THE FEASIBILITY OF USING CASPER TO ASSESS RISK FACTORS FOR NEGLECTED TROPICAL DISEASES

An Undergraduate Research Scholars Thesis

by

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ABSTRACT

Using CASPER to Assess Risk Factors for Neglected Tropical Diseases

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Although more than one billion people live at risk of neglected tropical diseases (NTDs) in areas of Asia, sub-Saharan Africa, and Latin America, the degree to which they burden countries like the United States is currently unclear. Even though many NTDs such as dengue, leishmaniasis, and Chagas disease are not endemic to the United States, the possibility of their emergence is noteworthy, especially in states like Texas, which has high levels of poverty, a large immigrant population, geographic proximity to endemic areas, and a climate amenable to the vectors for these diseases. Despite the health threat that emerging NTDs may pose, little is known about the prevalence of risk factors for NTDs the United States. We tested the Community Assessment for Public Health Emergency Response (CASPER) method to assess the prevalence of risk factors for NTDs in Brazos County, Texas. Using this method, we collected data on a representative sample of households in Brazos County and surveyed them for risk on the basis of five major factors: demographics, travel history, housing quality, vector contact and prevention behaviors, and pets and animals near the home. We found that, while residents were generally at low risk, imported cases from international travel or visitors still pose a risk to import cases into Bryan-College Station and the surrounding area.

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NOMENCLATURE

CASPER	Community Assessment for Public Health Emergency Response
NTD	Neglected Tropical Diseases
WHO	World Health Organization
CDC	Centers for Disease Control
BCS	Bryan/College Station, Texas
H.B. 2055	Texas House Bill 2055
SMART	Survey Management and Response Tools
NCIPH	North Carolina Institute for Public Health

CHAPTER I

INTRODUCTION

Neglected tropical diseases (NTDs) are communicable diseases common in subtropical and tropical countries that cause a substantial disease burden due to high morbidity rates. Across the world, over 1 billion people live in at-risk areas.[1] Although NTDs are most commonly found in developing countries, developed countries also report NTDs, and it is becoming increasingly clear that, with the spread of vectors and the ease of global travel, no region of the world can remain free of these infections. In the United States, the State of Texas has the heaviest potential public health burden associated with NTDs due to its high poverty rate, large immigrant population, geographic proximity to endemic areas, and a climate amenable to the vector life cycle.[2]

Over the past 10 years, Texas has seen the emergence of several vector-borne viral and parasitic diseases; of these: three are of major public health concern. Dengue fever is caused by four viruses that are spread by mosquitos. Mosquitos become infected when they bite a person with the dengue virus in their blood and transmit the virus to other people via a mosquito bite. Dengue fever has reestablished itself as endemic to the United States-Mexico border region. A 2005 study of Brownsville, Texas residents found a seroprevalence of 39 percent and an incidence of 4 percent.[3] In 2013, the Centers for Disease Control (CDC) reported an outbreak of 53 confirmed cases of dengue in Texas's southernmost counties.[4]

Leishmaniasis is a parasitic disease caused by *Leishmania mexicana*, the vector of which is sandflies of the genus *Lutzomyia*. These vectors have a wide and increasing geographic range in the United States.[19] While risk factors for this disease include many of those mentioned above for mosquito-borne illnesses, unique risk factors include: rural residence, frequent interaction with nature, and wildlife hosts residing in or near the home. Reservoirs include wood rats, cotton rats, opossums, and armadillos.[5] Suspected cases of locally-acquired leishmaniasis have been reported in southern Texas sporadically for decades.[5] However, leishmaniasis seems to have been increasing in range in a northeastward direction since about 2000.[6] Cases or clusters of cases of cutaneous leishmaniasis have been identified in Dallas and Waco, Texas, and McCurtain County, Oklahoma, areas that had never previously reported cases.[7,8]

Chagas disease is a parasitic infection caused by *Trypanosoma cruzi* and transmitted by kissing bugs of the genus *Triatoma*. Although the highest density and diversity of kissing bugs species can be found in the Southwest, kissing bugs species have been reported in at least twenty-six states.[8] Risk factors for Chagas include poor housing quality, including cracks, gaps, poor roofing, dirty interior; infected dogs in or around the home; and raising chickens near the home, which increases vector density by providing a stable food source.[20] Previous data also suggest that stray dogs in shelters are documented carriers; therefore, large numbers of stray dogs in a community should also be considered a risk factor.[9] Chagas disease is known to regularly infect both human and animal reservoirs in Texas. There are an estimated 300,000 cases of Chagas disease in the United States,[9] and a recent study estimated a 9 percent seroprevalence of Chagas in shelter dogs across Texas.[10] Further work using a community mail-

in submission program showed a 63.3 percent prevalence of Chagas disease in submitted kissing bugs.[11]

