respondents, almost half (48.1%) believed that bioterrorism may be the most likely method of terrorism to be used next against the United States (Table 4). A majority of respondents claimed that they were at least somewhat familiar with the concepts of “bioterrorism” (80.2%) and “smallpox” (75.3%), and 71.6% were knowledgeable of the method in which smallpox is transmitted.

Sixty-seven respondents (82.7%) indicated that they would get themselves vaccinated against smallpox if the vaccinations were offered in Tarrant County while 64 participants (79.0%) stated that they wished Tarrant County would provide them with more information on local bioterrorism preparedness. Over half of respondents indicated that they were uncomfortable (18.5% very uncomfortable, 42.0% somewhat uncomfortable) with what they

knew about Tarrant County's preparedness for an attack, although they were split regarding the likelihood of such an attack occurring in Tarrant County.

Table 4

Response Frequencies for Terrorism Related Questions

Question Responses	Frequency	Percent
Most Likely Method of Terrorism		
Plane Hijacking	7	8.6%
Bioterrorism	39	48.1%
Nuclear Attack	4	4.9%
Chemical Warfare	17	21.0%
Other	4	4.9%
I don't know	10	12.3%
Smallpox an Effective Weapon?		
Yes	60	74.1%
No	14	17.3%
I don't know	7	8.6%
Placed into food at a local restaurant	14	17.3%
Spread through the air in a crowded area	58	71.6%
Injected into patients in a local hospital	3	3.7%
Spread onto toilet seats in a public restroom	3	3.7%
Did not answer	3	3.7%

(Table 4 cont.)

Response Frequencies for Terrorism Related Questions

Question Responses	Frequency	Percent
Familiarity with Smallpox Symptoms and Disease		
Very Familiar	15	18.5%
Somewhat Familiar	46	56.8%
Not Familiar	20	24.7%
Familiarity with Bioterrorism		
Very Familiar	18	22.2%
Somewhat Familiar	47	58.0%
Not Familiar	16	19.8%

Table 5

Response Frequencies for Public Response Questions

Question Responses	Frequency	Percent
Tarrant County as the Site of a Smallpox Bioterrorist Attack		
Very likely	7	8.6%
Somewhat likely	28	34.6%
Not likely	35	43.2%
Very unlikely	6	7.4%
I don't know	5	6.2%
Get Smallpox Vaccinations		
Yes	67	82.7%
No	9	11.1%
I don't know	5	6.2%
Overall Comfort Level		
Very comfortable	2	2.5%
Comfortable	27	33.3%
Somewhat uncomfortable	34	42.0%
Very uncomfortable	15	18.5%
I don't know	3	3.7%
More information from Tarrant County About Preparedness?		
Yes	64	79.0%
No	16	19.8%
I don't know	1	1.2%

More than half of respondents replied that they did not believe Tarrant County was prepared to control and contain a smallpox outbreak, and an additional 27.2% indicated that they did not know. Respondents were split according to whether or not they would receive adequate medical care in the event of a smallpox outbreak in Tarrant County (Table 6). These results indicate a lack of public confidence in and/or knowledge of the state of county preparedness for such an attack.

Table 6

Response Frequencies for Preparedness Questions

Question Responses	Frequency	Percent
Tarrant County Prepared to Control and Contain Smallpox Outbreak		
Yes	17	21.0%
No	42	51.9%
I don't know	22	27.2%
Receive Adequate Medical Care		
Yes	40	49.4%
No	36	44.4%
I don't know	5	6.2%

Frequencies and Chi Squared Analysis of Outcome and Demographic Variables

Chi-squared analysis was performed for survey outcome responses compared with the demographic characteristics of age, education, gender, marital status, household status, language spoken most in the home, and years in current neighborhood. (No analyses could be performed for language spoken most in the home, as 97% of respondents were primarily

English speaking.) The following tables highlight results observed for the hypothesized relationship between the demographic variables and familiarity with the concepts of bioterrorism, smallpox, the threat of a smallpox attack, and Tarrant County's ability to respond. Significant results for other cross tabulations are also presented here.

