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Shawna J. Feinman Date

Primary Drinking Water Source and Associated Acute Gastrointestinal Illness in New Mexico, USA

By

Shawna J. Feinman

Master of Public Health

Environmental Health

P. Barry Ryan, Ph.D.

Committee Chair

Julia Gargano, Ph.D.

Committee Member

Paige Tolbert, Ph.D.

Committee Member

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By

Shawna J. Feinman

B.S.
University of South Florida
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Thesis Committee Chair: P. Barry Ryan, Ph.D.

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Abstract

Primary Drinking Water Source and Associated Acute Gastrointestinal Illness in New Mexico, USA

By Shawna J. Feinman

Background: Approximately 15% of Americans rely on private wells, which are not regulated under federal law, for their drinking water. Many well owners do not test or maintain their water quality even though the water source may be influenced by nearby surface waters and subject to fecal contamination. Consequently, many Americans may routinely drink water that increases their risk of illness.

Objectives: This study characterized the demographics of New Mexico residents according to their primary drinking water source and compared the incidence of self-reported AGI by primary drinking water sources.

Methods: This study analyzed data from the 2007 New Mexico Behavioral Risk Factor Surveillance System, using complex survey procedures to provide descriptive statistics and analyze associations. The primary outcome was self-reported acute gastrointestinal illness (AGI) in the previous 30 days, and the secondary outcome was AGI resulting in a health care visit. We evaluated the association between primary water source and AGI using logistic regression models, controlling for demographic characteristics and health status indicators.

Results: In total, 6,606 individuals were included in the study. Fifty-five percent of individuals used public water, 18% used private wells, and 27% used commercially bottled water; 42% reported filtering their water. Overall 30-day incidence of AGI was 15%, and did not vary significantly by primary water source or filtration. Drinking water sources varied age, marital status, education, employment, region, number of adults and children in the household, race/ethnicity, and rural/urban status. The final adjusted model suggested individuals using well water had a decreased odds of reporting AGI and seeking medical attention for AGI, however the differences were not significant (odds ratio (OR) = 0.83, 95% CI = 0.65, 1.06 and OR = 0.85, 95% CI = 0.41, 1.80).

Conclusion: Demographic characterization of respondents indicated that primary drinking water sources are not uniformly distributed throughout the population; this is useful information when determining how to target educational materials. Analyses did not reveal any significant associations between primary water source and AGI; however, the result of this cross-sectional survey does not exclude the possibility that some contaminated wells may pose a health risk in New Mexico.

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Written in memory of Charles Feinman (1927-2012).

Contents

Background

Water is essential for life on Earth; without it, many organisms cannot live. For humans, it is especially important that the water consumed and used for everyday activities (such as cooking and hygiene) is clean. While the United States enjoys some of the cleanest drinking water in the world, there are many people within the country's borders who do not drink water treated to the same standards as the public water supply. This thesis serves to discuss the differences in drinking water types, analyze the people who use them, and quantify associated incidence of acute gastrointestinal illness (AGI) specifically in New Mexico, USA.

Drinking Water

A public water system is a type of water supply that serves water to at least 25 people or 15 service connections for at least 60 days each year [1]. While most Americans get their water from a public water system, many use individual sources, such as privately owned wells [1]. The United States Geological Survey (USGS) estimates over 43 million Americans – about 15% of the total U.S. population – drink water from privately owned household wells [2]. Data from American Housing Surveys suggest this number may be on the increase [3, 4]. While the Safe Drinking Water Act (SDWA) empowers the Environmental Protection Agency (EPA) to regulate public water supplies (which by definition serve a larger population than private sources), individual sources are not regulated under Federal law. Instead, the responsibility to maintain and periodically test the private well's water quality falls upon the discretion of the well owner who is not legally obligated by any federal regulations to perform such tests.

The lack of regulation and surveillance of private water quality implies a substantial number of Americans depending on individual sources may be exposed to harmful biological contaminants that could make them sick. This background explores this public health gap and its potential effects on the US population. In that context, the rest of the project will look specifically at data from a 2007 New Mexico Behavioral Risk Factor Surveillance System to characterize the state's private well users and to link association with acute gastrointestinal illness and answer the question: is acute gastrointestinal illness prevalence associated with primary drinking water source among residents of New Mexico?

Recommendations and Benchmarks

The EPA provides educational information for well owners on the EPA website [5]. Current guidelines recommend private well owners test their well water annually for nitrate, total dissolved solids, total coliform bacteria, and pH levels since these indicators are not inclusive of all potential hazards but can be warning signs of contamination. Well owners are encouraged to conduct a thorough survey of the immediate area around their well to identify potential sources of contamination such as livestock, pesticides, fertilizers, septic systems, local roads, and improper disposal of household wastes. In addition, the EPA suggests well owners remain vigilant and proactive to identify any city planning or other incoming industries that may negatively impact ground water supplies [5].

Benchmarks set in the SDWA include Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) [6]. A MCLG is roughly defined as

the level at which there no expected adverse effect on human health [7]. The MCL is the regulation value set by the EPA to get contamination levels as close as feasibly possible to the MCLG, taking into account cost/benefit analysis [8]. The MCLG value is determined by evidence of carcinogenity and other major health concerns [9]. It is not mandatory for a public water supply to meet MCLGs; it is mandatory for a water supplier to meet the MCLs [6]. The EPA's National Drinking Water Regulations requires public water suppliers to oversee many contaminants, which are defined by the SDWA as "any physical, chemical, biological, or radiological substance, or matter in water" [6]. This broad definition includes any amount of all dissolved or suspended substances in water, even those that may be beneficial in small amounts. Though the SDWA does not govern private sources, using benchmarks set for public supplies may provide a standardized guideline for characterizing a safe water standard for private sources within the United States.

Well Types

There are three types of wells: dug, driven, and drilled [5]. The type of well installed depends on several factors including depth of water table, type of soil, other geological attributes, and local permit requirements. EPA guidelines state wells should be built at least 50 feet away from septic tanks, livestock yards, silos, and septic leach fields, 100 feet away from petroleum tanks, manure and fertilizer storage, 250 feet away from manure stacks, and on mounded ground to prevent contamination. In addition, the well should be located so rainwater flows away from it, as rainwater can collect contaminants from the land surface and carry it down to the water source [5].

Dug wells are shallow, usually only 10-30 feet deep and lined with rock, brick, tile, or concrete to prevent collapsing. Driven wells are driven through gravel or sandy soil to a depth of approximately 50 feet. These inexpensive and quickly installed wells are the wells of choice for vacation homes and camps. Both dug and driven wells are easy to contaminate because of their shallow design. Drilled wells reach deeper with depths of 100 to 400 feet below the surface. The drilled well's depth allows water more time to percolate through the soil for a filtering effect; drilled wells are considered the safest from contamination [10]. However, multiple studies have found chemical and microbial contamination in all types of wells, including those recently installed and those drilled deep [11-16]. Possible contamination in recently installed wells may be due to well placement. Contamination of deep wells may come from underground storage tanks, or through unanticipated underground geology.

Private Well Water Quality Perceptions and Testing Behaviors

Jones et al. (2003) convened a Canadian focus group to study private well owners' perceptions of their water and behaviors with monitoring and maintenance. The focus group revealed that many well water owners believe their water supply to be superior to municipal water supplies. As one participant explained: "the earth is a natural filter, and you just get cleaner water..." Another participant suggested that his private well water was better than city water because, in his words: "I know where my water is coming from. I know what's in it. I don't have to worry about someone monkeying with it." One participant admitted: "I'm not all that diligent in checking my water. As long as it tastes good, that's fine." Many participants acknowledged they do not test their water

regularly and are not concerned about what is actually in it, though some worried about agricultural practices and development nearby. Another mentioned: “When something comes up and people start getting concerned, everyone's testing and complaining, well, [then] we'll get it tested.” The main reasons for not having the private well water tested included complacency, lack of knowledge, cost of maintenance, and fear of government interference / general distrust of government [17].

A study by Laflamme and VanDerslice (2004) tracked Behavioral Risk Factor Surveillance System (BRFSS) answers from 1996 and 1998 in Washington State regarding well water use and testing behaviors. Contrary to Jones’ study, within the BRFSS participants, 76– 83% domestic well users declared that their well water had been tested at some point and two-thirds of these indicated it had been tested within the past 3 years [18]. Despite the high percentage of residents reporting their well had been tested, 24-17% of residents reporting not having their well tested correlates to approximately 77,000-125,000 residents in Washington State. This is a large amount of people who are unknowingly drinking potentially harmful water.

American Housing Surveys from 1997 to 2007 indicate 12.9 million to 15.6 million households use private well water as their primary source of drinking water [3, 19]. The substantial number of Americans using private well water and the general perception that ground water is inherently safe means millions of Americans may be consuming unsafe and untreated water from private well sources.

Potential Waterborne Causes of Gastrointestinal Illness

Despite the perception that ground water is safe, there are many substances that can contaminate drinking water supplies. These contaminants can be chemical or biological. This work focuses specifically on biological contamination, as it is most likely associated with gastrointestinal illness. The regulated waterborne biological agents that can cause acute gastrointestinal illness when ingested include viruses, parasites, and bacteria [5, 20].

Viruses

Viruses commonly detected in groundwater include adenovirus, enterovirus, hepatitis A virus, norovirus, and rotavirus [15]. Enteric viruses are the most likely of the mentioned pathogens to contaminate groundwater due to a triad of favorable characteristics: (1) enteric viruses are small in size [14], (2) soil pH is favorable to enteric viruses [15, 21], and (3) large numbers of enteric viruses are shed by infected persons increasing chances of reinfection [15]. Though they can survive in the environment, enteric viruses are host-specific and obligate to their host for long-term survival and reproduction. Therefore enteric viruses found in drinking water are specifically indicative of nearby fecal contamination into a water source [15]. Public water suppliers using surface water or ground water directly influenced by surface water are required to treat the water so 99.99% of viruses are removed or inactivated before continuing on to public supply [22].

Parasites

Among the known contaminants associated with drinking water, parasites such as *Cryptosporidium hominis, Cryptosporidium parvum,* and *Giardia intestinalis* caused nearly one-fifth of the US outbreaks between the years of 1971 and 2006 [23]. Both *Cryptosporidium* spp. and *Giardia* spp. are enteric protozoa that are transmitted through the fecal-oral route and are tolerant to chlorine disinfection [24, 25].

Cryptosporidium causes the condition known as cryptosporidiosis. The health effects of cryptosporidiosis can range from asymptomatic to severe diarrhea, but very few deaths in North America directly result from the disease [26]. *Cryptosporidium* oocytes can infect both humans and animals ingesting contaminated water [27, 28]. Surveillance by the Centers for Disease Control and Prevention (CDC) describe an increase of reported Cryptosporidiosis cases in the US from 3,505 in 2003 to 8,951 in 2010 [27, 28]. The public health goal for Cryptosporidium in drinking water is set to 0 oocytes per L and the EPA's surface water treatment rule requires systems fed by surface water or by groundwater under direct influence of surface water to filter out 99% of *Cryptosporidium* contaminants [22].

Becoming infected with as little as 10 *Giardia* cysts may cause giardiasis, a health condition with symptoms of diarrhea, abdominal cramps, bloating weight loss, and malabsorption [29]. Cysts are transmitted via the fecal-oral route and can be found in humans, livestock, dogs, cats, and rats [26]. Slightly fewer than 20,000 cases of giardiasis were reported per year in 2009 and 2010 with children 1-9 years of age being most affected [29]. Public water supplies using surface water or ground water directly

influenced by surface water are required to treat the water so that 99.9% of *Giardia* is inactivated or removed [22].

Bacteria

Bacteria that can potentially contaminate water supplies and cause acute gastrointestinal illness AGI includes *Salmonella* spp., *Shigella* spp., *Escherichia coli, Aeromonas* spp., *Pseudomonas aeruginosa, Mycobacterium avium, Campylobacter* spp., *Vibrio cholera, Helicobacter pylori* and *Yersinia enterocolitica* [20]. *Legionella* spp. are also transmitted through water but causes respiratory illness rather than gastrointestinal problems. According to CDC surveillance, approximately 14% of all outbreaks associated with drinking water from 1971-2006 were traced to non-*Legionella* bacteria [23].

Contaminant Indicators

Total Coliforms

Testing for multiple types of pathogens that may cause AGI can be time consuming and expensive. Because most are caused by the contamination of fecal matter, testing for an indicator of this contamination is an easier and less costly way to determine potential health risks. Total coliforms are considered an indicator of fecal contamination. The total coliform rule (TCR) requires public drinking water supplies to test for total coliform in finished drinking water [30]. Major concerns have arisen from using total coliforms as an indicator as their origins are not exclusively from fecal matter produced by mammals, capturing a contaminated area may be difficult, and correlation of

contamination and AGI is imperfect. It is possible to have total coliforms in the water without contamination; likewise, it is possible to have pathogens in the water even if indicators test negative [31, 32].

Turbidity

Turbidity, the measurement of water cloudiness, is often associated with gastrointestinal illness. Turbidity is measured by nephelolometric turbidity unit (NTU) and public systems using conventional or direct filtration cannot exceed 1 NTU in any sample; 95% of monthly samples must be less than or equal to 0.3 NTU. Public systems using other filtration devices must abide by state guidelines, which are not to exceed the federal standard of 5 NTU at any time [22]. Turbid water can be caused by numerous factors including contamination by soil, and is believed to provide a more favorable environment for biological contaminants to grow [1]. Many regulations were conceived on the idea that concentration of suspended particles closely correlates with the level of microorganisms present [33]. Through the process of making water less turbid by removing sediments, pathogens may be also removed from the water during the cleaning. However, beyond typical drinking water utility cleaning processes, the correlation is weak between pathogen concentration and turbidity [34]. As a result, turbidity may best be used as an indicator, only marking the potential of contamination.

Groundwater Outbreak Surveillance and Regulation

Both public and private water sources may be supplied by groundwater sources and therefore susceptible to outbreaks from contaminated ground water. Water-related

outbreak surveillance captured 780 drinking water outbreaks caused by 801 identified deficiencies between the years of 1971-2006. A large proportion (31%) of drinking water outbreaks were caused by untreated ground water. Of all the deficiencies resulting in outbreaks reported in public water systems, 88 of 341 were due to using untreated or improperly treated contaminated ground water. In individual water systems, 70 of 84 identified deficiencies were due to untreated or improperly treated contaminated groundwater [23].

Since the implementation of the Safe Drinking Water Act in 1974, there have been many updates to incorporate new science and the changing needs of the country. These updates such as the Long Term 1 Enhanced Surface Water Treatment Rule (67 FR1812), and the Long Term 2 Enhanced Surface Water Treatment Rule (71 FR 654) have not decreased the number of outbreaks associated with groundwater use mainly because they are aimed at governing surface waters [23]. The 2006 Ground Water Rule was a notable exception, which focused on increasing protection against microbial risks in public systems supplied by groundwater. This rule, however, does not apply to all groundwater sources, nor does it apply to all public sources supplied by groundwater. Rather, the rule only requires that "ground water systems that are at risk of contamination" take action to "reduce cases of illnesses and deaths due to exposure to microbial pathogens." [35].

Well Water Contamination

Ground water, though historically perceived as pristine due to filtering by the earth it travels through, can contain microbial contaminants that may make people, especially the immunocompromised, sick. Contaminants that reach the groundwater can

originate from a variety of sources including wastewater treatment; improper management of wastewater or animal waste disposal; underground storage tank, septic tank, or landfill leaks; and runoff into shallow wells [36]. The underground placement of many of these sources suggests problems with them may remain undetected until water quality testing indicates otherwise. Despite efforts by the EPA to educate owners on proper well maintenance and the importance of testing their water, well owners may be uninformed, unwilling, or unable to provide the necessary treatment steps for their water [1, 36, 37]. Most may not even realize their well water is contaminated unless they experience drastic changes in aesthetic qualities such as the water's color, taste, or odor. Often, these changes are not present when microbial contamination has occurred [38].

Although the number of individual water system outbreaks reported from 1971 to 2006 is relatively small [23], this is likely an underrepresentation of the true burden associated with having potentially contaminated, and most likely untreated, well water as a primary drinking water source. Many illnesses caused by individual water sources may go undetected for several proposed reasons: (1) there is only a single case and therefore it is not recorded as an "outbreak", (2) persons experiencing acute problems may not seek medical attention, (3) persons experiencing AGI problems on private well water may not associate their problem with the water, (4) persons with contaminated well water may develop immunity to the pathogens in their water therefore masking the health effects associated with drinking tainted water. For reasons such as these, determination of the relationship between illness and drinking water proves difficult.

Introduction

Study Area

Demographics

According to U.S. Census data, New Mexico boasts a rich cultural background, with 10% of its population identifying as "American Indian and Alaska Native" persons and 47% as of "Hispanic or Latino" origin. The US population, by comparison, is only 1.2% "American Indian and Alaska Native" persons and 17% "Hispanic or Latino" origin. Over a third (36%) of New Mexico residents speak a language other than English at home (20% for US) New Mexico is about average with respect to education, with 83% graduating high school and 25% of residents obtaining a Bachelor's degree or higher (85% and 28% for US, respectively). However, the median New Mexico household income from 2007-2011 was a little more than $8,000 below the national average of $52,762 and New Mexico's proportion of persons below poverty level for the same years was 19%, nearly 5% higher than the national average [39]. The CDC estimates that in 2007, 94% of New Mexico households had a landline in their home [39, 40].