The soil transmitted helminthes, which include ascariasis, hookworm, trichuriasis, taeniasis, cysticercosis, echinococcosis, paragonimiasis, and fascioliasis, heavily affect most Latin American countries. Recent estimates suggest that most Latin Americans live at-risk of ascariasis, trichuriasis, and hookworm.[21] Although infection rates are still low in the United States, infections do occur in areas with the proper conditions. For example, a 2004 cross border seroprevalence study of El Paso and Ciudad Juarez found a 3.3 percent prevalence of *Taenia* spp., with most *Taenia* infections occurring on the El Paso side of the border.[22] To prevent these infections from becoming endemic in poor areas with high numbers of Latin American immigrants, careful surveillance may be warranted. These diseases, caused by various types of parasitic worm, are transmitted by the ingestion of fully developed eggs, commonly found in soil, water, or produce contaminated with infected feces. Therefore, risk factors for these infections revolve around unsanitary conditions.[23] Some examples include lack of proper sewage disposal, drinking unsanitary water, poor hygiene,[24] not washing produce before consumption, and consumption of undercooked pork and seafood. Some of these diseases involve animal reservoirs; for example, cysticercosis is associated with pig husbandry and cystic echinococcosis commonly occurs in sheep ranchers.

Like most states, Texas has a passive surveillance system for infectious diseases, and most NTDs are already reportable conditions within one week.[12] However, even with such a surveillance program, NTDs are most likely being underreported for several reasons. The

literature clearly shows that apart from a few communicable diseases of concern like tuberculosis, infectious diseases are reported less than 50 percent of the time.[13] In the case of dengue and other arboviral diseases, symptoms are usually nonspecific and frequently misdiagnosed, especially in the case of mild infections. Because most NTDs are not yet endemic in the United States, American health care personnel are less familiar with these diseases and may not consider them in their differential diagnoses. Additionally, some vector-borne disease infections may result in no symptoms, allowing a disease to persist in human, animal, and vector populations and making them unlikely to be detected through passive surveillance.

In addition to regular passive surveillance system that count cases of human disease, health departments can conduct monitoring of infections in veterinary disease cases, mosquitos, dead birds, or other sentinel animals. For example, ArboNET is a national arboviral surveillance system that addresses risk factors for West Nile Virus.[29] In addition, vector control professionals at the federal, state, and local levels can conduct mosquito surveillance, such as locating potential breeding containers and larval sites, and testing trapped adult mosquitos to calculate rates of infection. With limited resources, it may be difficult for health departments to have the surge capacity necessary for all types of human and vector surveillance. In addition, the sporadic nature of outbreaks makes it difficult to collect baseline data.

While passive surveillance and the monitoring of vector populations are certainly useful in establishing priorities and guiding policy decisions, this alone cannot paint a complete picture of NTDs in Texas. In response to the potential threat posed by NTDs, Texas House Bill 2055 established a sentinel surveillance program in Texas focusing on NTDs of interest in the state,

particularly Chagas, leishmaniasis, dengue, ascariasis, hookworm, trichuriasis, taeniasis/cysticercosis, echinococcosis, paragonimiasis, and fascioliasis.[17] In order to assess the potential future burden of these diseases, systematic collection of risk factor prevalence data is needed. The Community Assessment for Public Health Emergency Response (CASPER) is a method that could potentially be used to accomplish these goals. CASPER is an epidemiologic method designed to provide household-level information about an affected community's needs quickly and at a relatively low cost. Although initially adapted by the Centers for Disease Control and Prevention (CDC) from the World Health Organization's Rapid Needs Assessment for use post-disaster, CASPER has been utilized to assess household preparedness, underlying vulnerabilities, and community perceptions regarding public health emergencies such as H1N1 novel Influenza A and other hazards.[14-15] Recently, CASPER was utilized by the Austin-Travis Public Health Department to assess their community's knowledge of Zika virus and mosquito bite prevention.[16] While this CASPER was novel in that it was focused on aspects of Zika virus, the utility of CASPER to systematically assess the prevalence of risk factors for infectious diseases has not yet been documented. We hypothesized that CASPER can provide state and local health departments with relatively quick and cost-effective access to data that can be used to make informed decisions about the allocation of resources to address risk factors for NTDs.

CHAPTER II

METHODS

Study Location

Brazos County, Texas (Figure 1), is located in central east Texas and is the location of Texas A&M University, a public university with an enrollment of nearly 60,000 students located on over 5,200 acres of land. In 2015, Brazos County had a population of approximately 215,000, which was 10.4% greater than its 2010 population. It is home to a single metropolitan statistical area known as Bryan-College Station as well as a surrounding rural area of about 600 square miles[27].