Table 7 illustrates that familiarity with the concepts of bioterrorism and smallpox did not differ significantly according to any of the demographic variables, most notably age, education, or gender.

Perceptions regarding the threat of bioterrorism and use of smallpox differed significantly according to age, but not according to gender or level of education. More respondents over age 55, when compared to other age groups, indicated "I don't know" when asked if smallpox would be an effective bioterrorist weapon ($\chi^2 = 8.611$, $df = 4$, $p < .05$). More participants aged 18-34 years old, when compared to other age groups, believed that an attack on Tarrant County using smallpox was not likely, while more respondents aged 35-55 indicated that such an event was "somewhat likely" ($p < .10$). These findings are presented in Table 8.

Table 7

Cross Tab Results: Familiarity with Bioterrorism and Smallpox ConceptsAccording to Demographic Variables of Sample (n = 81)

Demographic Variable	Familiarity with Bioterrorism					Familiarity with Smallpox				
	VF	SF	NF	χ^2	p	VF	SF	NF	χ^2	p
Gender				1.30	0.52				0.71	0.70
Male	8	14	5			4	15	8		
Female	10	33	11			11	31	12		
Years in Current Neighborhood				7.68	0.47				4.84	0.77
Less than 1 year	1	5	3			3	4	2		
3-5 years	8	10	3			2	14	5		
5-10 years	2	9	2			1	9	3		
>10 years	4	14	7			6	12	7		
Age				8.61	0.07				6.61	0.16
18-34	6	15	2			1	16	6		
35-54	9	17	4			7	18	5		
>55	3	15	10			7	12	9		
Marital Status				2.20	0.33				3.40	0.18
Married/in a partnership	13	32	8			8	34	11		
Single/divorced/widowed	5	15	8			7	12	9		
Head of Household				0.19	0.91				2.45	0.29
Yes	10	24	9			9	21	13		
No	8	23	7			6	25	7		

Note. VF = Very Familiar; SF = Somewhat Familiar; NF = Not Familiar.

(Table 7 cont.)

Cross Tab Results: Familiarity with Bioterrorism and Smallpox Concepts

According to Demographic Variables of Sample (n = 81)

Demographic Variable	Familiarity with Bioterrorism					Familiarity with Smallpox				
	VF	SF	NF	χ^2	p	VF	SF	NF	χ^2	p
Education				5.16	0.27				1.57	0.81
College grad or some College	9	26	8			8	25	10		
HS grad or some HS	5	16	8			5	15	9		
Post-graduate work or grad	4	5	0			2	6	1		

Note. VF = Very Familiar; SF = Somewhat Familiar; NF = Not Familiar.

Significant results were seen in cross tabulations that were not directly part of the hypothesis, namely interest in preparedness and the method of terrorism respondents believed would most likely be directed at the United States. As noted in Table 9, more females than males indicated that they desired more information from Tarrant County regarding bioterrorism preparedness.

More females (55.6%) than males (33.3%) also indicated that bioterrorism was most likely the method of terrorism that may be used should an attack be levied against the United States. Table 10 illustrates this finding.

Interestingly, no statistically significant associations were observed for any of the outcome questions with regards to marital status, years spent in current neighborhood, position in the household, or level of education.

Table 8

Cross Tab Results: Perception of Threat According to Demographic Variables of Sample (n = 81)

Demographic Variable	Threat of Smallpox Attack in Tarrant County							Smallpox as Effective Weapon?				
	VL	SL	NL	VU	IDK	χ^2	p	Yes	No	IDK	χ^2	p
Gender						3.06	0.55				0.40	0.82
Male	3	10	10	1	3			19	5	3		
Female	4	18	25	5	2			41	9	4		
Years in Current Neighborhood						8.95	0.92				12.95	0.11
Less than 1 year	0	3	4	1	1			4	3	2		
1-2 years	0	6	7	0	0			9	3	1		
3-5 years	2	6	9	2	2			14	6	1		
5-10 years	2	5	5	0	1			13	0	0		
>10 years	3	8	10	3	1			20	2	3		
Age						13.47	0.10				10.40	0.03
18-34	1	6	15	1	0			15	6	2		
35-54	3	13	12	1	1			23	7	0		
>55	3	9	8	4	4			22	1	5		
Marital Status						9.14	0.06				2.56	0.28
Married/in a partnership	5	21	24	1	2			42	8	3		
Single/divorced/widowed	2	7	11	5	3			18	6	4		

Note. VL = Very Likely; SL = Somewhat Likely; NL = Not Likely, VU = Very Unlikely; IDK = I Don't Know.