New Mexico Wells

Its dry, arid climate and lack of surface waters may be one major reason why New Mexico relies on ground water to supply nearly 90% of its domestic water needs [2]. An estimated 360,000 (20%) of New Mexico residents rely on private well water in the year 2000, which is distinctly higher than the national average for the same time period (11%) [2, 3]. Drought conditions occasionally prevail resulting in further decrease in water

tables and exacerbating water availability inconsistency. The New Mexico Department of Health provides expansive information for well owners experiencing drought [41].

New Mexico also faces challenges with septic tanks and outdated cesspools as a potential source of ground water contamination. The Liquid Waste (Septic Tank) Program maps documented ground water contamination by septic tanks and estimates over 100 indigent households are at risk for ground water contamination by cesspools [42, 43].

Online searches for well information specifically pertaining to New Mexico yield few results. There is a New Mexico Ground Water Association, which is a non-profit organization consisting of well drillers, pump installers, ground water scientists, well owners, suppliers and manufacturers of well equipment. This association's website declares one of the group's missions is to "support and protect the interest and welfare of the ground water industry and ground water users in New Mexico" [44]. However, there was no specific private well information on the website regarding water testing or other information for well owners in simple terminology.

Albuquerque, which is the largest city in New Mexico, is in Bernalillo County. The Bernalillo County Environmental Health Office provided a webpage particularly for well owners [45]. Bernalillo establishes that the plumbing and construction of the well are the first methods of protecting it from contamination. Regardless, wells should be tested annually for contaminants and chlorinated when coliform bacteria are present [46]. Bernalillo also provides a comprehensive well owner's guide. The guide is written in

plain English and is short enough to encourage reading [47]. Unfortunately, this document may not be easily accessible to the typical homeowner.

Also available online was a "New Mexico Environment Department Well Test Form." This form is a template for labs to collect valuable information on wells, and provides an area to record well test results. This testing is free to New Mexico Residents [48]. However, this document only allowed for the reporting of pH, temperature, specific conductance, dissolved oxygen, organic vapor, fluoride, iron, sulfate, and nitrate. A notice on the back page of the form indicated that the tests performed by the New Mexico Environmental Department are limited and microbial pathogens and indicators are not tested (Appendix A).

Problem Statement

Understanding New Mexico's dependence on wells and problems associated with the ground water highlights the possibility for a public health problem. We address the question: Is acute gastrointestinal illness prevalence associated with primary drinking water source among residents of New Mexico?

Hypothesis

Private well water is usually not tested and treated to the same standards as municipal water supplies; therefore a positive association between private well water use and reported acute gastrointestinal illness is anticipated. The following serves as the null hypothesis of this research project: *Among residents of New Mexico, there is no*

statistically significant association between primary source of drinking water and reported acute gastrointestinal illness.

Specific Aims

The number of households using private well water is increasing in the United States. Therefore, it is important to understand and quantify the health consequences of consuming potentially untreated private well water. This study seeks to identify the relationship between private well water consumption and acute gastrointestinal illness (AGI) in New Mexico. The identified objectives of this project are to:

1. Characterize the demographics of New Mexico residents according to their primary drinking water source (sources are categorized as public, private, and commercial).
2. Describe the prevalence of self-reported AGI by primary drinking water sources in New Mexico and determine if there is an association between primary drinking water source and self-reported AGI prevalence in New Mexico.

Methods

Study Design

This is a secondary analysis of health and behavioral information collected during the 2007 New Mexico Behavioral Risk Factor Surveillance System (BRFSS) survey, which was made possible by an Environmental Public Health Tracking grant (number 1U38EH000183). Established in 1984, the BRFSS is a nation-wide cross-sectional health survey created and supported by the CDC's Behavioral Surveillance Branch and

conducted via telephone by state health departments. Once contacted, the participant was asked to confirm that the number is that of a home phone and that no other household residents have taken the survey already. The purpose of the BRFSS is to collect prevalence information on risk behaviors, preventive practices, and health care access primarily related to chronic disease and injury in order to maintain national health priorities and strategies [49, 50]. The BRFSS is designed to be representative of the non-institutionalized adult population; an estimated 350,000 non-institutionalized adults are surveyed each year, making the BRFSS the largest telephone health survey in the world [50]. Though the mandatory core questions are cooperatively created with the CDC, state health agencies administering the survey can add modules to the core survey to capture information relevant to that state. Participants receive no compensation for participating in this voluntary survey. For the 2007 survey, participants were contacted via landlines; cell phone numbers were excluded from the study.

Data Collection

In 2007, the New Mexico BRFSS telephone survey captured 6,606 adults living in the state within five New Mexico-defined public health regions (Appendix B). In addition to the core questions, New Mexico included a "Drinking Water Module", which was supported by the Centers for Disease Control and Prevention through Environmental Public Health Tracking grant funding. Three questions were included in the drinking water module to identify information on basic water consumption habits. Survey participants were asked, "What is the main source for your drinking water?" Available answers to the question were: "Public piped water (city or municipal water supply)",

"Well (private or shared)", "Bottled water", "Tanker truck", "Water machine dispenser (supermarket)" "Other, specify", "Don't know/not sure", and "Refused". This question serves as the primary exposure in the study. The categories of "Bottled water", "Tanker truck", and "Water machine dispenser (supermarket)" were collapsed into a single category called "commercial water." Other questions included in the water module included: "Do you filter your drinking water in any way?" and "On average how many cups of home tap water do you drink each day?"

The primary outcome was identified by the survey question, "In the past 30 days, did you have diarrhea that began within the 30 day period?" Respondents were given the options of "Yes", "No", "Don't know/not sure", and "Refused" for answers. Diarrhea was defined for the study participants as ≥ 3 loose stools in a 24-hour period. Follow up questions to the primary outcome included "Did you visit a doctor, nurse, or other health professional for this diarrheal illness?" and "When you visited your health care professional, did you provide a stool sample for testing?"

Although there were many more questions in the BRFSS survey, only data pertaining to the identified specific aims were made available for purposes of this study. The full survey can be found in Appendix C. Other survey data available and included in this analysis were general health, diabetes, high blood pressure, cholesterol, myocardial infarction, heart disease, and stroke, alcohol use, diet, smoking status, age, race, number of adults in household, number of children in household, education level, marital status, area of residence, employment status, and gender. Other plausible associations, such as groups previously identified with high AGI prevalence, were explored. Information

gathered from the literature review highlighted important factors associated with either well water use, or AGI [1, 10, 51]. Previous literature suggests that there will be an association with AGI in age, and with age related health variables [1, 36, 51]. The association between these may be strong because older populations are considered a sensitive subpopulation. In addition to age related independent variables, this analysis also anticipates an association with general health status, and number of children in household, and pregnancy status [1, 10, 51].

New Mexico Department of Health provided explicit permission for the use of data ascertained (Appendix D). The Emory Institutional Review Board exempted this project from review (Appendix E).

Data Analysis

All data were analyzed using the Survey procedures in SAS ® version 9.3 (SAS Institute Inc., Cary, NC). Survey procedures are required to analyze BRFSS data to account for the BRFSS complex survey design. With the complex survey design each respondent within the survey is grouped in strata and clusters and assigned a weight based on attributes pertaining to those strata and clusters. A respondent's weight determines how many people he or she represents within that population. Stratification is the process of separating a sample into smaller sub-samples, according to specific criteria. Clustering is a set of statistical methods used to group variables or observations into interrelated subgroups [52].

In the 2007 BRFSS survey, responses were stratified on age, gender, and New Mexico health region. Clusters were defined as the three-digit prefix that follows the area

code of the phone number. Post-stratification methods forced the sum of the weights to equal U.S. Census numbers [53]. This process assigned each surveyed individual a weight, which is the representation of how many people he or she represents in the overall non-institutionalized New Mexico adult population. Weights help minimize sampling bias by giving more weight to those who may be under-sampled, and decreases the weight of those who are in heavily sampled groups. Weights also help adjust for non-response or refused questions by making similar respondents who answered sensitive or traditionally skipped questions have a higher weight within the overall dataset.

For individual questions, refused answers were coded as "missing" and not included in the analysis. For analysis purposes, missing data was assumed to be not missing completely at random. This assumption was made because respondents were allowed to refuse to answer any question. Subsequently, many questions have missing values, and the number of missing observations varies by question. However, the questions were not refused randomly, but rather there was a reason for refusal that may have encouraged a non-response (e.g. sensitive or confusing questions may have lower response rates). This assumption requires the data to be analyzed as "not missing completely at random". With this option, SAS considers the entire population as the missing and non-missing responses and analyzes non-missing values as a subpopulation within this total population. As a result, standard errors for the missing responses and non-missing responses are analyzed with the same statistical method [54]. Strict interpretation of results analyzed as not missing completely at random, should start with

"In a subpopulation of those who would respond to (insert question)…." This should be assumed when results are read.

Throughout this analysis, statistical significance was defined as a p-value of <0.05 or a 95% odds ratio confidence level that did not include 1.

Created Variables and Groupings

Some variables used in tabulating demographic characteristics and the analyses were not specifically asked in the survey but were derived from original variables. Likewise, there were some categories that, due to the large amount of potential responses, needed to be grouped for reporting and analysis.

For demographic analysis, age in years were grouped into the following age categories: 18-24 years, 25-62 years, and 65+ years [53]. For modeling, the ages were grouped 18-24, 25-44, 45-64, and 65+. Marital status was grouped as "married or living together", "separated or divorced", "widowed", or "never married." Highest level of education completed was grouped by "< High School", "High School Diploma or GED", "Some College", and "College Graduate". Employment status grouping was not changed in demographic characteristic reporting, however it was changed for associative model building. Those who were self-employed were categorized as "employed," and "homemakers" were categorized as "unemployed" for modeling purposes only. Number of children in household was categorized as "0 children", "1 child", and "2+ children". Race was reported according to the New Mexico Department of Health Guidelines for Race/Ethnicity Data and included categories of "American Indian or Alaska Native",

"Asian or Pacific Islander", "Black or African American", "Hispanic" and "White" (Appendix F).

The variable Metro Status Codes (MSC) was derived from respondents' telephone numbers and cluster information. The codes are grouped into four categories, depending on relation to metropolitan statistical areas (MSA). An MSA is defined as county or counties containing an urbanized area with a population of 50,000 or more. Adjacent counties that have a high degree of social and economic integration with the MSA are considered "suburban counties". The four MSC categories defined are: "In the Central City of MSA", "In county with the MSA", "Suburban County", or "Not in an MSA" [55].

When asked about primary source of drinking water, twenty of the surveyed respondents indicated that the primary source of their drinking water was from an "other" source not mentioned explicitly in the survey. Upon closer analysis, these "other" answers were deemed to be nonsensical or not homogeneous enough to be included in the analysis as one lumped category. Thus those 20 answers were excluded from analyses regarding water source. Due to the subjective nature of the question "Would you say that in general your health is . . ." the variable was not considered in the model building process.

In the survey, respondents were asked if they had ever had their blood cholesterol level checked. Regardless of how they responded to this question, they were then asked if they were ever told by a health professional that their blood cholesterol level was high. Since the skip pattern did not take into account those who responded "no," "don't know," or "refused," to ever having their blood cholesterol level checked, it was possible for

people to say they did not have their cholesterol checked, did not know if they had it checked, or refused the question, yet were still told by a health professional that their cholesterol level was high (n=51). Answers such as these presented themselves as potential false positives. Therefore the high cholesterol variable was modified to only include the answers from respondents who had their cholesterol level checked.

Demographic and AGI Characteristics

Demographic characteristics of New Mexico were analyzed with respect to both primary drinking water source and reported AGI. Frequencies were calculated using the survey procedure in SAS and by creating two-way frequency tables. The frequencies presented express the raw counts from the survey data while percentages presented are appropriately weighted to the non-institutionalized adult population of New Mexico.

Analytic Strategy

AGI association was modeled with two different dependent variables. The first model included only self-reported AGI instances as the measured outcome. Concerns with the specificity of self-reported AGI encouraged the refining of the category for a secondary model analysis of those who sought medical attention for their AGI. By defining the outcome more specifically, this outcome is more likely to capture severe cases of AGI and reduce reporting bias, as seeking medical attention might serve as a memory prompt of events in the past 30 days.

Logistic regression was used to analyze association because the two primary outcomes - having an AGI episode and seeking medical attention for an AGI episode -

were coded in a binary (yes or no) form. Due to the complex survey design, logistic regression was carried out with the SAS survey procedures, and thus weighted appropriately. All approximation methods were done by the SAS default, Taylor series linearization.

A parsimonious model for each outcome was developed from variables determined from the literature review, significantly associated variables, significant interaction terms, and identified confounders. First, separate associative models for demographic characteristics and health status indicators were developed using backward selection methods. When deciding which variables to keep in the model, a variable's significance was based on the whole category instead of its individual parts, as measured by the analysis of effects. The variable with the most insignificant p-value in the fully adjusted analysis of effects were during removed each step of the process until the model contained only the significant variables and water source.

Next, potential confounding covariates were entered to each model individually and adjusted odds ratios (OR) were compared with unadjusted OR; variables that changed the OR by $\geq 10\%$ were considered confounders and retained in the final model, regardless of their overall statistical significance[1].

Once significant associative models for both demographic characteristics and health status were obtained, those two models were combined to create one overall associative model presenting all significant variables. Variables from this model

[1] Variables that have influence on the primary exposure and the primary outcome but are not in the causal pathway (Gordis, 2009). When determining association among variables, it is important to keep confounders in models to preserve their effect on the primary exposure and outcome variables.

underwent a backwards selection process again, removing the most highly insignificant variable at each step. The final associative model was created by significantly associated variables and identified confounders. If two or more models gave similar results, the model with fewer variables (more parsimonious model) was chosen.

This modeling procedure was repeated using those who had AGI and sought medical attention as the outcome.

Results

General

Out of an estimated total population of 1.3 million, a total of 6,606 non-institutionalized New Mexico adult residents were included in the BRFSS telephone survey. The survey captured 2,457 males and 4,149 females aged 18-99 years, with a median age of 53. Calls were made consistently throughout the year, with 23% were made in the winter months of December, January, and February; 22% in the spring months of March – May; 28% in the summer months of June – August; and 26% in the fall months of September – November.

Table 1 shows the response percentages of survey questions included in this analysis. Most questions had item response rates between 90-100% with the exception of questions on high cholesterol (79%) and income (89%). The question "To your knowledge, are you now pregnant?" was only posed to females between the ages of 18-44 and therefore has a different number of total respondents able to answer (n=1,337); of these 99.3% answered the question.

Water Source

Primary drinking water sources of New Mexico residents according to respondent demographic characteristics are shown in Table 2. Of the 5,963 that reported their drinking water source, 55% (3321) survey participants reported obtaining water from public piped water; 18% (1142) reported getting water from a well; 27% (1500) reported using commercial water. When weighted to the non-institutionalized New Mexico adult population (1.3 million), approximately 720,000 people obtain their water from public piped water; 236,000 from a private well; and 350,000 from commercially bottled sources. With the exception of sex and income, all respondent characteristics tested were significantly associated with aforementioned drinking water sources. The proportion using a public water source tended to increase with age: 45% in 18-24 year olds, 55% in ages 25-64, and 64% in those older than 65 years. Commercial water use was highest among those aged 18-24 years (37%) and lowest among those aged 65+ (17%). Private well water use was similar across age groups (18% to 19%). Public water supply use was highest among the widowed (62%) and lowest among those who were never married (47%). Residents who were never married reported the highest usage of commercial water (36%). Residents with a college education were more likely to report using public piped water (61%), residents with less than a high school diploma were most likely to use commercial water (35%), and those with a high school diploma or GED were most likely to use private well water (20%). Water source varied by employment status: retired persons reported highest use of public water supply (63%) and lowest for commercial water use (17%). Self-employed persons reported the highest proportion of private well

water use (24%). Unemployed persons reported the highest proportion of commercial water drinkers (42%) and the lowest proportion of public water drinkers (43%). The majority of Region 3 residents are on public water supplies (66%), while only 9% are on private well sources. Region 2 of New Mexico has just over one-third of the population on private well water sources (34%) and has the lowest proportion of population using commercial water (18%). Both Region 3 and Region 4 have nearly one-third of their populations reporting commercial water as their primary drinking source (33% and 32%, respectively). The season the survey was administered was also associated with water type: the highest proportion of public and commercial water users were surveyed in summer (28% and 26%, respectively), while the highest proportion of private well users were surveyed in the spring (29%). Households with 1-2 adults had the largest proportion of public water drinkers (57%) and the lowest proportions of private well water drinkers (18%) and commercial water consumers (25%). In households with three or more adults, 49% used public water, 19% used private water, and 32% used commercial water sources. Households with two or more children made up the highest proportion of public water drinkers (60%) and the lowest proportion of commercial water drinkers (25%). Households with one child made up the highest proportion of commercial water drinkers (32%) and the lowest public water drinkers (54%). Households with no children reported the highest proportion using private well water (20%). All races, except for black or African American, reported public water as the most commonly used source of water. Blacks or African American reported the highest use of commercial water (50%). Those in a central city of a metropolitan statistical area (MSA) were mostly on public water

supplies (64%) and least likely to be using well water (9%) for primary drinking water sources. Those outside the central city but in a county with a metropolitan statistical area represented the largest proportions on both well water (29%) and commercial water supplies (29%).