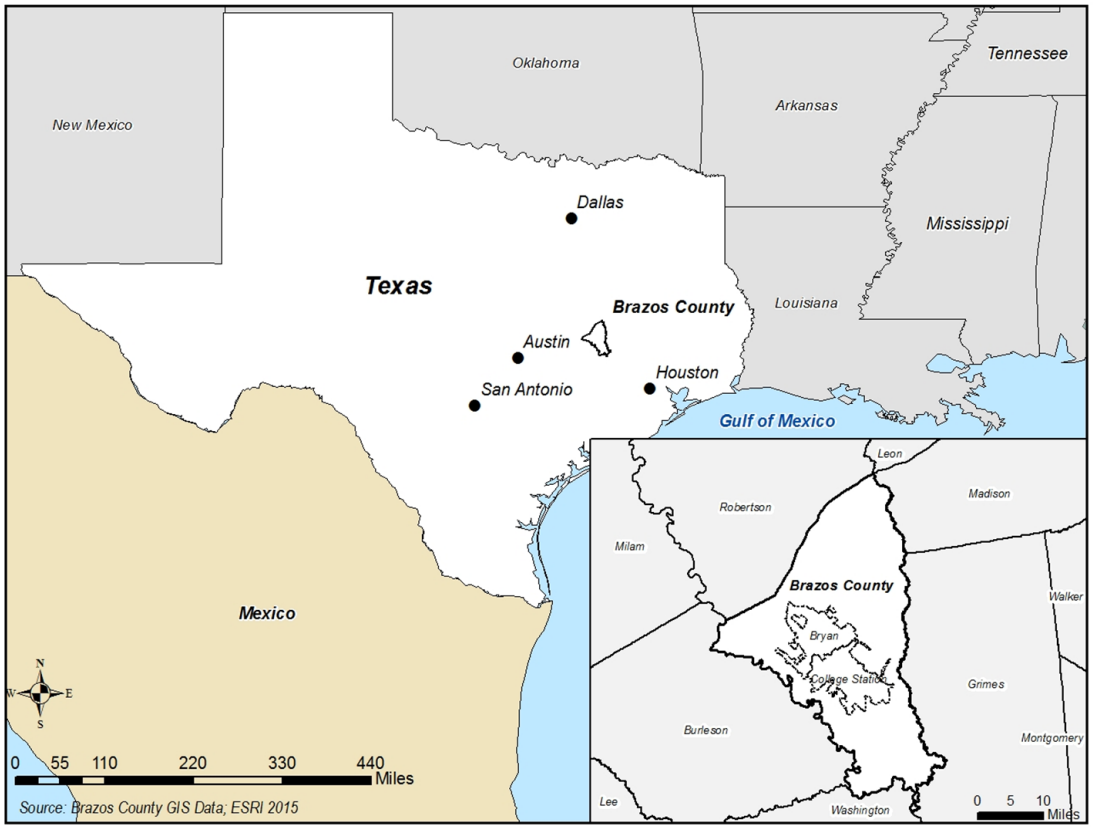

Figure 1. Location of Bryan-College Station, Brazos County within the state of Texas.

Data Sources

A community population-based sample in Brazos County, Texas, was selected using the Collect SMART Survey Management and Response Tool (Figure 2), a suite of software developed to help users design and implement a CASPER (http://www.collectsmartdata.org/). Thirty census blocks were selected probability proportionate to population size and a random starting point was selected within each block for each interview team.