(Table 8 cont.)

Cross Tab Results: Perception of Threat According to Demographic Variables of Sample (n = 81)

Demographic Variable	Threat of Smallpox Attack in Tarrant County						Smallpox as Effective Weapon?					
	VL	SL	NL	VU	IDK	χ^2	p	Yes	No	IDK	χ^2	p
Head of Household						2.04	0.73				4.69	0.10
Yes	4	13	19	3	4			32	5	6		
No	3	15	16	3	1			28	9	1		
Education						3.13	0.93				5.09	0.28
College grad or some College	3	17	17	3	3			34	7	2		
HS grad or some HS	3	8	13	3	2			18	7	4		
Post-graduate work or grad	1	3	5	0	0			8	0	1		

Note. VL = Very Likely; SL = Somewhat Likely; NL = Not Likely, VU = Very Unlikely; IDK = I Don't Know.

Table 9

Cross Tab Results: Public Desire for Information According to
Demographic Variables of Sample (n = 81)

Demographic Variable	Desire More Information From Tarrant County About Preparedness?			χ^2	p
	Yes	No	IDK		
Gender				7.10	0.03
Male	17	9	1		
Female	47	7	0		
Years in Current Neighborhood				14.48	0.07
Less than 1 year	8	1	0		
1-2 years	10	3	0		
3-5 years	11	9	1		
5-10 years	12	1	0		
>10 years	23	2	0		
Age				3.38	0.50
18-34	17	6	0		
35-54	26	4	0		
>55	21	6	1		
Marital Status				2.59	0.27
Married/in a partnership	41	12	0		
Single/divorced/widowed	23	4	1		
Head of Household				3.02	0.22
Yes	31	11	1		
No	33	5	0		

(Table 9 cont.)

Cross Tab Results: Public Desire for Information According to

Demographic Variables of Sample (n = 81)

<u>Demographic Variable</u>	<u>Desire More Information From</u> <u>Tarrant County About Preparedness?</u>			<u>χ^2</u>	<u>p</u>
	<u>Yes</u>	<u>No</u>	<u>IDK</u>		
Education				1.12	0.89
College grad or some College	33	9	1		
HS grad or some HS	24	5	0		
Post-graduate work or grad	7	2	0		

Note. IDK = I Don't Know.

Table 10

Cross Tab Results: Responses to Possible Methods for Future Terrorism According to Demographic Variables (n = 81)

Demographic Variable	Most Likely Terror Method Against United States						χ^2	p
	PH	BIO	NUC	CHE	OTH	DNA		
Gender							12.16	0.03
Male	1	9	2	7	4	4		
Female	6	30	2	10	0	6		
Years in Current Neighborhood							15.71	0.73
Less than 1 year	2	4	0	1	0	2		
1-2 years	0	7	0	5	0	1		
3-5 years	2	11	1	3	1	3		
5-10 years	2	5	0	4	1	1		
>10 years	1	12	3	4	2	3		
Age							10.91	0.36
18-34	2	14	2	2	2	1		
35-54	1	12	1	9	2	5		
>55	4	13	1	6	0	4		
Marital Status							4.67	0.46
Married/in a partnership	5	27	1	12	3	5		
Single/divorced/widowed	2	12	3	5	1	5		

Note. PH = Plane Hijacking, BIO = Bioterrorism, NUC = Nuclear Attack, CHE = Chemical Warfare, OTH = Other, DNA = Did Not Answer

(Table 10 cont.)