Water Source by Health Indicators

Table 3 summarizes the source of drinking water by health indicators. Of the health indicators examined, having high blood pressure, previously having a heart attack, and being diagnosed with arthritis were significantly associated with water source, even when controlled for age. In all, 57% of respondents with high blood pressure answered that they use public water sources, 20% responded they use well water, and 23% responded they use commercial water. Over half (54%) of respondents without high blood pressure answered that they use public water sources, 18% responded they use well water, and 28% responded they use commercial water. The majority (63%) of respondents who had previously suffered from a heart attack said they were on public water sources and only 16% used well water. Of those without a previous heart attack, 55% were on public water, 18% were on wells, and 27% were on commercial water supplies. A total of 59% of those with arthritis, and 54% of those without use public water while 19% of those with arthritis, and 18% of those without reported drinking well water.

Incidence of Acute Gastrointestinal Illness

Table 4 shows AGI incidence in New Mexico according to respondent demographic characteristics. The 30-day incidence of AGI was 15%. Of the 993 residents with AGI, 123 sought medical attention for their diarrhea (2% of all residents), and 54 provided a stool sample to their health care provider. In these bivariate analyses, AGI did not differ significantly by sex, education, employment status, income, region, season of survey, number of adults in household, number of children in household, or metro status code. AGI was significantly associated with age and marital status; of those aged 25-64, 17% reported AGI, which was the highest among the ages (p=0.0008). Those aged 18-24 reported the lowest incidence of AGI (8%). Respondents who were divorced or separated reported the highest incidence of AGI (20%) those who were never married reported the lowest incidence of AGI+ (12%) (p=0.0068).

Incidence by Health Indicators

Table 5 shows AGI incidence in New Mexico by health indicators. High blood pressure, asthma, previously having a heart attack, stroke, current pregnancy, high cholesterol, and having health insurance were not significantly associated with AGI incidence; all other health status indicators were significantly associated with AGI. AGI incidence was highest in residents who reported poor general health (28%) and lowest in residents who reported excellent health (10%) (p<0.0001). Of those with angina or coronary heart disease, 23% reported an episode of AGI while 15% of those without heart disease reported AGI (p=0.0031). About one-fifth of diabetics and pre-diabetics reported an AGI episode (19% and 20%, respectively), 15% of those without diabetes

reported AGI, and 9% of women had only been diagnosed with diabetes while pregnant reported AGI. Nearly a quarter of respondents (21%) with arthritis reported AGI and 13% of those without arthritis reported AGI. Of those who indicated they drank alcohol, 17% reported AGI; 14% of those who did not drink alcohol reported AGI ($p=0.02$). Of those who said they were current smokers, 20% reported an AGI episode in the last month whereas 14% of non-smokers reported AGI ($p<0.0001$).

Incidence by Water-related Behaviors

AGI incidence according to water consumption habits is shown in Table 6. Nearly 43% filtered their primary drinking water. Of those who filtered their water, a greater proportion indicated that they filter commercial water (22%) than well water (19%) (not shown). Nearly two-thirds (63%) of people reported drinking five or more cups of water a day. The majority of people using public and private sources reported drinking five or more cups a day; however, the majority of people using commercial water reported drinking zero to four cups a day. Of those on public water supplies or primarily drinking commercial water, 16% reported an AGI episode. This proportion decreased for people using private well sources (13%). These differences were not statistically significant ($p=0.1927$). Among people who said they filtered their water, 16% reported an AGI episode, compared to 15% of those who did not filter their water ($p=0.594$). Though the differences were statistically non-significant, the highest proportion of people who reported AGI were those who drank commercial, filtered water (17%) or drank five or more cups of commercial water a day (18%).

Modeling

AGI

Table 7 shows OR for AGI by water source from unadjusted and adjusted models. In the unadjusted model, the odds ratio of reporting an AGI episode is 0.80 (95% CL = 0.63, 1.02) for those who primarily use private well water and 1.05 (95% CL = 0.82, 1.34) for those who primarily use commercial water compared to those who primarily use public water sources. Demographic characteristics significantly associated with AGI included age, and marital status. In this demographics model, those in the age category of 25-44 years and 45-64 old had two-fold increased odds of AGI compared to the age group of 18-24 years old (25-44 years OR = 2.21, 95% CL = 1.22, 4.01; 45-64 years OR = 2.07, 95% CL = 1.15, 3.71). However, adjusting for age and marital status did not affect the magnitude of the odds ratio for primary drinking water sources ((0.80 (95% CL = 0.63, 1.03) for private well water and 1.06 (95% CL = 0.83, 1.35) for commercial water compared to public water). Significant health status indicators included arthritis, BMI, and current smoking status. These effects remained significant, even when adjusted for age. Those with arthritis had a significantly higher odds of AGI (OR = 1.84, 95% CL = 1.50, 2.25) compared to those without arthritis. A BMI categorized as "obese" also increased odds of AGI compared to respondents with a normal BMI (OR = 1.30, 95% CL = 1.02, 1.67). Current smokers had an increased odds of AGI compared to non- smokers (OR = 1.63, 95% CL = 1.29, 2.06). Adjusting for health status indicators did not significantly affect the magnitude of the odds ratio for primary drinking water sources (0.83 (95% CL = 0.65, 1.06) for private well water and 1.09 (95% CL = 0.85, 1.41) for

commercial water compared to public water). In the fully adjusted model, age, arthritis, and smoking remained significantly associated with AGI. Residents aged 25-44 had a significantly higher odds of AGI than residents aged 18-24 (OR =2.03 (95% CL = 1.10, 3.75)). Persons with arthritis had an increased odds of AGI (OR=1.90, 95% CL = 1.55, 2.33) compared to persons without arthritis. Current smokers had higher odds of AGI than non-smokers (OR= 1.61, 95% CL = 1.28, 2.03) compared to non-smokers. This model did not significantly alter the magnitude of the association with primary water sources (OR = 0.83, 95% CL = 0.65, 1.06) for private well water and 1.11 (95% CL = 0.86, 1.42) for commercial water compared to public water sources).

Sought Medical Attention for AGI

Table 8 summarizes the unadjusted and adjusted models for the outcome of sought medical attention for AGI versus did not seek medical attention or did not have AGI. In the unadjusted model, the OR for AGI episode was 0.74 (95% CL 0.36, 1.52) for those who primarily use private well water and 0.84 (95% CL = 0.49, 1.44) for those who primarily use commercial water compared to those who primarily use public water sources. Demographic characteristics significantly associated with seeking medical attention when adjusted for primary water source included employment and income. Since these significant demographic characteristic variables were collinear[2], employment was dropped from the model. Respondents in the highest income category had a significantly lower odds ratio for seeking medical attention (OR = 0.20, 95% CL = 0.07, 0.58), compared to respondents in the $35,000 - $50,000 income category. However, this

[2] Very high correlation among variables (Porta, 2008).

model did not significantly affect the magnitude of the odds ratio for primary drinking water sources. Significantly associated health status indicators included previously having a heart attack and having arthritis. Having a heart attack greatly increased the odds of seeking medical attention (OR=2.71, 95% CL = 1.32, 5.57) compared to those who had not had a heart attack. Additionally, people with arthritis had a higher odds of seeking medical attention (OR=5.41, 95% CL = 3.16, 9.28) compared to people without arthritis. When fit in a combined model, all variables remained significantly associated with seeking medical attention for AGI when adjusted by primary water source. In addition, hypertension was determined to be a confounding variable and was therefore added to the final adjusted model. Age was also forced back into the final model. The effect of primary water source increased in this combined model to 0.85 for well water (95% CL = 0.41, 1.80) and 0.97 for public water (95% CL = 0.54, 1.74) but associations were not significant.

Discussion

In this cross-sectional survey, AGI incidence did not vary significantly by primary water source, although contrary to the hypothesis, well water users had non-significantly lower odds of AGI than public water users. The original hypothesis was developed anticipating that the lack of regulation on wells would result in decreased monitoring and maintaining wells, a hypothesis supported by results of surveys and focus groups exploring well owners' management proclivity [17, 18]. To our knowledge, this study is the first that uses BRFSS data to quantify AGI burden associated with private wells within a population, although other studies have linked outbreaks to contaminated

groundwater [23, 56-62] and detected pathogens in well water used for drinking [14, 15, 51, 63, 64].

Multiple models were developed to tease out the effects of confounding variables in case they were masking the true association between primary water source and AGI. All associative analyses were controlled for age because of age's established association with AGI [1, 10]. In an attempt to increase specificity[3] of outcome, AGI was further refined to include only those who sought medical care for AGI. These changes had no effect on the magnitude of association with primary water source.

The lower odds (15-20% decrease) of developing AGI among private well users compared to public water users, though insignificant, might suggest that drinking water from private sources may be protective against AGI. It can also hypothesized that a "protective" effect is gained by previous exposure to pathogens transmitted by water [12, 65]. Respondents within the ages of 25-44 years had the highest prevalence of AGI of all the age groups, even higher than the prevalence for those 65+ years. This finding was surprising because the elderly are considered a sensitive population and are much more vulnerable to pathogens that may not make middle-aged individuals sick [1]. In conjunction with the results of drinking water source, this decreasing trend of AGI as age increases further implies that adults could have an acquired immunity to pathogens that may make younger individuals, especially children, sick. Although the survey did not include minors, other studies have indicated that children in households are most affected by the health burdens associated with pathogens transmitted via drinking water,

[3] Probability that a person without the disease will be correctly identified as non-diseased (Porta, 2008).

especially from private sources [1, 10, 65, 66]. On the contrary, the small decrease in odds of developing AGI among private well users compared to public water users might suggest people drinking from public water supplies are at an increased risk for AGI. Research on the country's aging public water infrastructure has suggested there are many points for potential contamination throughout the distribution system [34, 36, 67].

During the analyses, several other surprising associations were found. Arthritis was significantly associated with both AGI and seeking medical attention for an AGI episode, even when adjusted for age. The strength of this association implies that this result is not by chance. A literature review revealed that certain types of arthritis are commonly treated with non-steroidal anti-inflammatory drugs (NSAIDs), which are may cause AGI as a side effect [68]. The questionnaire did not ask about medications that respondents were taking. However, AGI documented as a side effect suggests that use of NSAIDs might be an unmeasured intermediate variable between arthritis and AGI. Smoking was also found to be significantly associated with AGI. Smoking causes a decreased production of bicarbonate secretion and increases gastric acid secretion, both of which change the pH of the stomach to be more favorable for bacteria. Therefore, smokers are more susceptible to bacterial infections that might not otherwise survive in the stomach pH [69]. Since AGI causing bacteria such as *E. Coli, Campylobacters spp.,* and *Salmonella spp.* can be transmitted via water, smokers may have a greater chance of getting sick, especially if using non-disinfected water sources.

People, especially children, are more likely to have AGI episodes by enteropathogens during winter or summer months [70] and these AGI instances are likely

to be spread among people living in the same household [71]. Despite this, the New Mexico survey did not find a significant monthly or seasonal association with incidence of AGI in any water source. Though source of drinking water was found to vary by season of the interview, this association was not explored, as it was likely the result of survey methodology among different population densities. Season was expected to have a much more pronounced association than it exhibited in this population. This anomaly may be due to regional circumstances, such as climate.

The 30-day incidence of AGI in this study, 15%, was high compared to that found in other population surveys. A similar survey done in British Columbia, Canada detected the 30-day incidence of AGI to be 10% in the survey population [66]. A summary of the Foodborne Diseases Active Surveillance Network (FoodNet) descried a 7.7% average monthly prevalence of diarrhea from 1996 – 2003 [72]. The reasons for this difference in incidence are not clear, and this finding is worth further exploration, especially since the Canadian and FoodNet studies expanded the case definition of AGI to contain vomiting and included children in their populations [66, 72].

In the New Mexico survey, diarrhea was defined as 3 or more loose stools in a 24 hour period, which is consistent with the World Health Organization's definition of diarrhea [73] but prone to potential bias as it allows the surveyed individual to decide if he or she fits the case definition [74]. This survey relied on responses from a 30-day period; studies on diarrheal symptoms commonly use a 7-day recall period and anything beyond 7 days is considered unreliable [75-78]. Longer recall periods or "reporting fatigue" increase response imprecision [75]. This survey may have invoked both of these

as the recall period was 30-days, and information for AGI episodes was asked towards the end of a 60+ page telephone survey. Respondents may have not recalled correctly or provided a quick answer to get through the survey quicker. Recall bias based on time is typically assumed to be non-differential and therefore may not have skewed associations [74]. However, recall bias may be different among groups who suffered from severe cases of diarrhea, as they might recall memorable AGI episodes more accurately, especially compared to individuals who suffered a minor episode. Although AGI might be considered a sensitive question, almost 94% of those in the study answered the question regarding AGI. Therefore question sensitivity is an unlikely bias in this study.

Modeling the association with seeking medical care for AGI was an attempt to increase the specificity of the primary outcome measured and identify any association with primary drinking water source that might have been missed due to outcome misclassification. The differences between this model and one looking at AGI as the outcome are noteworthy. People who had higher income ($75,000+ a year) were less likely to seek medical attention for AGI, but there was no association between income and AGI. People who had previously suffered from a heart attack were more likely to seek medical attention for an AGI episode compared to those who had no history of heart attack, even when adjusted for age. There was no association between history of heart attack and AGI. Although AGI and seeking medical attention for AGI were significantly associated with arthritis, the association is more pronounced in those who sought medical attention for AGI, even when adjusted for age. Smoking status was significantly associated with AGI, but not significantly associated with seeking medical attention for

that AGI episode. This information neither supports nor refutes the hypothesis that AGI would be related to water source, but provides valuable information regarding susceptible persons within a population and how to frame educational material for those people.

Demographic characterizations of respondents indicate that primary drinking water sources are not uniformly distributed throughout the population. Many demographic characteristics tested were significantly associated with primary drinking water source. This may be because the demographics vary greatly by population density (i.e. those who dwell in the city are demographically different from those who reside rural areas), and typically areas of greater population density use public water, while areas less densely populated use private well sources. This association does not imply causation, but merely highlights an interesting correlation. This demographic information is also useful when determining how to frame and distribute educational materials for well owners. For example, the survey found that 40% of well water users do not have any college education, 69% are between the ages of 25-64, and 65% have no children living in the household. Education materials with technical wording, or that highlight dangers in old or young populations may not capture the attention of the majority of well water users as they feel these dangers may not be applicable to their household. On the other hand, 35% of households on private well water *do* have children living in the household. The American Academy of Pediatrics warns that children on private sources, especially those that are not properly maintained or monitored have an increased risk of developing AGI symptoms [10]. Households with children and on private sources may need additional, targeted information on how to decrease this risk.

Water filtration devices might provide a false sense of security in terms of the microbiological safety of water, as water filtration devices had no significant impact on the association of AGI. About 16% of those with water filters reported AGI and 15% of those without water filters reported AGI (p=0.8781). Variable definitions of filtration devices may influence responses and lead to inconsistent measured associations. For example, home water filtration systems can vary greatly in their effectiveness. While reverse osmosis filters may be effective at removing contaminants, filters like those built in pitchers may not be as effective. Some filtration systems might require frequent maintenance and are rendered useless for effective filtration without this upkeep. In addition, many home water filters, including most pitcher and refrigerator filters, are not designed for pathogen removal [79, 80]. With such a wide spectrum of filter effectiveness, it is possible that people who reported filtering their water were actually using ineffective methods. In addition, the high rate of filtration reported among commercial water users suggests there is potential for misclassification. For example, someone may have inaccurately responded that they do filter their bottled water because the water is advertised as filtered; this is not what the question intended to measure. Therefore asking if residents use a water filtration system for their primary drinking water without inquiring about the type of filter used may produce inaccurate and imprecise results. This variability of the independent variable leads to a bias towards the null. In other words, it is not clear who is drinking effectively filtered water; therefore it is hard to establish if filtering water has any effect on AGI incidence.

The most effective way to determine association between drinking water, a long term exposure, and AGI episodes would be to conduct a cohort study following groups of multiple source water users from the day they start consuming water from a new source. For instance, group 1 could be a family who just moved from a place with a public water supply to a residence with a private well; group 2 could be the opposite. Following the different groups as they adjust to a new water source would eliminate the possibility of acquired immunity affecting the study results. An ideal study would include all age ranges, including children (especially those under 5) because each age range has a different risk associated with developing AGI symptoms and immunity.

Strengths and Limitations of Study

Strengths

This study used data from the BRFSS, a nationally established, and well-designed comprehensive survey funded by the Centers for Disease Control and Prevention and administered by individual states [50]. The BRFSS was able to capture over 6,600 non-institutionalized adults in the survey, providing an ample sample size for evaluating the study hypothesis. This survey was conducted and then weighted in a way that also increased the accuracy in which it represented the New Mexico non-institutionalized adult population [50].