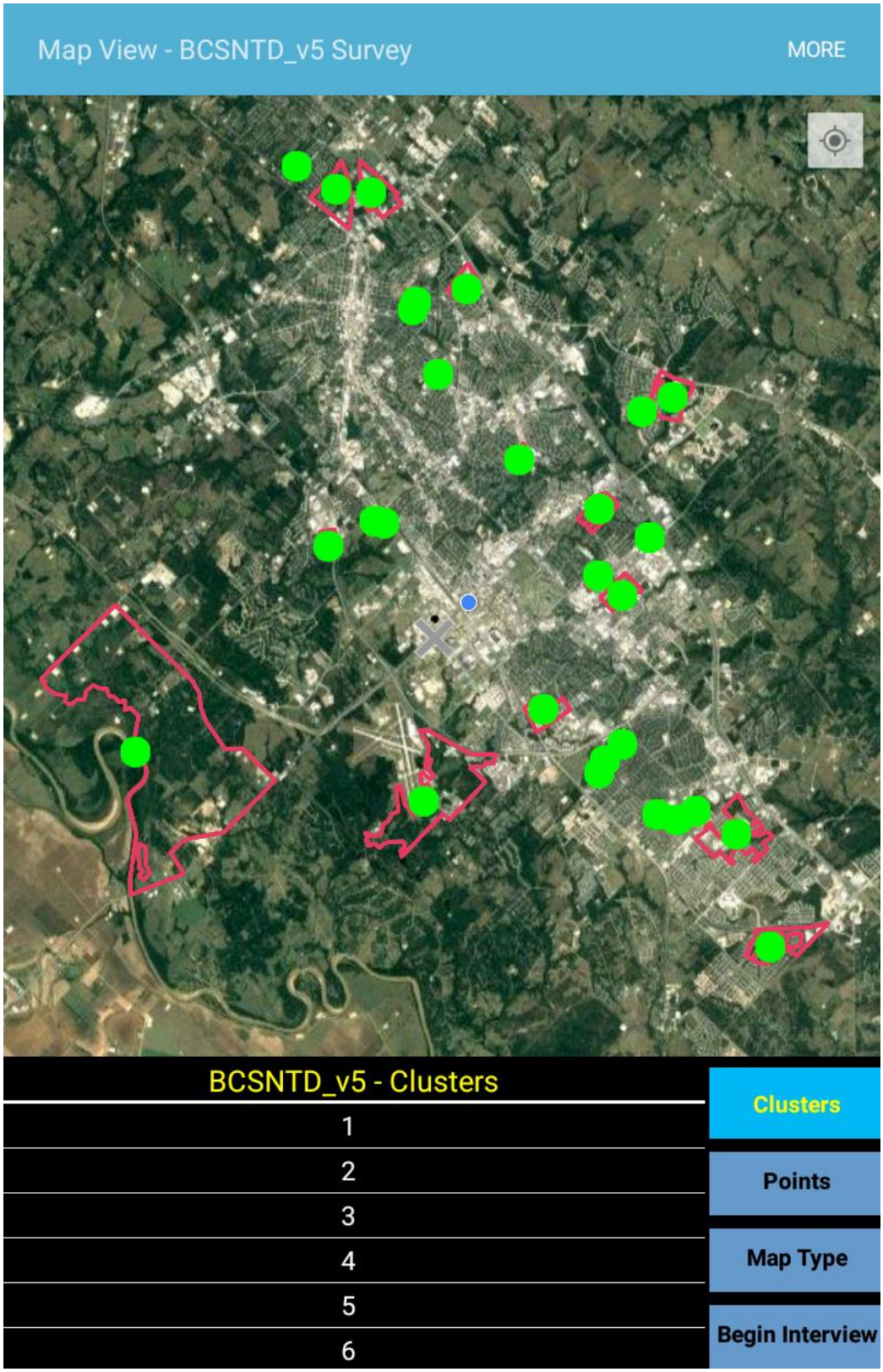

Figure 2 – Screenshot, CollectSMART App Project Screen, Samsung Galaxy Tab E Tablet

CASPER was used to select 210 households in a two-stage cluster sampling method. First, 30 census blocks (cluster) were selected with their probability proportionally to the estimated number of housing units in each cluster (CDC Manual reference). Seven households from each cluster were then sequentially selected from a random starting point in each cluster. Thus, 210 households was the goal; 30 census blocks x 7 households = 210 household interviews.

Data were collected between December 2, 2016 and December 14, 2016, using Samsung Tab E and Google Nexus 7 tablets, as well as paper surveys, via in-person interviews with one adult member of each selected household. Interviewers were routed to each location with a map generated with Collect SMART. Selected households were approached by an interview team and gave written informed consent.

Study Variables

To identify elements that should be included on the CASPER survey to assess the prevalence of risk factors for NTDs, a literature review focusing on each of the diseases in question was performed focusing on the dynamics of NTD transmission in Central and South America[28]. Several factors were associated with an increased risk of most or all of the diseases of interest, including immigrant status[18] and rural poverty[2]. Unique risk factors for certain NTDs transmitted via insect vectors include a lack of window screens or in-house air conditioning, urban density, standing water near the household, failure to use DEET, and not regularly wearing long sleeves when outside[3]. The final CASPER survey included 44 questions organized into five sections: demographics, travel history, housing characteristics, vector contact and prevention,

and pets and animals (Appendix I). The survey and associated consent materials were reviewed and approved by the Texas A&M University Institutional Review Board (IRB 2016-0495D).

Demographics

Because factors such as overcrowding and poverty are associated with the transmission of NTDs,[2-3] respondents were asked to report the number of people living in their household and whether or not their households' average income is above or below the federal poverty guidelines.[26]

Travel History

Although autochthonous transmission of NTDs in Texas has been suspected, travel remains an important risk factor for these diseases. Accordingly, the survey asked respondents to report if anyone in the household has traveled outside the United States in the last 3 months, specifically to counties in South and Central America and the Caribbean, as well as the duration of the trip. Survey participants were also asked whether they have hosted visitors from other countries in their household, and if so, the country of those visitors' residence.

Household Characteristics

Housing quality is an important determinant of individual risk, largely because low quality housing often increases interaction between humans and vectors.[3, 19] Certain aspects of a home can encourage households to act in ways that put them at risk. Specifically, households without air-conditioning encourage people to open their windows, allowing vectors access to the indoors. In order to gauge the level of human-vector interaction inside the home, questions about

air-conditioning, window screens, cracks or gaps in home structure, and questions about the presence of bugs inside the home were included.

Also included in the housing quality section were questions about water usage, food cleanliness, and waste removal services. Questions such as these are intended to gauge people's risk of soil-transmitted helminthiases, as these diseases generally require unsanitary conditions or the ingestion of unsanitary foods to spread to human hosts.

Vector Contact and Prevention

When considering vector-borne diseases, it is important to capture the level of interaction between humans and vectors as well as what community members are doing to control vector populations around their households. Therefore, this section of the survey includes questions asking about the frequency at which respondents are bitten, their use of bite prevention behaviors like DEET and long-sleeved clothing, and the number of artificial mosquito breeding habitats such as tires and flower pots around their home.