Cross Tab Results: Responses to Possible Methods for Future Terrorism According to Demographic Variables (n = 81)

Demographic Variable	Most Likely Terror Method Against United States						χ^2	p
	PH	BIO	NUC	CHE	OTH	DNA		
Head of Household							5.54	0.35
Yes	4	21	1	9	4	4		
No	3	18	3	8	0	6		
Education							10.05	0.44
College grad or some College	3	18	2	12	2	6		
HS grad or some HS	4	13	2	4	2	4		
Post-graduate work or grad	0	8	0	1	0	0		

Note. PH = Plane Hijacking, BIO = Bioterrorism, NUC = Nuclear Attack, CHE = Chemical Warfare, OTH = Other, DNA = Did Not Answer

CHAPTER V

DISCUSSION

The results obtained from the administration of this survey should be interpreted in light of the limitations of the study. Conducting the survey over the telephone using a standard telephone book immediately limited the potential survey population to those residents of Tarrant County that had listed phone numbers. Individuals who did not own a phone or had an unlisted number did not have an opportunity to participate in this study. This selection method may have introduced a selection bias toward households with at least minimal financial resources. Due to limitations of the interviewing process- one English speaking interviewer contacted all respondents over a 3 month period- additional bias are most likely present. As the interviewer did not speak conversational Spanish, all surveys had to be conducted in English. Interviews could not be completed with individuals who did not speak conversational English. The extended time frame during which interviews took place may have introduced an information bias as attitudes might have changed as the war on terrorism continued and possible war between the United States and Iraq loomed.

The administration of the survey by telephone may explain the observed low response rate- 16.9%. The resultant 81 respondents are a non-representative sample of the population of Tarrant County due to the low response rate and as indicated by the observation that two-thirds of respondents were female. I am hesitant to generalize survey findings in light of these limitations. Survey results should be interpreted accordingly.

Survey results support the conclusion that the public is not convinced that the governmental agencies of Tarrant County are prepared for a smallpox bioterrorist attack. At least half of respondents indicated that they did not believe Tarrant County agencies could control and prevent an outbreak of smallpox and about the same proportion responded that they are not comfortable with the risk of an attack when compared with Tarrant County's ability to respond. Equally as important, one-third of respondents did not have any opinion regarding whether or not Tarrant County is prepared for an attack. These results suggest a lack of confidence and knowledge about current levels of preparedness for a smallpox bioterrorist attack in Tarrant County.

Public perceptions regarding the effectiveness of smallpox as a bioterrorist weapon and the threat of such an attack occurring in Tarrant County differed according to age, as predicted earlier in this work. More participants between the ages of 35 and 54 indicated that the threat of an attack in Tarrant County was at least somewhat likely. Members of this age group were up to 15 years of age during the Cuban Missile crisis, a time when the threat of an attack with a weapon of mass destruction was very real and close. Individuals who lived during that tense era of American history may be more likely to acknowledge that a similar threat towards them and their neighbors is likely. Gray (2002) explains that "humans tend to fear similar things, for similar reasons...explain[ing] the ways we subconsciously 'decide' what to be afraid of and how afraid to be." Alternatively, more respondents between the ages of 35 and 54 acknowledged that smallpox would make an effective bioterrorist weapon than any other age group, while more respondents older than age 55 replied that they didn't know.

The differences in perception according to age may reflect varying levels of awareness of the growing concern regarding the use of microbes as weapons.

Contrary to the hypothesis discussed in the introduction, perception of Tarrant County's preparedness to respond to an attack and self-assessed familiarity with the concepts of bioterrorism and smallpox did not differ according to age, gender or level of education. The observation that the majority of respondents claimed that they were at least somewhat familiar with the terms bioterrorism and smallpox contrasts with Blendon's conclusions (2003) that the public is generally misinformed regarding smallpox and related concepts. An important difference between these two surveys is that the Blendon survey gauged knowledge of bioterrorism concepts according to answers given in response to questions that required a demonstration of knowledge, while the survey that is the basis for this work asked for respondents to "self-assess" their own knowledge level/familiarity. The contrast in results of these two surveys may indicate that although the public generally believes it is familiar with smallpox and bioterrorism concepts, it may be misinformed. Steps toward educating and informing the public with accurate information may reduce unnecessary fear and concern.