Limitations

Since this study was a secondary analysis, this analysis inherits any design flaws from the original survey. The BRFSS survey was not created for the purpose of investigating the association between water source and AGI; therefore the questions were

not designed to be specifically analyzed in this context. Had the survey been created for the purposes of this study, it might have included more relevant questions (e.g., the respondents' time on well water) to establish a clearer picture of the AGI association, perhaps even strengthening the association of AGI by accounting for more confounders and other related variables. Excluding children also prevented a full understanding of risks associated with AGI because they are anticipated to have different incidences than adults [10]. Not having children in the study may have decreased the real incidence of AGI and discounts the ability to look at acquired immunity, a potentially major factor when dealing with long-term exposure.

Primary source of drinking water also does not cover all the water sources people drink from, as primary water source is not an exclusive exposure. For example, a person may use a public water supply at home, but drink commercial water at work, and visit people or businesses that use private well sources. In this instance, multiple exposures could complicate the ability to accurately determine associated risks.

Although the BRFSS expanded to include cell phones in later years, the 2007 survey only included households with landlines. Given the increasing use of cell phones and their replacement in landlines, the BRFSS may have created a sampling bias by intentionally excluding an important section of the population from the survey population. Particularly, this may have impacted the number of young individuals able to be in the study, as younger individuals are more likely to rely on a cell for their primary phone.

Finally, cross-sectional studies, such as the BRFSS survey, may not be ideal for measuring the causation of illnesses caused by chronic exposure because the temporal relationship between exposure and outcome cannot be established from a one-time survey of the population [81]. Measuring incidence cannot determine the duration of the diarrhea symptoms [82], an important indication of severity of illness within an individual [83].

These limitations are why the analysis focused on determining association, to determine if sections of the population were more affected by AGI or not, when controlled for primary drinking water source and other related factors. It is important to reiterate that association does not imply causation, and this analysis cannot imply that drinking from private sources or any other variable analyzed causes AGI episodes. Likewise, even though no association was found, this study cannot state that drinking from private sources or any other variable analyzed does not cause AGI episodes. Further research, especially research that includes children and accounts for the long term exposure is needed to understand association.

Conclusions and Recommendations

This analysis gave an overview of the demographics of water users, and looked at the association of primary water use type with AGI incidence. There are many factors that contribute to the burden of AGI within a community and an individual. The 2007 New Mexico BRFSS gave insight to factors such as health indicators, demographics, and water consumption and filtration habits. However, since the survey was not specifically designed for understanding AGI in the context of drinking water source, future

investigators can use this information as a launching point in understanding the underlying risk factors for AGI. Specific areas for follow up studies include:

1. Tailoring a questionnaire to understand water consumption habits and behaviors most commonly associated with AGI
2. Including survey to analyze minors' consumption habits and AGI episodes
3. Expanding and promoting online and other easy to access methods of reference for proper well maintenance including regional factors and problems
4. Developing and a cost/benefit analysis of policy requiring well owners to test their drinking water annually
5. Discussing ways to reduce the financial and time burden associated with testing water

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Table 1: Response Percentages of Survey Questions (N=6,606)

Item	n	%
Adults in Household	6,606	100%
Age[a]	6,606	100%
AGI	6,197	93.8%
Arthritis	6,450	97.6%
Asthma	6,592	99.8%
Body Mass Index	6,605	100%
Children in Household	6,596	99.8%
Coronary Heart Disease	6,562	99.3%
Diabetes	6,604	100%
Education	6,191	93.7%
Employment	6,589	99.7%
General Health	6,599	99.9%
Heart Attack	6,566	99.4%
High Cholesterol[b]	4,952	99.7%
Household Income	5,902	89.3%
Hypertension	6,598	99.9%
Maritial Satus	6,583	99.7%
Metro Status Code	5,963	90.3%
New Mexico Health Region	6,574	99.5%
Pregnant[c]	1,327	99.3%
Primary Water Source	5,963	90.3%
Race/Ethnicity	6,543	99.0%
Sex	6,606	100%
Sought Medical Attention for AGI	6,197	93.8%
Stroke	6,583	99.7%
Water Consumption	5,963	90.3%
Water Filter	5,961	90.2%

a. Response mandatory for inclusion in survey

b. Restricted to respondents who had blood level checked (n=4,965)

c. Restricted to females aged 18-44 (n=1,337)

Note: Percentages rounded

Table 2: Souce of Drinking Water by Respondent Demographic Characteristics

Variables	Public Water		Private Well Water		Commercial Water		P-Value
	Unweighted N	Weighted Row %	Unweighted N	Weighted Row %	Unweighted N	Weighted Row %	
Total	3,321	55.2%	1,142	18.1%	1,500	26.7%	-
Sex							
Male	1,264	56.0%	460	17.4%	475	25.2%	0.1877
Female	2,057	54.4%	682	18.8%	1,025	28.2%	
Age (in years)							
18-24	119	45.5%	37	18.1%	101	36.5%	
25-64	2,192	55.0%	796	17.9%	1,115	27.2%	<.0001
65+	998	63.8%	307	19.0%	278	17.2%	
Marital Status							
Married / Living together	1,893	57.1%	712	18.8%	817	24.1%	
Separated / Divorced	594	55.5%	179	15.3%	306	29.2%	<.0001
Widowed	466	62.0%	123	15.4%	147	22.6%	
Never Married	362	46.6%	123	18.0%	225	35.5%	
Education							
< High School Diploma	375	52.7%	114	12.7%	264	34.6%	
High School Diploma/GED	887	52.8%	330	20.0%	403	27.2%	<.0001
Some College	865	52.4%	301	19.4%	399	28.2%	
College Graduate	1,190	60.7%	396	17.3%	433	22.0%	
Employment Status							
Employed for wages	1,450	55.2%	453	16.4%	716	28.4%	
Self-employed	293	52.6%	178	24.3%	144	23.1%	
Unemployed	100	42.8%	41	15.3%	81	41.9%	
Homemaker	325	56.7%	104	17.6%	153	25.7%	<.0001
Student	69	45.0%	20	21.5%	41	33.5%	
Retired	872	62.5%	286	20.5%	251	17.0%	
Unable to Work	202	57.3%	59	13.2%	109	29.5%	
Household Income							
Less than $20,000	637	52.9%	225	15.6%	354	31.5%	
$20,000 - $35,000	697	55.5%	234	18.1%	308	26.4%	
$35,000 - $50,000	491	53.2%	161	17.2%	243	29.6%	0.1865
$50,000 - $75,000	515	56.8%	168	18.8%	209	24.5%	
$75,000 or more	640	55.0%	246	20.2%	252	24.8%	
New Mexico Region							
Region 1	1,046	55.0%	371	19.8%	458	25.2%	
Region 2	494	47.8%	332	33.9%	188	18.3%	
Region 3	701	65.7%	71	8.6%	209	25.6%	<.0001
Region 4	513	52.8%	137	13.8%	291	33.4%	
Region 5	556	46.4%	228	21.7%	349	31.9%	
Season							
Winter	779	53.9%	284	18.0%	378	28.1%	
Spring	788	51.8%	276	21.6%	357	26.5%	0.0286
Summer	900	58.8%	274	14.6%	393	26.5%	
Fall	854	55.9%	308	18.2%	372	25.9%	
Adults in Household							
1-2	2,950	57.2%	988	17.7%	1,265	25.0%	0.0067
3+	371	49.4%	154	19.1%	235	31.6%	
Children in Household							
0	2,265	54.3%	837	19.5%	963	26.1%	
1	375	51.8%	123	15.9%	231	32.3%	0.0089
2+	679	59.6%	181	15.8%	303	24.6%	
Race/Ethnicity							
American Indian or Alaska Native	176	46.6%	83	18.5%	160	35.0%	
Asian or Pacific Islander	24	50.1%	**	**	**	**	<.0001
Black or African American	28	45.6%	**	**	29	49.7%	
Hispanic	1026	54.9%	310	14.2%	572	30.8%	
White	2,038	56.6%	728	21.1%	709	22.3%	
Metro Status Code							
Central City of MSA	1,331	63.9%	224	9.0%	502	27.0%	
County with MSA	383	42.6%	95	28.7%	166	28.7%	<.0001
Suburban County	394	49.5%	222	26.9%	182	23.6%	
Not in an MSA	1,213	48.5%	601	24.7%	650	26.8%	

** Cell counts less than 20 are supressed

Note: Percentages may not add up to 100% due to rounding

Table 3: Source of Drinking Water by Health Indicators

	Public Water		Well Water		Commercial Water		
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	
Variables	**N**	**Row %**	**N**	**Row %**	**N**	**Row %**	**P-Value**
General Health							
Excellent	555	53.1%	226	19.7%	251	27.2%	
Very Good	1,007	56.5%	344	19.6%	406	23.9%	
Good	1,117	55.7%	362	16.0%	510	28.4%	0.2649
Fair	453	54.8%	145	17.7%	229	27.5%	
Poor	188	54.1%	62	16.6%	102	29.3%	
High Blood Pressure							
Yes	1,095	57.3%	373	19.5%	448	23.2%	0.0195
No	2,220	54.4%	767	17.5%	1,052	28.1%	
Asthma							
Yes	452	54.2%	152	16.6%	214	29.2%	0.4243
No	2,861	55.4%	989	18.3%	1,284	26.3%	
Coronary Heart Disease							
Yes	180	62.9%	51	16.8%	59	20.4%	0.0957
No	3,122	55.0%	1,075	18.0%	1,433	27.0%	
Heart Attack							
Yes	202	66.8%	52	15.8%	55	17.4%	0.0016
No	3,098	54.7%	1,076	18.0%	1,442	27.2%	
Stroke							
Yes	108	52.5%	31	17.6%	45	30.0%	0.7786
No	3,198	55.3%	1,108	18.1%	1,452	26.7%	
Heath Care Coverage							
Yes	1,795	54.3%	645	18.3%	866	27.4%	0.0781
No	511	50.9%	185	16.3%	349	32.8%	
Diabetes							
Yes	334	54.8%	103	19.1%	162	26.1%	
Yes, but only when pregnant	25	56.7%	**	**	**	**	0.9602
No	2,909	55.2%	1,011	17.9%	1,296	26.8%	
No, but pre-diabetic	52	54.2%	**	**	30	29.2%	
Pregnant							
Yes	24	55.7%	**	**	20	40.9%	0.1467
No	581	52.7%	187	15.8%	370	31.5%	
High Cholesterol							
Yes	1,085	58.7%	355	18.0%	432	23.3%	0.0911
No	1,610	54.7%	574	18.8%	729	26.5%	
Arthritis							
Yes	1,226	59.3%	397	18.8%	486	21.9%	0.0003
No	2,091	53.7%	741	17.7%	1,009	28.6%	
BMI Category							
Underweight	53	61.5%	20	16.4%	24	22.1%	
Normal	1,186	56.1%	442	18.8%	500	25.1%	0.3177
Overweight	1,183	55.8%	391	18.1%	504	26.1%	
Obese	899	52.9%	289	17.0%	472	30.1%	
Drink Any Alcohol							
Yes	1,549	55.7%	539	18.6%	634	25.6%	0.3848
No	1,763	54.7%	601	17.5%	863	27.8%	
Current Smoker							
Yes	645	57.7%	212	16.1%	298	26.2%	0.3244
No	2666	54.6%	927	18.5%	1197	26.8%	

** Cell counts less than 20 are supressed

Note: Percentages may not add up to 100% due to rounding

Table 4: Incidence of Acute Gastrointestinal Illness by Respondent Demographic Characterization

Variables	Unweighted N	Weighted Row %	P-Value
Total	993	15.0%	-
Sex			
Male	367	15.1%	0.9073
Female	626	15.0%	
Age (in years)			
18-24	26	8.3%	
25-64	730	16.9%	0.0008
65+	234	13.1%	
Marital Status			
Married / Living together	542	15.1%	
Separated / Divorced	231	20.2%	0.0068
Widowed	106	13.1%	
Never Married	110	12.2%	
Education			
< High School Diploma	103	12.9%	
High School Diploma/GED	254	14.2%	0.2267
Some College	303	17.0%	
College Graduate	332	15.0%	
Employment status			
Employed for wages	430	15.1%	
Self-employed	108	14.6%	
Unemployed	44	15.6%	
Homemaker	85	15.6%	0.0631
Student	25	9.8%	
Retired	207	13.9%	
Unable to Work	91	22.9%	
Household Income			
Less than $20,000	228	16.6%	
$20,000 - $35,000	214	15.3%	
$35,000 - $50,000	152	15.5%	0.6797
$50,000 - $75,000	154	16.5%	
$75,000 or more	164	13.9%	
New Mexico Health Region			
Region 1	327	15.4%	
Region 2	182	16.5%	
Region 3	151	15.1%	0.8009
Region 4	150	14.0%	
Region 5	181	14.3%	
Season of Survey			
Winter	229	14.5%	
Spring	237	14.8%	0.7181
Summer	254	14.5%	
Fall	273	16.3%	
Adults in Household			
1-2	872	15.3%	0.5761
3+	121	14.3%	
Children in Household			
0	677	15.6%	
1	128	13.8%	0.6075
2+	187	14.7%	
Race/Ethnicity			
American Indian or Alaska Native	77	13.9%	
Asian or Pacific Islander	**	**	
Black or African American	**	**	0.0325
Hispanic	304	13.5%	
White	591	16.3%	
Metro Status Code			
Central City of MSA	324	14.7%	
County with MSA	105	14.6%	
Suburban County	136	15.7%	0.9022
Not in an MSA	428	15.5%	

** Cell counts less than 20 are supressed

Note: Percentages may not add up to 100% due to rounding

Table 5: AGI Incidence Within Past 30 Days By Health Indicators

Variables	Unweighted N	Weighted Row %	P-Value
General Health			
Excellent	108	10.3%	
Very Good	254	12.7%	
Good	363	17.0%	<.0001
Fair	168	17.8%	
Poor	100	28.4%	
High Blood Pressure			
Yes	353	16.7%	0.0791
No	636	14.4%	
Asthma			
Yes	164	16.7%	0.2608
No	828	14.8%	
Coronary Heart Disease			
Yes	65	23.1%	0.0031
No	916	14.7%	
Heart Attack			
Yes	66	19.7%	0.0647
No	916	14.8%	
Stroke			
Yes	41	20.3%	0.1008
No	947	14.9%	
Diabetes			
Yes	115	19.3%	
Yes, but only when pregnant	**	**	0.0263
No	850	14.7%	
No, but pre-diabetic	20	19.7%	
Pregnant			
Yes	**	**	0.0752
No	179	13.6%	
High Cholesterol			
Yes	340	16.2%	0.3985
No	448	15.0%	
Arthritis			
Yes	455	20.9%	<.0001
No	537	12.8%	
BMI Category			
Underweight	**	**	
Normal	308	13.1%	0.0035
Overweight	320	14.7%	
Obese	351	18.4%	
Heath Care Coverage			
Yes	569	15.9%	0.2749
No	186	14.1%	
Drink Any Alcohol			
Yes	489	16.5%	0.02
No	502	13.6%	
Current Smoker			
Yes	258	20.0%	<.0001
No	731	13.7%	

** Cell counts less than 20 are supressed

Note: Percentages may not add up to 100% due to rounding

Table 6: AGI Incidence According to Water Source, Filtration and Consumption

	Total		AGI +		
	Unweighted		Unweighted	Weighted	
Variables	**N**	**%**	**N**	**Row %**	**P-Value**
Primary Water Source					
Public	3,321	55.2%	540	15.7%	
Well	1,142	18.1%	176	12.9%	0.1927
Commercial	1,500	26.7%	246	16.3%	
Water Filter					
Yes	2,408	42.8%	396	15.6%	0.8781
No	3,553	57.2%	569	15.4%	
Water Consumption					
0-4 cups/day	2,081	37.2%	362	15.2%	0.7764
5+ cups/day	3,882	62.8%	600	15.6%	
Filtered by Source					
Public, filtered	1,401	24.0%	229	15.6%	
Public, unfiltered	1,905	31.4%	311	15.8%	
Well, filtered	465	8.3%	71	12.7%	0.594
Well, unfiltered	670	9.8%	105	13.3%	
Commercial, filtered	530	10.6%	93	17.2%	
Commercial, unfiltered	952	16.0%	151	16.0%	
Water Consumption by Source					
Public, 0-4 cups	856	15.5%	151	15.5%	
Public 5+ cups	2452	39.8%	387	15.7%	
Well, 0-4 cups	278	5.0%	46	13.5%	0.4787
Well 5+ cups	856	13.1%	130	12.8%	
Commerical, 0-4 cups	938	16.8%	163	15.2%	
Commercial 5+ cups	545	9.8%	80	18.3%	
Water Consumption by Filtration					
0-4 cups, filtered	747	14.6%	125	15.1%	
0-4 cups, unfiltered	1,318	22.6%	236	15.4%	0.979
5+ cups, filtered	1,653	28.2%	270	15.9%	
5+ cups, unfiltered	2,205	34.5%	329	15.4%	

Note: Percentages may not add up to 100% due to rounding

Table 7: Unadjusted and Adjusted Model Odds by Primary Water Source, Demographic Characteristics, and Health Status Indicators