Pets and Animals

Animals can also increase NTD risk in a household, acting as food sources, carriers, and intermediate hosts of infection. For example, dogs, especially stray dogs, have been found to be infected with both Chagas and leishmaniasis, and therefore, a high prevalence of stray dogs in an area, combined with other known risk factors, could elevate community's risk. Therefore, questions in this section asked about household pets, whether chickens or pigs are raised in or near the house, and about the prevalence of stray dogs near the residence.

Interviewer Observations

In addition to directly asking questions to household members, surveyors can ask permission to assess certain aspects of the household, such as the number of visible artificial containers, any noticeable housing quality defects, and the distance between homes. Surveyors can also take note of other things they notice in the community, such as drainage ditches filled with stagnant water, large numbers of stray animals, and whether the community is largely rural or urban.

Data Analysis

A database was created in EpiInfo 7, and data from paper-based surveys was entered into the database by one person and checked by two different people through a 10% double data entry for quality assurance. Data were exported from EpiInfo 7, cleaned in Microsoft Excel 2016, and imported back into EpiInfo 7 for analysis. The count or percentage and its corresponding 95% confidence interval (CI) was calculated for each question. Questions asked of all respondents were weighted to account for cluster sampling. Each household received a relative weight based on the number of households in its cluster; the total number of housing units in Brazos County divided by the product of the number of housing units interviewed within the cluster and 30. Questions asked to a subset of respondents were not weighted.

CHAPTER III

RESULTS

Study Population

A total of 747 homes were approached by an interview team. Of these, contact was made with a resident 308 times, a contact rate of 41.2%. Of those reached, 62%, or 191 total (Table 1), completed the survey, an overall completion rate of 91%t. 115 residents refused to be interviewed, and in only 2 cases did interviewers encounter a language barrier that could not be overcome. Compared to the calculated average contact, cooperation, and completion rates of CASPERs across the United States[28], the contact rate was low, while the overall cooperation and completion rates were slightly above average.

Demographics

Consistent with known demographic information about Brazos County, survey respondents were majority white (128 of 191, 69%) or Hispanic (X of 191, 21.4%). African Americans made up a small portion of the sample (X of 191, 4.5%) and were likely underrespresented in comparison to 2010 Census data. Data collected also slightly overestimated the average number of individuals per household and the individual poverty rate (Table 1).

Table 1. Demographic characteristics of households in Brazos County, TX compared to population demographics according to 2010 Census Data. Percentages.

	Sample	95% Confidence Limit	Brazos County
Population size	191	N/A	194,851
People per household	2.9	N/A	2.53
Race/Ethnicity			
Black	4.5%	(4.4 – 4.7)	10.4%
Hispanic	21.4%	(21.1 – 21.7)	17.4%
White	69.0%	(68.9 – 69.3)	65.5%

Other	6.0%	(5.82 – 6.15)	6.7%
Households in poverty	25.3%	(24.9 – 25.6)	27.9%*

*2015 American Community Survey data used for individual poverty estimates

Travel History

A total of 12.2% (X of 191) of respondents reported travel outside of the United States in the last three months. Further, just over 5% (X of 191) of respondents reporting travel to Central/South America, areas that are endemic to the neglected tropical diseases of interest to this study. Some respondents (X of 191, 10%) reported hosting visitors from foreign countries; specifically, 5.2% (X of 191) of respondents hosted visitors from Central/South America. Another 10.1% (X of 191) of residents reported previous residence in a country outside of the United States, with 3.1% (X of 191) of respondents indicating residence in a Central/South American country.

Table 2. Travel characteristics of households in Brazos County, Texas.

	Percent Prevalence	95% Lower Confidence Limit	95% Upper Confidence Limit
Traveled outside of US	12.2	11.9	12.4
- Endemic area*	5.2	2.5	9.4
- Other area	5.8	2.9	10.1
- Length of visit			
o Less than 7 days	2.1	0.6	5.3
o 7-14 days	2.1	0.6	5.3
o More than 14 days	4.2	1.8	8.1
o Travel length not given	3.7	1.5	7.4
Hosted recent visitors	10.0	9.7	10.2
- Endemic area	5.2	2.5	9.4
- Other area	5.2	2.5	9.4
Length at current address			
- Less than 6 months	22.4	22.2	22.7
- 6 months to 1 year	11.7	11.5	11.9
- More than a year	64.9	64.6	65.2
Previous residence outside US	10.1	9.9	10.3

- Endemic area	3.1	1.2	6.7
- Other area	5.2	2.5	9.4

*Endemic area is defined for these purposes as all Central and South American countries

Note: Some subcategories are not weighted because subcategory questions were only asked if respondents gave an affirmative to the more general question. Thus, 95 percent confidence intervals for these subcategories are much wider. This is true of relevant sections of all tables.

Household Characteristics

An overwhelming majority of respondents reported living in houses with air conditioning and window screens on all windows, but nearly 30 percent of respondent's housing units contained cracks, gaps, or other holes that may allow insects access to the home's interior. About one-third of respondents (X of 191; 31.9%) reported seeing mosquitoes inside their housing units, while much smaller percentages reported seeing sandflies or kissing bugs (2.1 and 3.7%, respectively). Residents reported high confidence in the quality of their water, and a large majority of residents were provided waste removal services by either their city or Brazos County (X of 191, 83.1%).