General acknowledgement of bioterrorism as a possible threat and the intention to take measures to protect oneself against smallpox differed according to gender. More females than males believed that the next act of terrorism will involve the use of a biological agent, indicated they would get themselves and their families vaccinated against smallpox, and desired more information regarding Tarrant County preparedness for a smallpox attack.

Explanation for this observation was not found in scientific literature- future studies might address possible rationale for this behavior.

In the absence of accurate education and information dissemination, public perception and/or fear will often not mirror reality. In recent years, Tarrant County has made several important steps toward strengthening the capacity for public health response to emergencies, including incorporation of the "Health Alert Network," development of hospital response teams, and the addition of epidemiology and disease intervention staff. While Tarrant County does engage in efforts toward educating residents about county preparedness and bioterrorism concepts, more programs and informational outlets could be used to make sure that accurate information gets disseminated. Misinformation about bioterrorism, smallpox, and preparedness can inspire individuals to take unnecessary risks or make irrational decisions with regard to their own lives and others (Gray, 2002). Even though the majority of the public may feel that they are correctly informed about these concepts, they may often be basing these conclusions on false and inaccurate information.

There is an important line between educating and scaring the public. According to Dr. Bobby Jones, Tarrant County Epidemiology Manager, it is currently the philosophy of the Tarrant County Public Health Department to keep public response to a potential threat as calm as possible (personal communication, November 21, 2002). Steps toward educating the public must be sensitive toward preserving public peace. Currently, communication with the public and health care community is coordinated by a Tarrant County Public Health information officer. Regular communication with media sources and the public via the Public Health Department's informational website currently provide information about

county efforts to prepare for a bioterrorist attack as well as highlights about educational opportunities. While efforts to educate the public about bioterrorism do exist, increased opportunities for the public to get questions answered are needed. Augmentation of the frequency and accessibility of education is needed, along with improved efforts to make sure correct information gets into the home. Informational brochures and literature about bioterrorism facts and educational opportunities generated by public health department and distributed to Tarrant County communities would help in increasing public awareness and reducing misinformation.

As Tarrant County continues to strengthen the public health infrastructure responsible for the surveillance of disease and response to intentional release of biological agents, a strategic plan focused on the dissemination of information and education of the public and first responder personnel via multiple media resources should raise public awareness and improve the community knowledge base. As the community becomes more familiar with the threat of bioterrorism, how Tarrant County government agencies are prepared to both detect and respond to an event, and its own role and responsibilities should an event occur, a more rational public perspective and response should become more likely.

APPENDIX
PHONE SURVEY

Phone Survey

Survey ID:

UNIVERSITY OF NORTH TEXAS
HEALTH SCIENCE CENTER AT FORT WORTH
SCHOOL OF PUBLIC HEALTH

Zip code: _____

Date: _____ Time: _____ Interviewer's Initials: _____

HELLO, MY NAME IS _____. I AM WORKING ON A RESEARCH PROJECT BEING CONDUCTED BY THE UNIVERSITY OF NORTH TEXAS HEALTH SCIENCE CENTER SCHOOL OF PUBLIC HEALTH. I AM HELPING TO CONDUCT A SURVEY TO DETERMINE YOUR PERCEPTIONS REGARDING BIOTERRORISM FOR RESEARCH PURPOSES. WOULD YOU LIKE TO PARTICIPATE IN THIS SURVEY?

PLEASE KEEP IN MIND THAT THIS SURVEY IS FOR RESEARCH PURPOSES ONLY AND IS NOT BASED ON ANY CURRENT OR PAST THREAT OR DANGER. YOUR PARTICIPATION IS VOLUNTARY; YOU MAY STOP AT ANY TIME. YOU WILL NOT BE IDENTIFIED IN THE SURVEY. THE SURVEY SHOULD TAKE ONLY APPROXIMATELY 20 MINUTES. WOULD YOU LIKE TO PARTICIPATE IN THIS SURVEY?