Variables	Unadjusted Model n = 5937			Demographics Model n = 5921			Health Status Indicators n = 5906			Combined Model n = 5906		
	OR	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**	
Primary Water Source												
Public	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Well	0.80	0.63	1.02	0.80	0.63	1.03	0.83	0.65	1.06	0.83	0.65	1.06
Commercial	1.05	0.82	1.34	1.06	0.83	1.35	1.09	0.85	1.41	1.11	0.86	1.42
Age (years)												
18-24				Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
25-44				2.21	1.22	4.01	1.98	1.07	3.68	2.03	1.10	3.75
45-64				2.07	1.15	3.71	1.59	0.87	2.94	1.62	0.89	2.95
65+				1.63	0.89	2.99	1.18	0.63	2.23	1.16	0.62	2.16
Marital Status												
Never Married				1.10	0.79	1.54						
Married or Living together				Ref.	Ref.	Ref.						
Seperated or Divorced				1.40	1.10	1.78						
Widowed				0.96	0.69	1.33						
Arthritis												
No							Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes							1.84	1.50	2.25	1.90	1.55	2.33
BMI Category												
Underweight							0.71	0.33	1.52			
Normal							Ref.	Ref.	Ref.			
Overweight							1.06	0.82	1.37			
Obese							1.30	1.02	1.67			
Current Smoker												
No							Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes							1.63	1.29	2.06	1.61	1.28	2.03

Ref. = Reference Variable

Table 8: Unadjusted and Adjusted Model Odds of Seeking Medical Attention for AGI by Primary Water Source, Demographic Characteristics, and Health Status Indicators

Variables	Unadjusted Model n = 5937			Demographics Model n = 5358			Health Status Indicators n = 5887			Combined Model n = 5307		
	OR	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**	
Primary Water Source												
Public	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Well	0.74	0.36	1.52	0.83	0.39	1.76	0.72	0.339	1.52	0.85	0.41	1.80
Commercial	0.84	0.49	1.44	0.81	0.45	1.46	1.005	0.58	1.74	0.97	0.54	1.74
Household Income												
Less than $20,000				1.09	0.44	2.73				0.99	0.41	2.38
$20,000 - $35,000				0.43	0.17	1.12				0.41	0.16	1.03
$35,000 - $50,000				Ref.	Ref.	Ref.				Ref.	Ref.	Ref.
$50,000 - $75,000				0.61	0.21	1.75				0.63	0.23	1.77
$75,000 or more				0.20	0.07	0.58				0.22	0.08	0.61
Heart Attack												
No							Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes							2.71	1.32	5.57	3.07	1.50	6.30
Arthritis												
No							Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes							5.41	3.16	9.28	6.34	3.27	12.31
Hypertension												
No										Ref.	Ref.	Ref.
Yes										1.49	0.70	3.16
Age (years)												
18-24										Ref.	Ref.	Ref.
25-44										3.01	0.60	15.28
45-64										1.32	0.26	6.57
65+										0.91	0.17	4.98

Ref. = Reference Variable

Appendix

Appendix A: New Mexico Environment Department Well Test Form

New Mexico Environment Department Well Test Form

1-800-219-6157, www.nmenv.state.nm.us

Well Information (use ball-point pen, and PRESS HARD)

Name		Phone
Mailing Address		
E-Mail Address		
Well Owner/Location (if different from above)		
Well depth _____ feet	Depth to water _____ feet	Casing material ☐ Steel ☐ PVC
Concrete pad around well? ☐ Yes ☐ No	Well cap or sanitary seal? ☐ Yes ☐ No	
Distance to nearest septic system leach field _____ feet	Lot size _____ acres	
Age of well _____ years	Name of well driller	
Well used as source of drinking water? ☐ Yes ☐ No		
Suspected water-quality problems? ☐ Yes ☐ No Describe		
Water filter or treatment? ☐ Yes ☐ No Describe		
Additional Information		

GPS Information (use decimal degrees for latitude and longitude)

	Latitude	Longitude	Elevation (feet)
Well			
Septic System			

Test Results

Parameter	***Recommended Values***
pH (units)	Between 6.5 and 8.5
Temperature (°C)	
Specific Conductance (uS/cm @ 25°C)	Less than 1000 uS/cm
Dissolved Oxygen (mg/L)	
Organic Vapor ☐ Not detected ☐ Detected _____ ppm	Not detectable
Fluoride (mg/L)	Less than 2.0 mg/L
Iron (mg/L)	Less than 0.3 mg/L
Sulfate (mg/L)	Less than 250 mg/L
Nitrate (mg/L as Nitrogen)	Less than 10 mg/L
Comments	
Test Date / Testing Supervisor	

See the back of this form for additional information on test results.

Notice - The tests performed by NMED are only for those chemicals or characteristics listed on this form. The tests are not a substitute for a complete laboratory analysis, nor do they include tests for bacteria or other organisms. In addition, if a dirty sample container was used, or if the sample was collected more than 24 hours prior to analysis, the test results may be inaccurate. If you have any questions, please ask an NMED representative.

Explanation of Test Parameters

pH - The pH indicates whether water is basic, neutral or acidic. It is a measure of hydrogen ion activity in water, on a scale from 0 to 14. A pH value equal to 7 is neutral. A value above 7 is basic or alkaline, and a value below 7 is acidic. The pH of water is important because high or low pH can cause aesthetic problems, and can cause toxic metals to leach from plumbing materials. **NMED recommends a pH between 6.5 and 8.5 for drinking water.**

Specific Conductance – Conductivity is a measure of how water can conduct an electrical current, and increases with total dissolved solids (TDS), electrolytes, ions, or salts. High TDS can impart an unpleasant taste and odor to water, and can cause mineral deposits on plumbing fixtures. In many areas of New Mexico, where calcium is the predominant cation, TDS is proportional to water hardness. Specific conductance is conductivity at room temperature (25°C). Specific conductance can be multiplied by 0.7 to estimate TDS. **NMED recommends a maximum specific conductance of 1,000 microSiemens per centimeter (uS/cm) for drinking water to prevent aesthetic nuisances.**

Dissolved Oxygen – Dissolved oxygen (DO) is an important parameter for ground water geochemistry. Low DO can indicate anoxic conditions (discussed below). No standards have been set for DO in drinking water.

Organic Vapor - The detection of organic vapor may indicate that your water contains gasoline, cleaning solvents, or other volatile organic chemicals. It may also indicate the presence of harmless methane gas that can occur in anoxic water (explained below). There are health standards for some volatile organic chemicals, including trichloroethylene, benzene, toluene, and xylene. **NMED recommends that organic vapor be not detectable in drinking water.** If organic vapor other than methane is detected in your water, further sampling will be conducted by the NMED.

Fluoride - Fluoride is a naturally occurring element that is commonly found in ground water. Fluroide in drinking water can be assimilated into the bones and teeth. High fluoride in drinking water can cause dental fluorosis (mottling of the teeth), and skeletal fluorosis (weakening of the bones). **NMED recommends a maximum fluoride concentration of 2 milligrams per liter (mg/L) in drinking water to prevent dental and skeletal fluorosis.**

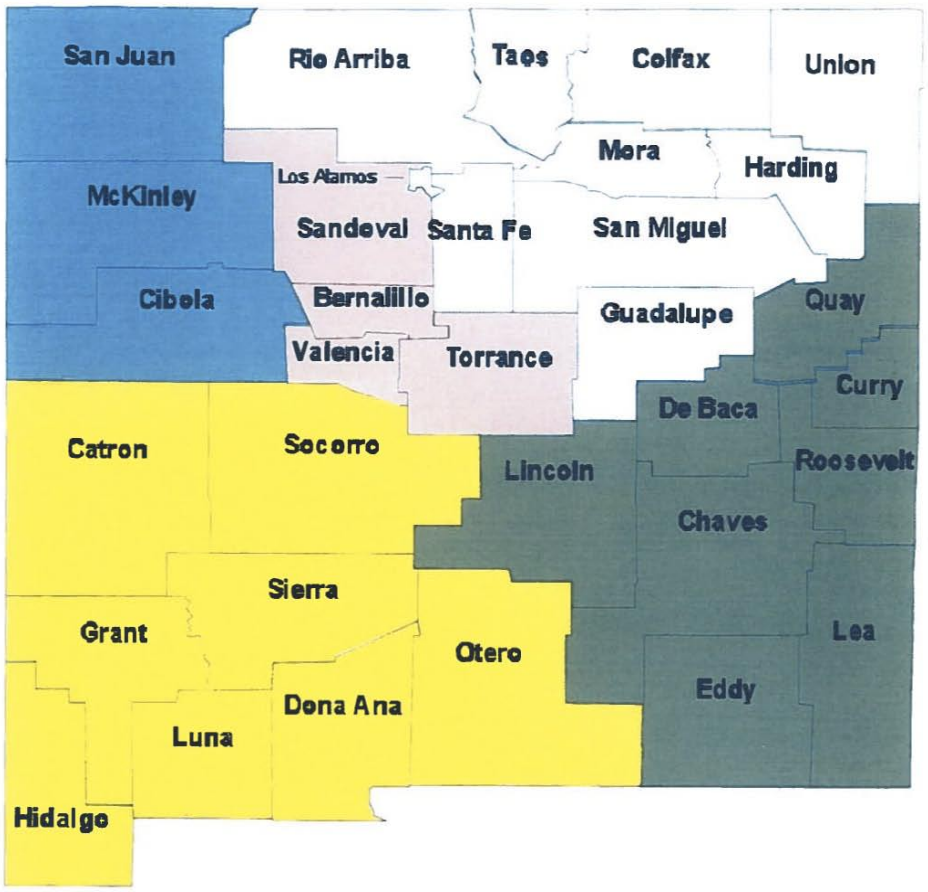
Iron and Anoxic Contamination (iron, manganese, hydrogen sulfide, methane) - Anoxic contamination is a chemical condition in which the water is deficient in oxygen. It can be caused by septic tank discharges or by naturally occurring geologic deposits such as humus and peat. Iron, manganese, hydrogen sulfide, and methane, typical anoxic contaminants, can cause severe taste and odor problems. Anoxic water often has a sulfurous "rotten egg" odor and a metallic taste. If the water is agitated, such as in a washing machine, sink, tub or toilet, it becomes oxygenated, and the iron and manganese can precipitate as oxides. These oxides range in color from black, gray and brown to red, orange and yellow, and can appear as small particles in the water or can cause stains on laundry and porcelain. The federal aesthetic standard for iron in drinking water is 0.3 milligrams per liter (mg/l). Manganese in drinking water may be a neurotoxin, and the federal drinking water health advisory is set at 0.3 mg/L. **NMED recommends a maximum iron concentration of 0.3 milligrams per liter (mg/L) to prevent aesthetic nuisances, and a maximum manganese concentration of 0.3 milligrams per liter (mg/L) to prevent neurotoxicity.**

Sulfate - Sulfate is a compound of sulfur and oxygen that is commonly found in natural ground water. Sulfate can give an unpleasant taste to drinking water and can cause diarrhea. **NMED recommends a maximum sulfate concentration of 250 milligrams per liter (mg/l) for drinking water.**

Nitrate - Nitrate is a compound of nitrogen and oxygen. There are many possible sources of nitrate contamination including fertilizer, animal waste, septic tanks, refuse dumps, and natural geologic deposits. High concentrations of nitrate in drinking water can cause the "blue baby syndrome" a rare, but potentially serious, disease in infants less than six months old. There also is concern that nitrate may be associated with certain cancers in adults. **State and federal health standards for nitrate are set at 10 milligrams per liter (mg/l) nitrate as nitrogen (N).**

Appendix B: New Mexico Public Health Regions (2005-2012)

New Mexico Health Regions



Northwest Region: San Juan, McKinley, Cibola
Northeast Region: Rio Arriba, Taos, Colfax, Union, Los Alamos, Santa Fe, Mora, San Miguel, Guadalupe, Harding
Metro Region: Bernalillo, Sandoval, Torrance, Valencia
Southeast Region: Quay, DeBaca, Curry, Lincoln, Roosevelt, Chaves, Eddy, Lea
Southwest Region: Catron, Socorro, Grant, Sierra, Hidalgo, Luna, Dona Ana, Otero

Revised July 26, 2012

Appendix C: New Mexico BRFSS Survey, 2007

NEW MEXICO 2007 BRFSS

Behavioral Risk Factor Surveillance System

2007 Questionnaire VERSION 10, 3.13.07

INTERVIEWER'S SCRIPT:

HELLO, I am calling for the New Mexico Department of Health. My name is **(name)**. We are gathering information about the health of New Mexico residents. This project is conducted by the health department with assistance from the Centers for Disease Control and Prevention. Your telephone number has been chosen randomly, and I would like to ask some questions about health and health practices.

Is this **(phone number)** ?

If "no,"
Thank you very much, but I seem to have dialed the wrong number. It's possible that your number may be called at a later time. **STOP**

Is this a private residence?

If "no,"
Thank you very much, but we are only interviewing private residences. **STOP**

Is this a cellular telephone?

Read only if necessary: "By cellular telephone we mean a telephone that is mobile and usable outside of your neighborhood".

If "yes,"

Thank you very much, but we are only interviewing land line telephones and private residences. **STOP**

I need to randomly select one adult who lives in your household to be interviewed. How many members of your household, including yourself, are 18 years of age or older?

__ Number of adults

If "1,"
Are you the adult?

If "yes,"
Then you are the person I need to speak with. Enter 1 man or 1 woman below (Ask gender if necessary). **Go to page 5.**

If "no,"
Is the adult a man or a woman? Enter 1 man or 1 woman below. May I speak with **[fill in (him/her) from previous question]**? **Go to "correct respondent" on the next page.**

How many of these adults are men and how many are women?

__ Number of men

__ Number of women

The person in your household that I need to speak with is _____.

If "you," go to page 4

TO THE CORRECT RESPONDENT:

HELLO, I am calling for the New Mexico Department of Health. My name is **(name)**. We are gathering information about the health of New Mexico residents. This project is conducted by the health department with assistance from the Centers for Disease Control and Prevention. Your telephone number has been chosen randomly, and I would like to ask some questions about health and health practices.

CORE SECTIONS

I will not ask for your last name, address, or other personal information that can identify you. You do not have to answer any question you do not want to, and you can end the interview at any time. Any information you give me will be confidential. If you have any questions, I will provide a telephone number for you to call to get more information.

SECTION 1: HEALTH STATUS

1.1 Would you say that in general your health is . . . (73)

Please read:

1 Excellent
2 Very good
3 Good
4 Fair
5 Poor

Do not read:

7 Don't know / Not sure
9 Refused

SECTION 2: HEALTHY DAYS — HEALTH-RELATED QUALITY OF LIFE

2.1 Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?

(74–75)

_ _ Number of days
8 8 None
7 7 Don't know / Not sure
9 9 Refused

2.2 Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?

(76–77)

_ _ Number of days
8 8 None **[If Q2.1 and Q2.2 = 88 (None), go to next section]**
7 7 Don't know / Not sure
9 9 Refused

2.3 During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?

CATI: THE RESPONSE FOR 2.3 CANNOT BE GREATER THAN THE TOTAL OF 2.1 + 2.2. ADD A CHECK FOR THIS SEE BRFSS 2006

(78-79)

_ _ Number of days
8 8 None
7 7 Don't know / Not sure
9 9 Refused

SECTION 3: HEALTH CARE ACCESS

3.1 Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare?

(80)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

3.2 Do you have one person you think of as your personal doctor or health care provider?

If "No," ask: "Is there more than one, or is there no person who you think of as your personal doctor or health care provider?"

(81)

1 Yes, only one
2 More than one
3 No
7 Don't know / Not sure
9 Refused

3.3 Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?

(82)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

3.4 About how long has it been since you last visited a doctor for a routine checkup? A routine checkup is a general physical exam, not an exam for a specific injury, illness, or condition.

(83)

1 Within past year (anytime less than 12 months ago)
2 Within past 2 years (1 year but less than 2 years ago)
3 Within past 5 years (2 years but less than 5 years ago)
4 5 or more years ago
7 Don't know / Not sure
8 Never
9 Refused

SECTION 4: EXERCISE

4.1 During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?

(84)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

SECTION 5: DIABETES

5.1 Have you ever been told by a doctor that you have diabetes?

If "Yes" and respondent is female, ask: "Was this only when you were pregnant?"

If respondent says pre-diabetes or borderline diabetes, use response code 4.

(85)

1 Yes ***Go to M3 Diabetes***
2 Yes, but female told only during pregnancy ***Go to Section 6***
3 No ***Go to Section 6***
4 No, pre-diabetes or borderline diabetes ***Go to Section 6***
7 Don't know / Not sure ***Go to Section 6***
9 Refused ***Go to Section 6***

MODULE 3: DIABETES

To be asked following Core Q5.1; if response is "Yes" (code = 1)

1. How old were you when you were told you have diabetes?

(244-245)

_ _ Code age in years **[97 = 97 and older]**
9 8 Don't know / Not sure
9 9 Refused

2. Are you now taking insulin?

(246)

1 Yes
2 No
9 Refused

3. Are you now taking diabetes pills?

(247)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

4. About how often do you check your blood for glucose or sugar? Include times when checked by a family member or friend, but do NOT include times when checked by a health professional.

(248-250)

1 _ _ Times per day
2 _ _ Times per week
3 _ _ Times per month
4 _ _ Times per year
8 8 8 Never
7 7 7 Don't know / Not sure
9 9 9 Refused

5. About how often do you check your feet for any sores or irritations? Include times when checked by a family member or friend, but do NOT include times when checked by a health professional. (251-253)

1 _ _ Times per day
2 _ _ Times per week
3 _ _ Times per month
4 _ _ Times per year
5 5 5 No feet
8 8 8 Never
7 7 7 Don't know / Not sure
9 9 9 Refused

6. Have you ever had any sores or irritations on your feet that took more than four weeks to heal?

(254)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

7. About how many times in the past 12 months have you seen a doctor, nurse, or other health professional for your diabetes?