Table 3. Household characteristics of households in Brazos County, Texas.

	% (or mean, as appropriate)	95% Lower Confidence Limit	95% Upper Confidence Limit
Households with air conditioning	98.3	98.2	98.4
Window screens on all windows	84.4	84.1	84.6
Cracks, gaps, holes in structure	29.8	29.5	30.1
Seen bugs in home	55.0	54.6	55.3
- Mosquitos	31.9	25.4	39.1
- Sandflies	2.1	0.6	5.3
- Kissing bugs	3.7	1.5	7.4
Use city water source for:			
- Drinking	61.9	61.6	62.2
- Bathing	93.3	93.1	93.4

- Washing produce	92.8	92.6	93.0
- Washing clothes/dishes	93.7	93.6	93.9
Wash fresh produce regularly	82.9	82.6	83.1
Rated quality of water	4.0 (out of 5.0)	N/A	N/A
Waste removal by city or county	83.1	82.9	83.4

Vector Contact and Prevention

A majority of respondents reported being bitten by mosquitoes in or around their home, with only 21.7% (X of 191) responding that they had never been bitten. Substantially smaller percentages of respondents recall ever being bitten by a sandfly or kissing bug. Further, survey respondents reported rather sparse mosquito prevention behavior, with only 29.1% (X of 191) of respondents saying the always or frequently wore long sleeved shirts/pants and only 31.1% (X of 191) reporting always or frequently using repellant containing DEET.

Table 4. Vector contact and prevention characteristics of households in Brazos County, Texas.

	Percent Prevalence	95% Lower Confidence Limit	95% Upper Confidence Limit
Frequency of mosquito bites			
- Always	8.5	8.3	8.7
- Frequently	23.0	22.7	23.3
- Sometimes	45.8	45.4	46.1
- Never	21.7	21.4	22.0
Ever bitten by sandfly	3.7	3.6	3.9
Ever bitten by kissing bug	3.0	2.9	3.1
Wear long sleeved shirts and pants			
- Always	14.1	13.9	14.4
- Frequently	15.0	14.8	15.3
- Sometimes	53.3	52.9	53.6
- Never	16.7	16.4	16.9
Wear DEET mosquito repellent			
- Always	13.5	13.2	13.7
- Frequently	17.6	17.4	17.9
- Sometimes	35.6	35.2	35.9
- Never	31.7	31.4	32.0

Outside around dusk and dawn			
- Always	8.4	8.2	8.6
- Frequently	33.7	33.4	34.1
- Sometimes	37.3	37.0	37.7
- Never	16.1	15.8	16.3

Table 5. Containers around households in Brazos County, Texas. Self-reported prevalence and estimated average observed per household

	Percent Prevalence	95% Lower Confidence Limit	95% Upper Confidence Limit	Mean Containers Per Household	Median Containers Per Household
Bird bath	19.0	18.7	19.3	1.0	1.0
Tires	6.0	5.8	6.2	4.0	3.0
Pet water dishes	28.3	28.0	28.6	3.4	1.0
Flower pots	35.8	35.4	36.1	5.8	3.0
Fountains	6.8	6.6	7.0	Not observed	Not observed
Yard ornaments	11.1	10.9	11.4	Not observed	Not observed
Rain barrels	5.4	5.3	5.6	1.3	1.0
Pools	12.9	12.6	13.1	1.0	1.0

Pets and Animals

A majority of respondents reported pet ownership (59.2%, X of 191), and households owned an average of 2.4 animals. Four in five (78.5%) of all pet owners reported that their pets slept indoors at night. About 50% (X of 191) of all respondents noted the presence of stray dogs within one mile of their home, with 11% (X of 191) reporting always or frequent sightings. Very few respondents reporting raising chickens or pigs near the home (5% and 1.1%, respectively).

Table 6. Pets and animal characteristics of households in Brazos County, Texas.

	Percent Prevalence	Mean	Median	95% Lower Confidence Limit	95% Upper Confidence Limit

Have pets	59.2	N/A	N/A	58.9	59.6
- Average number	N/A	2.4	2.0	Standard Deviation: 2.8	
- Sleep indoors	78.5	N/A	N/A	69.5	85.9
Noticed stray dogs (within 1 mile)					
- Always	3.6	N/A	N/A	3.5	3.7
- Frequently	7.4	N/A	N/A	7.2	7.6
- Sometimes	30.1	N/A	N/A	29.7	30.4
- Never	49.2	N/A	N/A	48.8	49.5
Raise chickens	4.95	N/A	N/A	4.8	5.1
Raise pigs	1.1	N/A	N/A	1.1	1.2

CHAPTER IV

DISCUSSION

To our knowledge, this is the first known CASPER to occur in Brazos County, Texas. This CASPER was also novel because it was the first CASPER attempted solely for the purpose of assessing a community's risk for neglected tropical diseases. Overall, our data suggest that the Bryan/College Station community has a low prevalence of most risk factors, but several factors point to the potential for isolated local transmission or travel associated NTD cases in the future. For example, a majority of residents reporting on sometimes or never wreathing long sleeved shirts and pants or using mosquito repellence with DEET, two of the four recommendations made by CDC to prevent mosquito bites (CDC https://www.cdc.gov/zika/prevention/protect-yourself-and-others.html). This presents public health authorities with clear avenues for implementing health education and intervention campaigns aimed at reducing exposure to risk factors for NTDs.