1. If a country or group were to engage in terroristic activities against the United States, how would they most likely do it? **(INTERVIEWER: READ CHOICES.)**
 1. Plane hijacking
 2. Bioterrorism
 3. Nuclear attack
 4. Chemical warfare
 5. Other: _____
 6. I don't know

2. How familiar are you with what "bioterrorism" means? **(INTERVIEWER: READ CHOICES.)**
 1. Very familiar
 2. Somewhat familiar
 3. Not familiar

3. Are you familiar with the symptoms and disease caused by the smallpox virus?
(INTERVIEWER: READ CHOICES.)
 1. Very familiar
 2. Somewhat familiar
 3. Not familiar
4. Do you feel that smallpox would make an effective weapon if used by terrorists?
 1. Yes
 2. No
 3. I don't know
5. If smallpox were to be used as a biological weapon, how would it most likely be used? Please choose an answer from the following list. **(INTERVIEWER: READ CHOICES)**
 1. Placed into food at a local restaurant
 2. Spread through the air in a crowded area
 3. Injected into patients in a local hospital
 4. Spread onto toilet seats in a public restroom
6. Do you believe that you would receive adequate medical care if you were infected by smallpox during a bioterrorist attack?
 1. Yes
 2. No
 3. I don't know
7. Would you get yourself and your family if you have one vaccinated against smallpox if smallpox vaccinations were offered in Tarrant County?
 1. Yes
 2. No
 3. I don't know
8. How likely do you think that the Tarrant County is to be the site of a smallpox bioterrorist attack? **(INTERVIEWER: READ CHOICES.)**
 1. Very likely
 2. Somewhat likely
 3. Not likely
 4. Very unlikely
 5. I don't know

9. Do you feel that the Tarrant County is sufficiently prepared to control and contain an outbreak of this disease?
 1. Yes
 2. No
 3. I don't know
10. Please indicate your overall comfort level, from the list that follows, with respect to the threat of an outbreak of this disease and the Tarrant County's ability to respond. **(INTERVIEWER: READ CHOICES.)**
 1. Very comfortable
 2. Comfortable
 3. Somewhat uncomfortable
 4. Very uncomfortable
 5. I don't know
11. Do you wish the county health department would provide you with more information on bioterrorism preparedness in Tarrant County?
 1. Yes
 2. No
 3. Don't Know

INTERVIEWER: SO THAT WE CAN BETTER DETERMINE AND ANALYZE COMMUNITY KNOWLEDGE ABOUT THESE QUESTIONS, I NEED TO ASK YOU SOME PERSONAL QUESTIONS.

12. Are you male or female?
 1. Male
 2. Female
13. How many years have you lived in your current neighborhood?
(INTERVIEWER: READ CHOICES.)
 1. Less than 1 year
 2. 1-2 years
 3. 3-5 years
 4. 5-10 years
 5. Longer than 10 years
14. In what year were you born? _____
15. We would like to know your marital status. Are you: **(INTERVIEWER: READ CHOICES.)**
 1. Married/in a partnership
 2. Single/divorced/widowed

16. Are you the head of the household?
1. Yes
 2. No
17. What is the language spoken most in your home? (**INTERVIEWER: READ CHOICES.**)
1. English
 2. Spanish
 3. Other: _____
18. What was the last grade of school you completed?

EXAMPLE: COMPLETED HIGH SCHOOL = 12, 2 YEARS OF COLLEGE = 14, 4 YEARS OF COLLEGE = 16.

INTERVIEWER: THANK YOU FOR ANSWERING OUR SURVEY. YOU HAVE HELPED WITH IMPORTANT RESEARCH. FURTHER INFORMATION REGARDING THIS SUBJECT CAN BE FOUND AT [HTTP://WWW.WHO.INT](http://www.who.int) AND AT [HTTP://WWW.CDC.GOV](http://www.cdc.gov).

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