(255-256)

_ _ Number of times **[76 = 76 or more]**
8 8 None
7 7 Don't know / Not sure
9 9 Refused

8. A test for "A one C" measures the average level of blood sugar over the past three months. About how many times in the past 12 months has a doctor, nurse, or other health professional checked you for "A one C"?

(257-258)

_ _ Number of times **[76 = 76 or more]**
8 8 None
9 8 Never heard of "A one C" test
7 7 Don't know / Not sure
9 9 Refused

CATI Note: If Q5 = 555 (No feet), go to Q10.

9. About how many times in the past 12 months has a health professional checked your feet for any sores or irritations? (259-260)

_ _ Number of times **[76 = 76 or more]**

8 8 None
7 7 Don’t know / Not sure
9 9 Refused

10. When was the last time you had an eye exam in which the pupils were dilated? This would have made you temporarily sensitive to bright light.
(261)

Read only if necessary:

1 Within the past month (anytime less than 1 month ago)
2 Within the past year (1 month but less than 12 months ago)
3 Within the past 2 years (1 year but less than 2 years ago)
4 2 or more years ago

Do not read:

7 Don’t know / Not sure
8 Never
9 Refused

11. Has a doctor EVER told you that diabetes has affected your eyes or that you had retinopathy?

(262)

1 Yes
2 No
7 Don’t know / Not sure
9 Refused

12. Have you EVER taken a course or class in how to manage your diabetes yourself?

(263)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

SECTION 6: HYPERTENSION AWARENESS

6.1 Have you EVER been told by a doctor, nurse, or other health professional that you have

high blood pressure?

(86)

If "Yes" and respondent is female, ask: "Was this only when you were pregnant?"

1	Yes	
2	Yes, but female told only during pregnancy	**[Go to 7.1]**
3	No	**[Go to 7.1]**
4	Told borderline high or pre-hypertensive	**[Go to 7.1]**
7	Don't know / Not sure	**[Go to 7.1]**
9	Refused	**[Go to 7.1]**

6.2 Are you currently taking medicine for your high blood pressure?

(87)

1 Yes

2 No

7 Don't know / Not sure

9 Refused

SECTION 7: CHOLESTEROL AWARENESS

7.1 Blood cholesterol is a fatty substance found in the blood. Have you EVER had your blood cholesterol checked? (88)

1 Yes

2 No **[Go to 8.1]**
7 Don't know / Not sure **[Go to 8.1]**
9 Refused **[Go to 8.1]**

7.2 About how long has it been since you last had your blood cholesterol checked? (89)

Read only if necessary:

1 Within the past year (anytime less than 12 months ago)

2 Within the past 2 years (1 year but less than 2 years ago)

3 Within the past 5 years (2 years but less than 5 years ago)

4 5 or more years ago

Do not read:

7 Don't know / Not sure

9 Refused

7.3 Have you EVER been told by a doctor, nurse or other health professional that your blood cholesterol is high? (90)

1 Yes

2 No

7 Don’t know / Not sure

9 Refused

SECTION 8: CARDIOVASCULAR DISEASE PREVALENCE

Now I would like to ask you some questions about cardiovascular disease.

Has a doctor, nurse, or other health professional EVER told you that you had any of the following? For each, tell me "Yes", "No", or you're "Not sure."

8.1 (Ever told) You had a heart attack, also called a myocardial infarction? (91)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

8.2 (Ever told) You had angina or coronary heart disease? (92)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

8.3 (Ever told) You had a stroke? (93)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

SECTION 9: ASTHMA

9.1 Have you ever been told by a doctor, nurse, or other health professional that you had asthma?

(94)

1 Yes
2 No **[Go to 10.1]**
7 Don't know / Not sure **[Go to 10.1]**
9 Refused **[Go to 10.1]**

9.2 Do you still have asthma?

(95)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

SECTION 10: IMMUNIZATION

10.1 A flu shot is an influenza vaccine injected into your arm. During the past 12 months, have you had a flu shot? (96)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

10.2 During the past 12 months, have you had a flu vaccine that was sprayed in your nose? The flu vaccine sprayed in the nose is also called FluMist™ . (97)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

STATE ADDED MODULE 12: IMMUNIZATION

ASK JANUARY, FEBRUARY, NOVEMBER, DECEMBER 2007 ONLY

CATI note: If Q10.1 or Q10.2 = 1 (Yes), continue; otherwise go to SAM 12.2.

SAM 12.1 During what month and year did you receive your most recent flu vaccination? The most recent flu vaccination may have been either the flu shot or the flu spray. ()

_ _ / _ _ _ _ Month / Year
7 7 / 7 7 7 7 Don't know / Not sure **(Probe: "Was it before September 2006?" Code approximate month and year)**
9 9 / 9 9 9 9 Refused

If SAM12.1 is 09/2006 to 2/28/07 ask SAM 12.2.

If SAM 12.1 is < 09/02006 go to SAM 12.3.

If 10.1 and 10.2 >1 ask SAM12.2 and SAM12.3

If SAM12.1 =77/7777 or 99/9999 ask SAM12.2 and SAM12.3

SAM 12.2 Did you get a flu vaccination during the 'last flu season' in other words during the months of September 2005 through March 2006? ()

1 Yes

2 No

7 Don't know/Not sure

9 Refused

SAM 12.3 What is the MAIN reason you have NOT received a flu vaccination for this current flu season?

()

INTERVIEWER NOTE: The current flu season = Sept. '06 – Mar .'07.

Do <u>not</u> read answer choices below. Select category that best matches response.

0 1 Need: Do not think need it / not recommended
0 2 Concern about vaccine: side effects / can cause flu / does not work
0 3 Access / cost / inconvenience
0 4 Vaccine shortage: saving vaccine for people who need it more
0 5 Vaccine shortage: tried to find vaccine, but could not get it
0 6 Vaccine shortage: not eligible to receive vaccine
0 7 Some other reason
7 7 Don't know / Not sure **(Probe: "What was the <u>main</u> reason?")**
9 9 Refused

SAM 12.4 Has a doctor, nurse, or other health professional ever said that you have any of the following health problems?

()

<u>Read each problem listed below</u>:

- Lung problems, including asthma
- Heart problems
- Diabetes
- Kidney problems
- Weakened immune system caused by a chronic illness, such as cancer or HIV/AIDS, or medicines, such as steroids
- Sickle Cell Anemia or other anemia

1	Yes	
2	No	**[Go to SAM 12.6]**
7	Don't know / Not sure	**[Go to SAM 12.6]**
9	Refused	**[Go to SAM 12.6]**

SAM 12.5 Do you still have (this/any of these) problem(s)?

()

1	Yes
2	No
7	Don't know / Not sure
9	Refused

SAM 12.6 Do you currently work in a health care facility, such as a medical clinic, hospital, or nursing home? This includes part-time and volunteer work. ()

1	Yes	
2	No	**[Go to Q10.3]**
7	Don't know / Not sure	**[Go to Q10.3]**
9	Refused	**[Go to Q10.3]**

SAM 12.7 Do you have direct face-to-face or hands-on contact with patients as a part of your routine work? ()

1 Yes
2 No
7 Don't know / Not sure
9 Refused

SECTION 10: IMMUNIZATION CONTINUED

10.3 A pneumonia shot or pneumococcal vaccine is usually given only once or twice in a person's lifetime and is different from the flu shot. Have you ever had a pneumonia shot?

(98)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

10.4 Have you EVER received the hepatitis B vaccine? The hepatitis B vaccine is completed after the third shot is given. (99)

INTERVIEWER NOTE: Response is "Yes" only if respondent has received the entire series of three shots.

1 Yes
2 No
7 Don't know / Not sure
9 Refused

The next question is about behaviors related to Hepatitis B.

10.5 Please tell me if ANY of these statements is true for YOU. Do NOT tell me WHICH statement or statements are true for you, just if ANY of them are:

- You have hemophilia and have received clotting factor concentrate
- You have had sex with a man who has had sex with other men, even just one time
- You have taken street drugs by needle, even just one time
- You traded sex for money or drugs, even just one time
- You have tested positive for HIV
- You have had sex (even just one time) with someone who would answer "yes" to any of these statements
- You had more than two sex partners in the past year

Are any of these statements true for you? (100)

1 Yes, at least one statement is true

2 No, none of these statements is true
7 Don’t know / Not sure
9 Refused

SECTION 11: TOBACCO USE

11.1 Have you smoked at least 100 cigarettes in your entire life?

(101)

NOTE: 5 packs = 100 cigarettes

1 Yes
2 No **[Go to 12.1]**
7 Don't know / Not sure **[Go to 12.1]**
9 Refused **[Go to 12.1]**

11.2 Do you now smoke cigarettes every day, some days, or not at all?

(102)

1 Every day
2 Some days
3 Not at all **[Go to 12.1]**
7 Don't know/Not sure **[Go to 12.1]**
9 Refused **[Go to 12.1]**

11.3 During the past 12 months, have you stopped smoking for one day or longer because you were trying to quit smoking?

(103)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

SECTION 12: DEMOGRAPHICS

12.1 What is your age? (104-105)

_ _ Code age in years
0 7 Don't know / Not sure
0 9 Refused

12.2 Are you Hispanic or Latino? (106)

1 Yes ***(Ask 12.3 White Hispanic etc.)***
2 No
7 Don't know / Not sure
9 Refused

12.3 Which one or more of the following would you say is your race? (107-112)

(Check all that apply)

Please read:

1 White
2 Black or African American
3 Asian
4 Native Hawaiian or Other Pacific Islander
5 American Indian or Alaska Native ***(If only response go to SAM 1.1)***
6 Other [specify]_____ (SAM ???-???)

Do not read:

8 No additional choices
7 Don't know / Not sure
9 Refused

CATI note: If more than one response to Q12.3; continue. Otherwise, go to Q12.5.

12.4 Which one of these groups would you say best represents your race? (113)

1 White
2 Black or African American
3 Asian
4 Native Hawaiian or Other Pacific Islander
5 American Indian or Alaska Native ***(Go to SAM 1.1)***

6 Other [specify] _____ (SAM ???-???)

Do not read:

7 Don't know / Not sure
9 Refused

STATE ADDED MODULE 1: TRIBAL AFFILIATION

SAM 1. 1 What is your main tribe? (SAM ???)

Guidance: What is your tribal affiliation or tribal enrollment?

1. Apache (Jicarilla / Mescalero)
2. Navajo/Dine
3. Pueblo (Any of the 19 NM Pueblos)
4. Other, specify _____ (SAM ???-???)
7. Don't know/Not sure
9. Refused

12.5 Have you ever served on active duty in the United States Armed Forces, either in the regular military or in a National Guard or military reserve unit? Active duty DOES NOT include training for the Reserves or National Guard, but DOES include activation, FOR EXAMPLE, for the Persian Gulf War. (114)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

12.6 Are you…? (115)

Please read:

1 Married
2 Divorced
3 Widowed
4 Separated
5 Never married
6 A member of an unmarried couple

Do not read:

9 Refused

12.7 How many children less than 18 years of age live in your household? (116-117)

_ _ Number of children
8 8 None
9 9 Refused

12.8 What is the highest grade or year of school you completed? (118)

Read only if necessary:

1 Never attended school or only attended kindergarten
2 Grades 1 through 8 (Elementary)
3 Grades 9 through 11 (Some high school)
4 Grade 12 or GED (High school graduate)
5 College 1 year to 3 years (Some college or technical school)
6 College 4 years or more (College graduate)

Do not read:

9 Refused

12.9 Are you currently…? (119)

Please read:

1 Employed for wages
2 Self-employed
3 Out of work for more than 1 year
4 Out of work for less than 1 year
5 A Homemaker
6 A Student
7 Retired
8 Unable to work

Do not read:

9 Refused

12.10 Is your annual household income from all sources— (120-121)

If respondent refuses at ANY income level, code '99' (Refused)

Read only if necessary:

04 Less than $25,000 **If "no," ask 05; if "yes," ask 03**
($20,000 to less than $25,000)

03 Less than $20,000 **If "no," code 04; if "yes," ask 02**
($15,000 to less than $20,000)

02 Less than $15,000 **If "no," code 03; if "yes," ask 01**
($10,000 to less than $15,000)

01 Less than $10,000 **If "no," code 02**

05 Less than $35,000 **If "no," ask 06**
($25,000 to less than $35,000)

06 Less than $50,000 **If "no," ask 07**
($35,000 to less than $50,000)

07 Less than $75,000 **If "no," code 08**
($50,000 to less than $75,000)

08 $75,000 or more

Do not read:

77 Don't know / Not sure
99 Refused

12.11 About how much do you weigh without shoes?

(122-125)

Note: If respondent answers in metrics, put "9" in column 126.

Round fractions up

_ _ _ _ Weight
(pounds/kilograms)
7 7 7 7 Don't know / Not sure ***SKIP TO Q12.15***
9 9 9 9 Refused

12.12 About how tall are you without shoes?

(126-129)

Note: If respondent answers in metrics, put "9" in column 122.

Round fractions down

_ _ / _ _ Height
(f t / inches/meters/centimeters)
7 7 7 7 Don't know / Not sure
9 9 9 9 Refused

12.13 How much did you weigh a year ago? *[Female respondent: If you were pregnant a year ago, how much did you weigh before your pregnancy?]*

(130-133)

Note: If respondent answers in metrics, put "9" in column 130.

Round fractions up

_ _ _ _ Weight
(pounds/kilograms)
7 7 7 7 Don't know / Not sure
9 9 9 9 Refused

CATI note: Subtract weight one year ago from current weight. If weight is same go to Q12.15. If weight for 12.12 or 12.13 is 7777 or 9999 go to 12.15

12.14 Was the change between your current weight and your weight a year ago intentional?
(134)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

12.15 What county do you live in?
(135-137)

_ _ _ FIPS county code
7 7 7 Don't know / Not sure
9 9 9 Refused

12.16 What is your ZIP Code where you live?
(138-142)

_ _ _ _ _ ZIP Code
7 7 7 7 7 Don't know / Not sure
9 9 9 9 9 Refused

12.17 Do you have more than one telephone number in your household? Do not include cell phones or numbers that are only used by a computer or fax machine.
(143)

1 Yes
2 No **[Go to Q12.19]**
7 Don't know / Not sure **[Go to Q12.19]**
9 Refused **[Go to Q12.19]**

12.18 How many of these telephone numbers are residential numbers?
(144)

_ Residential telephone numbers **[6 = 6 or more]**
7 Don't know / Not sure
9 Refused

12.19 During the past 12 months, has your household been without telephone service for 1 week or more? Do not include interruptions of telephone service because of weather or natural disasters.

(145)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

12.20 Indicate sex of respondent. **Ask only if necessary.**

(146)

1 Male **[Go to next section]**
2 Female **[If respondent is 45 years old or older, go to Q13.1]**

12.21 To your knowledge, are you now pregnant?

(147)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

SECTION 13: ALCOHOL CONSUMPTION

13.1 During the past 30 days, have you had at least one drink of any alcoholic beverage such as beer, wine, a malt beverage or liquor?

(148)

1 Yes
2 No **[Go to 14.1]**
7 Don't know / Not sure **[Go to 14.1]**
9 Refused **[Go to 14.1]**

13.2 During the past 30 days, how many days per week or per month did you have at least one drink of any alcoholic beverage?

(149-151)

1_ _ _ Days per week
2_ _ _ Days in past 30 days
8 8 8 No drinks in past 30 days **[Go to next 14.1]**
7 7 7 Don't know / Not sure
9 9 9 Refused

13.3 One drink is equivalent to a 12-ounce beer, a 5-ounce glass of wine, or a drink with one shot of liquor. During the past 30 days, on the days when you drank, about how many drinks did you drink on the average?

(152-153)

_ _ Number of drinks
7 7 Don't know / Not sure
9 9 Refused

13.4 Considering all types of alcoholic beverages, how many times during the past 30 days did you have **X [CATI X = 5 for men, X = 4 for women]** or more drinks on an occasion?

(154-155)

_ _ Number of times
8 8 None
7 7 Don't know / Not sure
9 9 Refused

13.5 During the past 30 days, what is the largest number of drinks you had on any occasion?

(156-157)

_ _	Number of drinks
7 7	Don't know / Not sure
9 9	Refused

SECTION 14: DISABILITY

The following questions are about health problems or impairments you may have.

14.1 Are you limited in any way in any activities because of physical, mental, or emotional problems?

(158)

1 Yes
2 No
7 Don't know / Not Sure
9 Refused

14.2 Do you now have any health problem that requires you to use special equipment, such as a cane, a wheelchair, a special bed, or a special telephone?

(159)

Include occasional use or use in certain circumstances.

1 Yes
2 No
7 Don't know / Not Sure
9 Refused

SECTION 15: ARTHRITIS BURDEN

The next questions refer to the joints in your body. Please do **NOT** include the back or neck.