Conducting surveillance of potential breeding areas is also important. In this survey, the number of self-reported breeding areas (e.g., tires, pet bowls, and flower pots) was higher than the number observed by the interviewer. One explanation for this may be that there are additional potential breeding sites in backyards, where health department officials and CASPER surveyors do not look. This also presents an opportunity for local officials to stress the importance of residents' implementing outdoor control measures around their homes, such as throwing out, or regularly emptying and cleaning any items that hold water.

International travel is another potential avenue for education and intervention, since about 1 in 8 residents of Brazos County indicated travel outside the United States in the three months prior to the survey. Local officials should coordinate messaging with federal, state, and transportation authorities to ensure the effectiveness of messages being provided to travelers at airports and other locations. More research is likely needed about the modes of transportation used, and the specific location of travel, particularly since Texas is a border state with Mexico, where some of these diseases are endemic. Since Texas A&M University is a major employer in Brazos County, and many residents are also students, any official travel should be accompanied by messages highlighting the potential for being infected by or transmitting an NTD.

Limitations

This study has several limitations. In our study, as in a typical CASPER, those houses which were deemed either unapproachable or unsafe and were therefore not approached by an interview team may be most at risk due to poor housing quality or inconsistent removal of breeding containers for mosquitoes, leading to potential response bias. Since Bryan/College Station has a large percentage of households occupied by students, surveyors could not be sure if respondent's provided information about their own income or if they were a dependent of their parents, their parents' income. To address this, income data was calculated at the individual level and compared to the individual poverty rate supplied by 2010 Census data.

Due to the large immigrant population of the State of Texas and Brazos County, and the contentious political situation surrounding the immigration debate in the United States,

immigration status and personal travel history may potentially sensitive subjects for respondents, particularly respondents of Hispanic descent. To address this concern, respondents were assured of the confidentially of their responses as part of the informed consent process. Houses that presented with a language barrier (N=2) may also have been more likely to have residents or visitors from foreign countries. To minimize this problem, as many bilingual speakers as possible were recruited for the survey teams, and teams with a fluent Spanish speaker were assigned to clusters located in the areas of Brazos County where, according to the U.S. Census, more Spanish speakers live. Further, all interviewers were equipped with Spanish copies of the survey in the event that a translator could be found in the household.

One problem we anticipated was the potential for residents to misclassify the presence of mosquitoes, sandflies, and kissing bugs and the prevalence of their bites. It is highly likely that not all respondents knew exactly how to identify these insects or to determine with certainty if and when they had been bitten by them. To address this issue, surveyors were equipped with 8.5 x 11 color photos of the common species of these insects in Brazos County. When respondents indicated a lack of knowledge, surveyors showed respondents what the insects looked like and explained the details of their bite. When it came to kissing bugs, many look-alike species exist; in order to control for misclassification, pictures of these species (kissingbug.tamu.edu) were shown to respondents. This process gave our team the chance to do educational outreach in the community while also collecting data.

CHAPTER V

CONCLUSION

Concern over the potential for increasing rates of NTD infection and transmission in Texas, led the Texas State Legislature to mandate the establishment of a surveillance program for NTDs. We tested one potential methodology for the surveillance of NTDs – the use of CASPER for assessing the prevalence of risk factors in Brazos County, Texas. To be effective as a surveillance tool, additional CASPERs should be conducted in areas of the state where there have been more documented cases of NTDs (e.g., the Rio Grande Valley or the City of Houston). However, CASPER data, which can be collected rapidly and cost-effectively, can provide a starting point for the prevention of NTDs by identifying a number of avenues for education and prevention by local health departments.

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APPENDIX I: CASPER SURVEY QUESTIONS

Pre-Survey Household Characteristics:

Surveyors complete the following items before beginning an interview:

1. Number of visible water containers around the household:
    a. Buckets:
    b. Tires:
    c. Styrofoam containers:
    d. Bird baths:
    e. Pet water bowls:
    f. Clogged gutters:
    g. Flower pots and vases:

Demographics

2. How many people live in your household? (defined as those who regularly spend the night here)
3. Is your average annual income above or below the federal poverty line? (See attached poverty line information tables for more information)
    a. Above (Go to q. 5)
    b. Below (Go to q. 6)

Travel History

4. Has anyone in this household traveled outside of the United States in the last 3 months?
    a. Yes (Go to q. 8)
    b. No (Go to q. 10)
5. If yes, what countries have members of your household visited?
    a. Mexico
    b. Belize
    c. Costa Rica
    d. El Salvador
    e. Guatemala
    f. Honduras
    g. Nicaragua

h. Panama
i. Colombia
j. Ecuador
k. Venezuela
l. Puerto Rico (US Territory)
m. Caribbean island nations
n. Other, please explain

6. For how long?
    a. Less than 7 days
    b. 7-14 days
    c. More than 14 days
7. Have you hosted any recent visitors from other countries in your household in the last 3 months?
    a. Yes (Go to q. 10)
    b. No (Go to q. 11)
8. If so, which countries?
    a. Mexico
    b. Belize
    c. Costa Rica
    d. El Salvador
    e. Guatemala
    f. Honduras
    g. Nicaragua
    h. Panama
    i. Colombia
    j. Ecuador
    k. Venezuela
    l. Puerto Rico (US Territory)
    m. Caribbean island nations
    n. Other, please explain

9. Do other members of your extended family or neighbors you socialize with make regular trips to Central/South American/Caribbean countries?
    a. Yes
    b. No
10. How long have you lived at your current address?
    a. Less than 6 months (Go to q. 13)
    b. 6 months to 1 year (Go to q. 13)
    c. More than 1 year (Go to q. 16)
11. Before living at this address, did you or anyone in the household live outside of the United States?
    a. Yes (Go to q. 14)
    b. No (Go to q. 16)
12. Where outside of the United States?
13. Did you/they live in an area where insect-borne illnesses such as dengue or malaria were common?
    a. Yes
    b. No

Household Characteristics

14. Does your household have air-conditioning?
    a. Yes
    b. No
15. Are there window screens on all of your windows?
    a. Yes
    b. No
16. Have you noticed any cracks or gaps near windows, walls, doors, or in the roof that may allow bugs to access the inside of your home?
    a. Yes
    b. No
17. Have you noticed any bugs inside your household?
    a. Yes (Go to q. 20)
    b. No (Go to q. 22)

18. If so, have you noticed any of the following types (pictures included):
    a. Mosquitoes?
        i. Yes
        ii. No
    b. Sandflies?
        i. Yes
        ii. No
    c. Kissing Bugs?
        i. Yes
        ii. No
19. How often do you see bugs like these inside your home?
    a. Always
    b. Frequently
    c. Sometimes
    d. Never
20. What is the source of the water you use for:
    a. Drinking?
        i. City/municipal
        ii. Well
        iii. Bottled
        iv. Other, please explain
    b. Bathing?
        i. City/municipal
        ii. Well
        iii. Bottled
        iv. Other, please explain
    c. Washing produce & other food items?
        i. City/municipal
        ii. Well
        iii. Bottled
        iv. Other, please explain

d. Washing clothes/dishes?
    i. City/municipal
    ii. Well
    iii. Bottled
    iv. Other, please explain

21. Do you regularly wash all food items that you consume, such as fresh produce?
    a. Yes
    b. No

22. How would you rate the quality of the water that you drink on a daily basis?
    a. 1 → Very impure
    b. 2
    c. 3
    d. 4
    e. 5 → Very pure

23. Are your sewer/waste removal services provided by your local city or county?
    a. Yes (Go to q. 27)
    b. No (Go to q. 26)

24. If not, how do you dispose of sewage?
    a. Septic tank
    b. Aerobic wastewater treatment
    c. Gravity systems
    d. Filter systems
    e. Ultraviolet disinfection systems
    f. Other, please explain _____

Vector Contact and Prevention

25. How often are you bitten by mosquitoes directly around your household?
    a. Always
    b. Frequently
    c. Sometimes
    d. Never

26. Do you think you have ever been bitten by a sandfly (provide picture of the fly and description of bite)?
    a. Yes (Go to q. 29)
    b. No (Go to q. 30)
27. If yes, how often?
    a. Always
    b. Frequently
    c. Sometimes
    d. Never
28. Do you think you have ever been bitten by a kissing bug (provide picture of the bug and description of bite)?
    a. Yes (Go to q. 31)
    b. No (Go to q. 32)
29. If yes, how often?
    a. Always
    b. Frequently
    c. Sometimes
    d. Never
30. When you go outside, how often do you wear long sleeved shirts and pants in order to avoid being bitten?
    a. Always
    b. Frequently
    c. Sometimes
    d. Never
31. How often do you wear mosquito repellant containing DEET?
    a. Always
    b. Frequently
    c. Sometimes
    d. Never
32. Which of these containers do you have around the house?
    a. Bird bath

b. Tires
c. Pet's water dish
d. Flower pots
e. Fountains
f. Yard ornaments
g. Buckets
h. Rain barrel
i. Pool
j. Other, please explain

Pets/Animals

33. Do you have any pets?
    a. Yes (Go to q. 36)
    b. No (Go to q. 39)
34. If yes, how many?
35. If yes, what kind?
36. If yes, do they sleep indoors or outdoors at night?
    a. Yes
    b. No
37. How frequently do you see stray dogs in this area (within 1 mile of your residence)?
    a. Always
    b. Frequently
    c. Sometimes
    d. Never
38. Does your household raise chickens close to the home?
    a. Yes
    b. No
39. Is your household involved in raising pigs or do you have regular contact with pigs?
    a. Yes
    b. No