15.1 During the past 30 days, have you had symptoms of pain, aching, or stiffness in or around a joint?

(160)

1 Yes
2 No **[Go to Q15.4]**
7 Don't know / Not sure **[Go to Q15.4]**
9 Refused **[Go to Q15.4]**

15.2 Did your joint symptoms first begin more than 3 months ago?

(161)

1 Yes
2 No **[Go to Q15.4]**
7 Don't know / Not sure **[Go to Q15.4]**
9 Refused **[Go to Q15.4]**

15.3 Have you ever seen a doctor or other health professional for these joint symptoms?

(162)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

15.4 Have you ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?

(163)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

INTERVIEWER NOTE: Arthritis diagnoses include:

- **rheumatism, polymyalgia rheumatica**
- **osteoarthritis (not osteoporosis)**
- **tendonitis, bursitis, bunion, tennis elbow**
- **carpal tunnel syndrome, tarsal tunnel syndrome**
- **joint infection, Reiter's syndrome**
- **ankylosing spondylitis; spondylosis**
- **rotator cuff syndrome**

- **connective tissue disease, scleroderma, polymyositis, Raynaud's syndrome**
- **vasculitis (giant cell arteritis, Henoch-Schonlein purpura, Wegener's granulomatosis, polyarteritis nodosa)**

CATI Note: If either Q15.2 = 1 (Yes) or Q.15.4 = 1 (Yes); continue. Otherwise, go to 16.1.

15.5 Are you now limited in any way in any of your usual activities because of arthritis or joint symptoms?

(164)

1 Yes

2 No

7 Don't know / Not sure

9 Refused

INTERVIEWER NOTE: If a respondent question arises about medication, then the interviewer should reply: "*Please answer the question based on how you are when you are taking any of the medications or treatments you might use*."

SECTION 16: FRUITS AND VEGETABLES

These next questions are about the foods you usually eat or drink. Please tell me how often you eat or drink each one, for example, twice a week, three times a month, and so forth. Remember, I am only interested in the foods **you** eat. Include all foods *you* eat, both at home and away from home.

16.1 How often do you drink fruit juices such as orange, grapefruit, or tomato?

(165-167)

1 _ _ Per day
2 _ _ Per week
3 _ _ Per month
4 _ _ Per year
5 5 5 Never
7 7 7 Don't know / Not sure
9 9 9 Refused

16.2 Not counting juice, how often do you eat fruit?

(168-170)

1 _ _ Per day
2 _ _ Per week
3 _ _ Per month
4 _ _ Per year
5 5 5 Never
7 7 7 Don't know / Not sure
9 9 9 Refused

16.3 How often do you eat green salad?

(171-173)

1 _ _ Per day
2 _ _ Per week
3 _ _ Per month
4 _ _ Per year
5 5 5 Never
7 7 7 Don't know / Not sure
9 9 9 Refused

16.4 How often do you eat potatoes not including French fries, fried potatoes, or potato chips?

(174-176)

1 _ _ Per day
2 _ _ Per week

3 _ _ Per month
4 _ _ Per year
5 5 5 Never
7 7 7 Don’t know / Not sure
9 9 9 Refused

16.5 How often do you eat carrots?

(177-179)

1 _ _ Per day
2 _ _ Per week
3 _ _ Per month
4 _ _ Per year
5 5 5 Never
7 7 7 Don't know / Not sure
9 9 9 Refused

16.6 Not counting carrots, potatoes, or salad, how many servings of vegetables do you usually eat? (Example: A serving of vegetables at both lunch and dinner would be two servings.)

(180-182)

1 _ _ Per day
2 _ _ Per week
3 _ _ Per month
4 _ _ Per year
5 5 5 Never
7 7 7 Don't know / Not sure
9 9 9 Refused

SECTION 17: PHYSICAL ACTIVITY

CATI note: If Core Q12.9 = 1 (employed for wages) or 2 (self-employed) then continue. Otherwise, Go to Q17.2.

17.1 When you are at work, which of the following best describes what you do? Would you say—

(183)

If respondent has multiple jobs, include all jobs.

Please read:

1 Mostly sitting or standing
2 Mostly walking
3 Mostly heavy labor or physically demanding work

Do not read:

7 Don't know / Not sure
9 Refused

Please read:

We are interested in two types of physical activity - vigorous and moderate. Vigorous activities cause large increases in breathing or heart rate while moderate activities cause small increases in breathing or heart rate.

17.2 Now, thinking about the moderate activities you do **[fill in "when you are not working" if "employed" or self-employed"]** in a usual week, do you do moderate activities for at least 10 minutes at a time, such as brisk walking, bicycling, vacuuming, gardening, or anything else that causes some increase in breathing or heart rate?

(184)

1 Yes
2 No **[Go to Q17.5]**
7 Don't know / Not sure **[Go to Q17.5]**
9 Refused **[Go to Q17.5]**

17.3 How many days per week do you do these moderate activities for at least 10 minutes at a time?

(185-186)

_ _ Days per week
8 8 Do not do any moderate physical activity for at least 10 minutes at a time? **[Go to Q17.5]**

7 7 Don't know / Not sure **[Go to Q17.5]**
9 9 Refused **[Go to Q17.5]**

17.4 On days when you do moderate activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities?

(187-189)

_:_ _ Hours and minutes per day
7 7 7 Don't know / Not sure
9 9 9 Refused

17.5 Now, thinking about the vigorous activities you do **[fill in "when you are not working" if "employed" or "self-employed"]** in a usual week, do you do vigorous activities for at least 10 minutes at a time, such as running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate?

(190)

1 Yes
2 No **[Go to 18.1]**
7 Don't know / Not sure **[Go to 18.1]**
9 Refused **[Go to 18.1]**

17.6 How many days per week do you do these vigorous activities for at least 10 minutes at a time?

(191-192)

_ _ Days per week
8 8 Do not do any vigorous physical activity for at least 10 minutes at a time **[Go to 18.1]**
7 7 Don't know / Not sure **[Go to 18.1]**
9 9 Refused **[Go to 18.1]**

17.7 On days when you do vigorous activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities?

(193-195)

_:_ _ Hours and minutes per day
7 7 7 Don't know / Not sure
9 9 9 Refused

SECTION 18: HIV/AIDS

CATI note: If respondent is 65 years old or older, go to 19.1.

The next few questions are about the national health problem of HIV, the virus that causes AIDS. Please remember that your answers are strictly confidential and that you don't have to answer every question if you do not want to. Although we will ask you about testing, we will not ask you about the results of any test you may have had.

18.1 Have you ever been tested for HIV? Do not count tests you may have had as part of a blood donation. Include testing fluid from your mouth. (196)

1	Yes	
2	No	**[Go to 19.1]**
7	Don't know / Not Sure	**[Go to 19.1]**
9	Refused	**[Go to 19.1]**

18.2 Not including blood donations, in what month and year was your last HIV test? (197-202)

NOTE: If response is before January 1985, code "Don't know."

CATI INSTRUCTION: If the respondent remembers the year but cannot remember the month, code the first two digits 77 and the last four digits for the year.

_ _ /_ _ _ _	Code month and year
7 7/ 7 7 7 7	Don't know / Not sure
9 9/ 9 9 9 9	Refused

18.3 Where did you have your last HIV test — at a private doctor or HMO office, at a counseling and testing site, at a hospital, at a clinic, in a jail or prison, at a drug treatment facility, at home, or somewhere else? (203-204)

0 1	Private doctor or HMO office
0 2	Counseling and testing site
0 3	Hospital
0 4	Clinic
0 5	Jail or prison (or other correctional facility)
0 6	Drug treatment facility
0 7	At home
0 8	Somewhere else
7 7	Don't know/Not sure
9 9	Refused

CATI note: Ask Q.18.4; if Q.18.2 = within last 12 months. If 18.2 more than 12 months ago, go to 19.1.

18.4 Was it a rapid test where you could get your results within a couple of hours? (205)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

SECTION 19: EMOTIONAL SUPPORT AND LIFE SATISFACTION

The next two questions are about emotional support and your satisfaction with life.

19.1 How often do you get the social and emotional support you need?

INTERVIEWER NOTE: If asked, say "please include support from <u>any</u> source".

(206)

Please read:

1 Always
2 Usually
3 Sometimes
4 Rarely
5 Never

Do not read:

7 Don't know / Not sure
9 Refused

19.2 In general, how satisfied are you with your life?

(207)

Please read:

1 Very satisfied
2 Satisfied
3 Dissatisfied
4 Very dissatisfied

Do not read:

7 Don't know / Not sure
9 Refused

SECTION 20: GASTROINTESTINAL DISEASE

Now I would like to ask you some questions about diarrhea that you may have experienced and about medical care you sought for your diarrheal illness.

20.1 In the past 30 days, did you have diarrhea that began within the 30 day period? Diarrhea is defined as 3 or more loose stools in a 24-hour period.

(208)

1 Yes
2 No **[Go to SAM2.1]**
7 Don't know / Not sure **[Go to SAM21.]**
9 Refused **[Go to SAM2.1]**

20.2 Did you visit a doctor, nurse or other health professional for this diarrheal illness?

Note: Do not answer "Yes" if you just had telephone contact with a health professional.

(209)

1 Yes
2 No **[Go to SAM2.1]**
7 Don't know / Not sure **[Go to SAM2.1]**
9 Refused **[Go to SAM2.1]**

20.3 When you visited your health care professional, did you provide a stool sample for testing?

(210)

1 Yes
2 No
7 Don't know / Not sure
9 Refused

OPTIONAL MODULES

STATE ADDED MODULE: 2 NEURODEVELOPMENTAL PART 1

Now I have questions on some other health topics.

SAM 2.1 Has a doctor or health care professional ever told you that you had Multiple Sclerosis, that is MS?

1 Yes
2 No
7 Don't know / Not sure
9 Refused

MODULE 1: RANDOM CHILD SELECTION

CATI note: If Core Q12.7 = 88, or 99 (no children under age 18 in the household, or refused), go to SAM4.1.

If Core Q12.7 = 1, Interviewer please read: "Previously, you indicated there was one child age 17 or younger in your household. I would like to ask you some questions about that child." [Go to Q1]

If Core Q12.7 is >1 and Core Q12.7 does not equal 88 or 99, Interviewer please read: "Previously, you indicated there were [number] children age 17 or younger in your household. Think about those [number] children in order of their birth, from oldest to youngest. The oldest child is the first child and the youngest child is the last." Please include children with the same birth date, including twins, in the order of their birth.

CATI INSTRUCTION: RANDOMLY SELECT ONE OF THE CHILDREN. This is the "Xth" child. Please substitute "Xth" child's number in all questions below.

INTERVIEWER PLEASE READ:

I have some additional questions about one specific child. The child I will be referring to is the "Xth" [CATI: please fill in correct number] child in your household. All following questions about children will be about the "Xth" [CATI: please fill in] child."

1. What is the birth month and year of the "**Xth**" child?

(226-231)

_ _ /_ _ _ _	Code month and year
7 7/ 7 7 7 7	Don't know / Not sure
9 9/ 9 9 9 9	Refused

CATI INSTRUCTION: Calculate the child's age in months (CHLDAGE1=0 to 216) and also in years (CHLDAGE2=0 to 17) based on the interview date and the birth month and year using a value of 15 for the birth day. If the selected child is < 12 months old enter the calculated

months in CHLDAGE1 and 0 in CHLDAGE2. If the child is ≥ 12 months enter the calculated months in CHLDAGE1 and set CHLDAGE2=Truncate (CHLDAGE1/12).

2. Is the child a boy or a girl?

(232)

1 Boy

2 Girl

9 Refused

3. Is the child Hispanic or Latino?

(233)

1 Yes (Ask M1.4 White Hispanic etc)

2 No

7 Don't know / Not sure

9 Refused

4. Which one or more of the following would you say is the race of the child?

(234-239)

[Check all that apply]

Please read:

1 White

2 Black or African American

3 Asian

4 Native Hawaiian or Other Pacific Islander

5 American Indian, Alaska Native

6 Other [specify] _____

Do not read:

8 No additional choices

7 Don't know / Not sure

9 Refused

CATI note: If more than one response to Q4, continue. Otherwise, go to Q6.

5. Which one of these groups would you say best represents the child's race?

(240)

1 White

2 Black or African American

3 Asian

4 Native Hawaiian or Other Pacific Islander

5 American Indian, Alaska Native

6 Other

7 Don't know / Not sure

9 Refused

6. How are you related to the child?

(241)

Please read:

1 Parent (include biologic, step, or adoptive parent)

2 Grandparent

3 Foster parent or guardian

4 Sibling (include biologic, step, and adoptive sibling)

5 Other relative

6 Not related in any way

Do not read:

7 Don't know / Not sure

9 Refused

MODULE 2: CHILDHOOD ASTHMA PREVALENCE

CATI note: If response to Core Q12.7 = 88 (None) or 99 (Refused), go to SAM4.1.

The next two questions are about the "Xth" **[CATI: please fill in correct number]** child.

1. Has a doctor, nurse or other health professional EVER said that the child has asthma?

(242)

1	Yes	
2	No	**[Go to SAM2.2]**
7	Don't know / Not sure	**[Go to SAM2.2]**
9	Refused	**[Go to SAM2.2]**

2. Does the child still have asthma?

(243)

1	Yes
2	No
7	Don't know / Not sure
9	Refused

STATE ADDED MODULE: 2 NEURODEVELOPMENTAL PART 2

SAM 2.2 Has a doctor or health care professional ever told you that [*child FROM RANDOM SELECTION*] had Attention Deficit Disorder or Attention Deficit Hyperactive Disorder that is, ADD or ADHD?

1 Yes
2 No
7 Don't know / Not sure
9 Refused

SAM 2.3 Has a doctor, health care professional, teacher, or school official ever told you that [*child FROM RANDOM SELECTION]* had a Learning Disability?

1 Yes
2 No
7 Don't know / Not sure
9 Refused

STATE ADDED MODULE: 4 PANDEMIC FLU

(Pandemic Flu 2007)

CATI PROGRAMMER: ASK OF EVERYONE FROM JANUARY THROUGH MAY 2007

We would like to ask you some questions about recent respiratory illnesses.

SAM 4.1. Last month, during [previous calendar month, using December – April], were you ill with a fever?

1 = Yes

2 = No – ***skip to SAM5.1***

7 = Don't know – ***skip to SAM 5.1***

9 = Refused – ***skip to SAM5.1***

2. Did you also have a cough and/or sore throat?

1 = Yes

2 = No

7 = Don't know

9 = Refused

3. Did you visit a doctor, nurse, or other health professional for this illness?

1 = Yes

2 = No – ***go to SAM4.7***

7 = Don't know – ***go to SAM4.7***

9 = Refused – ***go to SAM4.7***

4. Did the doctor, nurse, or other health professional tell you this illness was influenza or the flu?

1 = Yes

2 = No – ***go to SAM4.7***

7 = Don't know

9 = Refused

5. Did you have a flu test that was positive for this illness? Usually a swab from your nose or throat is tested. Would you say…[interviewer: read off choices]

1 = Yes, had flu test and it was positive

2 = No, had flu test but it was negative

3 = No, flu test was not done

7 = Don't know

9 = Refused

6. Did you receive Tamiflu® or oseltamivir [*o sel TAM i veer*] or an inhaled medicine called Relenza® or zanamivir [*za NA mi veer*] to treat this illness?

1 = Yes

2 = No

7 = Don't know

9 = Refused

7. How many other members of your household had an illness similar to yours during the past month?

__ __ # persons

8 8 None

7 7 Don't know/Not Sure

9 9 Refused

CATI PROGRAMMER: ASKED OF EVERYONE FROM JUNE THROUGH DECEMBER 2007

We would like to ask you some questions about influenza or the flu.

8. During this past fall and winter, approximately November through March, did a doctor, nurse, or other health professional tell you that you had influenza or the flu?

1 = Yes

2 = No – ***skip to SAM5.1***

7 = Don't know – ***skip to SAM5.1***

9 = Refused – ***skip to SAM5.1***

9. Did you have a flu test that was positive? Usually a swab from your nose or throat is tested. Would you say…[interviewer: read off choices]

1 = Yes, had flu test and it was positive

2 = No, had flu test but it was negative

3 = No, flu test was not done

7 = Don't know

9 = Refused

10. Did you receive Tamiflu® or oseltamivir [*o sel TAM i veer*] or an inhaled medicine called Relenza® or zanamivir [*za NA mi veer*] to treat the flu?

1 = Yes

2 = No

7 = Don't know

9 = Refused

11. How many other members of your household also became sick with the flu during this past fall or winter, approximately November through March?

__ __ # persons

8 8 None

7 7 Don't know/Not Sure

9 9 Refused

STATE ADDED MODULE 5 : SEXUAL ORIENTATION

Ask of respondents 12.1<65. If 12.1=>65 go to either Binge Drinking SAM6 or Alcohol Dependence SAM7 depending on answer to S13.4. See Guidance at SAM6

SAM5.1 Now I'm going to ask you a question about sexual orientation. (SAM ????)

Do you consider yourself to be:

1 Heterosexual or straight, attracted to women
Heterosexual or straight, attracted to men

2 Homosexual or gay, attracted to men

Homosexual or lesbian, attracted to women

3 Bisexual, attracted to both men and women

4 Other [Specify] _____ (SAM ????-????)

Do not read

7 Don't know/Not sure

9 Refused

STATE ADDED MODULE 6: BINGE DRINKING

BRFSS 2004 Module 19: Binge Drinking
BRFSS 2005 State Added Module 4: Binge Drinking

CHANGE COLUMN NUMBERS!!!

Ask if Core Q13.4 = 1-30 (or does not equal 77, 88, 99) ALL OTHERS GO TO SAM7.1

If Q13.4 is blank go to SAM7.1

The next questions are about the most recent occasion when you had 5 or more alcoholic beverages. One alcoholic beverage is equal to a 12-ounce beer, a 5-ounce glass of wine, or a drink with 1 shot of liquor.

GUIDANCE:

NOTE: "Occasion" means 'in a row' or 'within a few hours'

NOTE: If the respondent asks about how to count an over-sized drink (e.g., a 40-ounce bottle of malt liquor), then repeat: "One alcoholic beverage is equal to a 12-ounce beer, a 4-ounce glass of wine, or a drink with 1 shot of liquor."

SAM 6.1. During the most recent occasion when you had 5 or more alcoholic beverages, about **how many beers**, including malt liquor, did you drink?
(SAM)

(Round up)

__ __ Number

8 8 None

7 7 Don't know / Not sure

9 9 Refused

SAM 6.2. During the same occasion, about **how many glasses of wine**, including wine coolers, hard lemonade, or hard cider, did you drink?
(SAM)

NOTE: Flavored malt beverages other than hard lemonade or hard cider (e.g., Smirnoff Ice and Zima, etc.) should be counted as wine.

(Round up)

__ __ Number

8 8 None

7 7 Don't know / Not sure

9 9 Refused

SAM 6.3. During the same occasion, about **how many drinks of liquor**, including cocktails, did you have?
(SAM)

(Round up)

__ __ Number

8 8 None

7 7 Don't know / Not sure

9 9 Refused

SAM 6.4. During this most recent occasion, **where were you** when you did **most** of your drinking? Would you say . . . (SAM)

1 At your home, for example, your house, apartment, condominium or dorm room

2 At another person's home

3 At a restaurant or banquet hall

4 At a bar or club

5 At a public place, such as at a park, concert, or sporting event

6 Other

Do not read

7 Don't know / Not sure

9 Refused

SAM 6.5. During this most recent occasion, **how did you get most** of the alcohol? Would you say . . .(SAM)

1 Someone else bought it for me or gave it to me

2 I bought it at a store, such as a liquor store, convenience store, or grocery store

3 I bought it at a restaurant, bar or public place

4 Other

Do not read

7 Don't know / Not sure

9 Refused

SAM 6.6. Did you drive a motor vehicle, such as a car, truck, or motorcycle **during or within a couple of hours after** this occasion?
(SAM)

1 Yes

2 No

7 Don't know / Not sure

9 Refused

STATE ADDED MODULE 7: ALCOHOL DEPENDENCE

NM BRFSS 2004 SAM: ALCOHOL DEPENDENCE (From ADAM)

NM BRFSS 2005 SAM 5: ALCOHOL DEPENDENCE

CHANGE COLUMN NUMBERS !!!

Now I would like to ask you about experiences related to alcohol use that you may have had in the **past 12 months.**

SAM7.1 A drink of alcohol is 1 can or bottle of beer, 1 glass of wine, 1 can or bottle of wine cooler, 1

cocktail, or 1 shot of liquor. During the past 12 months how often have you had at least one drink

of any alcoholic beverage?

(SAM)

Read Only If Necessary

1 Almost every day **Go to SAM 7.2**
2 3 or 4 days a week **Go to SAM 7.2**
3 1 or 2 days a week **Go to SAM 7.2**
4 1 to 3 days a month **Go to SAM 7.2**

If S12.4 < 77 continue, otherwise go to the SAM8.1

5 less than once a month **Go to SAM8.1**
8 No drinks in the past 12 months **Go to SAM8.1**

7 Don't know / Not sure **Go to SAM8.1**

9 Refused **Go to SAM8.1**

SAM7.2 In the past 12 months have you spent more time drinking than you intended?

(SAM)

1 Yes
2 No

7 Don't know / Not sure

9 Refused

SAM7.3 Have you neglected some of your usual responsibilities because of using alcohol?

(SAM)

1 Yes

2 No

7 Don't know / Not sure

9 Refused

SAM7.4 Have you wanted to cut down on your drinking? (SAM)

1 Yes

2 No

7 Don't know/Not sure

9 Refused

SAM7.5 In the past 12 months, has anyone objected to your use of alcohol? (SAM)

1 Yes

2 No

7 Don't know/Not sure

9 Refused

SAM7.6 Have you frequently found yourself thinking about drinking? (SAM)

1 Yes

2 No

7 Don't know/Not sure

9 Refused

SAM7.7 Have you used alcohol to relieve feelings such as sadness, anger, or boredom? (SAM)

1	Yes
2	No
7	Don't know/Not sure
9	Refused

STATE ADDED MODULE 8: EMERGENCY CONTRACEPTIVES

FROM NM BRFSS 2004, 2005, 2006 STATE ADDED MODULES

REVIEW SKIP PATTERN

ASK OF WOMEN AGE 18-44 (Q12.20=2, Q12.1 =>18 AND <=44). ALL OTHERS GO TO SAM13.1

Now I have a few questions about emergency contraceptive pills, ECP's.

SAM8.1. Have you ever heard about emergency contraceptive pills, ECPs? These used to be called the "morning after pill." If taken according to directions within 5 days after unprotected sex, they can prevent a pregnancy.
(SAM ???)

1 Yes

2 No. ***Go to next module***

7 Don't know/Not sure ***Go to next module***

9 Refused ***Go to next module***

SAM8.2. Have you ever used emergency contraceptive pills, ECPs? (SAM ???)

1 Yes

2 No.

7 Don't know/Not sure

9 Refused

MODULE 13: ARTHRITIS MANAGEMENT

CATI note: If Core Q15.2 or Q15.4 = 1 (Yes), continue. Otherwise, go to SAM10.1 (January-March 2007 only) April to December go to M16.1

1. Earlier you indicated that you had arthritis or joint symptoms. Thinking about your arthritis or joint symptoms, which of the following best describes you **today**? (345)

Please read:

1 I can do everything I would like to do
2 I can do most things I would like to do
3 I can do some things I would like to do
4 I can hardly do anything I would like to do

Do not read:

7 Don't know / Not sure
9 Refused

2. Has a doctor or other health professional EVER suggested losing weight to help your arthritis or joint symptoms? (346)

1 Yes
2 No
7 Don't know / Not Sure
9 Refused

3. Has a doctor or other health professional ever suggested physical activity or exercise to help your arthritis or joint symptoms? (347)

Note: If the respondent is unclear about whether this means an increase or decrease in physical activity, this means increase.

1 Yes
2 No
7 Don't know / Not Sure
9 Refused

4. Have you EVER taken an educational course or class to teach you how to manage problems related to your arthritis or joint symptoms?
(348)

1 Yes
2 No
7 Don't know / Not Sure
9 Refused

STATE ADDED MODULE 10: CELL PHONE PILOT 11/8/06

ASK ONLY JANUARY THROUGH MARCH 2007

SAM10.1. Do you have a cell phone for personal use? Please include cell phones used for both business and personal use.

1) YES ***[SKIP TO SAM10.3]***
2) NO
3) DON'T KNOW/NOT SURE
4) REFUSED

SAM10.2. Do you share a cell phone for personal use with other adults?

1 YES ***GO TO SAM10.4***
2 NO ***GO TO NEXT SECTION***
3 DON'T KNOW/NOT SURE ***GO TO NEXT SECTION***
4 REFUSED***GO TO NEXT SECTION***

SAM10.3. Do you usually share this cell phone with any other adults?

1 YES

2 NO ***GO TO SAM10.5***

3 DON'T KNOW/NOT SURE ***GO TO SAM10.5***

4 REFUSED ***GO TO SAM10.5***

SAM10.4. How many other adults use this cell phone at least one-third of the time?

INTERVIEWER: TWO IS THE MAXIMUM RESPONSE ALLOWED.

1) NONE
2) ONE
3) TWO OR MORE
4) DK
5) REF

SAM10.5. Was there any time in the past 12 months that you did not have cell phone service for a week or longer?

INTERVIEWER: WE ARE INTERESTED IN CONTINUOUS SERVICE IN THIS QUESTION. IF SOMEONE SWITCHED CELL PHONE COMPANIES, BUT DID NOT HAVE A BREAK IN SERVICE, THE ANSWER TO THIS QUESTION IS "NO."

1 YES
2 NO
3 DON'T KNOW/ NOT SURE
4 REFUSED

MODULE 16: MENTAL ILLNESS & STIGMA

Now, I am going to ask you some questions about how you have been feeling during the **past 30 days**.

1. About how often during the past 30 days did you feel **nervous** — would you say **all** of the time, **most** of the time, **some** of the time, **a little** of the time, or **none** of the time?

(358)

1 All

2 Most

3 Some

4 A little

5 None

7 Don't know / Not sure

9 Refused

2. During the past 30 days, about how often did you feel **hopeless** — **all** of the time, **most** of the time, **some** of the time, **a little** of the time, or **none** of the time?

(359)

1 All

2 Most

3 Some

4 A little

5 None

7 Don't know / Not sure

9 Refused

3. During the past 30 days, about how often did you feel **restless** or **fidgety**?

[READ ONLY IF NECESSARY: all, most, some, a little, or none of the time?]

(360)

1 All

2 Most

3 Some

4 A little

5 None

7 Don't know / Not sure

9 Refused

4. During the past 30 days**,** about how often did you feel **so depressed** that nothing could cheer you up?

READ ONLY IF NECESSARY: all, most, some, a little, or none of the time?]
(361)

1 All

2 Most

3 Some

4 A little

5 None

7 Don't know / Not sure

9 Refused

5. During the past 30 days, about how often did you feel that **everything was an effort**?

READ ONLY IF NECESSARY: all, most, some, a little, or none of the time?]

(362)

1 All

2 Most

3 Some

4 A little

5 None

7 Don't know / Not sure

9 Refused

6. During the past 30 days, about how often did you feel **worthless**?

READ ONLY IF NECESSARY: all, most, some, a little, or none of the time?] (363)

1 All

2 Most

3 Some

4 A little

5 None

7 Don’t know / Not sure

9 Refused

The next question asks if any type of mental health condition or emotional problem has recently kept you from doing your work or other usual activities.

7. During the past 30 days, for about how many days did a mental health condition or emotional problem **keep you from doing** your work or other usual activities?

(364-365)

_ _ Number of days

8 8 None

7 7 Don't know / Not sure

9 9 Refused

INTERVIEWER NOTE: If asked, "**usual activities**" includes housework, self-care, caregiving, volunteer work, attending school, studies, or recreation.

8. Are you now taking medicine or receiving treatment from a doctor or other health professional for any type of mental health condition or emotional problem?

(366)

1 Yes

2 No

7 Don't know / Not sure

9 Refused

These next questions ask about peoples' attitudes toward mental illness and its treatment. How much do you **agree** or **disagree** with these statements about people with mental illness...

9. Treatment can help people with mental illness lead normal lives. Do you – **agree** slightly or strongly, or **disagree** slightly or strongly?

(367)

GUIDANCE: Answers to these questions will be used by health planners to help understand public attitudes about mental illness and its treatment and to help guide health education programs.

Read only if necessary:

1 Agree strongly

2 Agree slightly

3 Neither agree nor disagree

4 Disagree slightly

5 Disagree strongly

Do not read:

7 Don't know / Not sure

9 Refused

10. People are generally caring and sympathetic to people with mental illness. Do you – **agree** slightly or strongly, or **disagree** slightly or strongly?

(368)

GUIDANCE: Answers to these questions will be used by health planners to help understand public attitudes about mental illness and its treatment and to help guide health education programs.

Read only if necessary:

1 Agree strongly

2 Agree slightly

3 Neither agree nor disagree

4 Disagree slightly

5 Disagree strongly

Do not read:

7 Don't know / Not sure

9 Refused

STATE ADDED MODULE 11: DRINKING AND DRIVING

CATI note: If Q13.1 >1; go to SAM13.1.

The next question is about drinking and driving.

SAM11.1 During the past 30 days, how many times have you driven when you've had perhaps too much to drink? (170-171)

_ _	Number of times
8 8	None
7 7	Don't know / Not sure
9 9	Refused

STATE ADDED MODULE 13: PERCEPTIONS OF HEALTH DISPARITIES

(1/11/07)

We would like to ask your opinion about people's health and health care experiences based on their race or ethnic background. These questions are not about YOUR personal experiences but are about the GENERAL population of New Mexico.

SAM13.1. Health care coverage includes health insurance, prepaid plans such as HMOs, or government plans such as Medicare to pay for health care. Do you believe that some race or ethnic groups are less likely to have any kind of health care coverage?

1. yes

2. no ***GO TO SAM13.3***

7. DK/not sure ***GO TO SAM13.3***

9. refused ***GO TO SAM13.3***

SAM13.2. Which group or groups are less likely to have any kind of health care coverage. Would you say…

INTERVIEWER GUIDANCE: Health care coverage includes health insurance, prepaid plans such as HMOs, or government plans such as Medicare.

INTERVIEWER: SELECT UP TO 8 OPTIONS

01. White non-Hispanic
02. Hispanic
03. Black or African American
04. Asian
05. Native Hawaiian or Other Pacific Islander
06. American Indian or Alaska Native
07. Other (specify) _____

08. No other
88. None
77. Don't Know/Not sure
99. Refused

SAM13.3. Which group or groups are more likely to develop diabetes? Would you say…

INTERVIEWER: SELECT UP TO 8 OPTIONS

01.White non-Hispanic
02. Hispanic
03. Black or African American
04. Asian
05. Native Hawaiian or Other Pacific Islander
06. American Indian or Alaska Native
07. Other (specify) _____

08. No Other
88. None
77. Don't Know/Not sure
99. Refused

SAM13.4. Which group or groups are more likely to become extremely overweight (obese)?

INTERVIEWER: SELECT UP TO 8 OPTIONS

01.White non-Hispanic
02. Hispanic
03. Black or African American
04. Asian
05. Native Hawaiian or Other Pacific Islander
06. American Indian or Alaska Native
07. Other (specify) _____

08. No Other
88. None
77. Don't Know/Not sure
99. Refused

STATE ADDED MODULE 9: DRINKING WATER

2007 SEE ALSO 1997-99 NM BRFSS

SAM9.1. What is the main source for your drinking water?

1. Public piped water (city or municipal water supply)
2. Well (private or shared)
3. Bottled water
4. Tanker truck
5. Water machine dispenser (supermarket)
6. Other, specify _____

7. Don't know/not sure
9. Refused

SAM9.2. Do you filter your drinking water in any way? This includes carbon filters, like Brita or Pure, reverse osmosis units and ion exchange units.

1. Yes
2. No

7. Don't know/not sure
9. Refused

SAM9.3. On average how many cups of home tap water do you drink each day? This includes all water used in making coffee, tea or juices. One cup equals 8 ounces.

1. Less than 1 cup
2. 1-4 cups

3. 5-8 cups
4. More than 8 cups

8. None

7. Don't know/not sure
9. Refused

SAM 3: ASTHMA CALL-BACK: SCRIPT TO ENLIST FOR ASTHMA CALL-BACK SURVEY 2007

If 9.1=1 and 12.7 =88 or 99 go to SAM3.1 (ADULT ONLY)

If 9.1=1 and 12.7 <12, and M2.1> 1 go to SAM3.1 (ADULT ONLY)

If 9.1=1 and 12.7 <12, and M2.1=1 go SAM3.1 (RANDOM SELECTION)

If 9.1>1 and 12.7<12 and M2.1=1 go to SAM3.1 (CHILD ONLY)

If 9.1>1 and 12.7<12 and M2.1> 1 go to closing statement. (NO ONE WITH ASTHMA)

CATI: DO RANDOM SELECTION RIGHT HERE RIGHT NOW.

CATI: ENTER # ADULT, ENTER # CHILD WITH ASTHMA. (TITO DO YOU WANT THIS TO BE QUESTION #'S? THIS COULD BE EXPORTED TO THE ASTHMA CALLBACK QUESTIONNAIRE WITH THE IDENTIFIERS.)

SAM3.1
We would like to call your household back within the next two weeks to talk in more detail about your experiences with asthma. (**CATI IF 2 PEOPLE INCLUDE NEXT SENTENCE**)[Since there are two people identified in you household with asthma the computer randomly selects only one for the follow up call.] **You/your blank year old child CATI: from random selection** has been selected. The information will be used to help develop and improve the asthma programs in New Mexico. The information you gave us today and any you give us in the future will be kept confidential. If you agree to this, we will keep your first name and phone number on file, separate from the answers collected today. Even if you agree now, you may refuse to participate in the future. Would it be okay if we called you back to ask additional asthma-related questions at a later time?

1 Yes
2 No go to closing statement

SAM3.2 Can I please have your first name so we will know who to ask for when we call back?

_____ Enter first name of adult

SAM3.3 Can I please have first name of the (RANDOMLY SELECTED CHILD FROM M1?

_____ Enter first name of child.

Go to closing statement.

Closing statement

That is my last question. Everyone's answers will be combined to give us information about the health practices of people in New Mexico. Thank you very much for your time and cooperation.

Appendix D: New Mexico Permission for Use of Information

SUSANA MARTINEZ, GOVERNOR

STATE OF NEW MEXICO DEPARTMENT OF HEALTH
CARING FOR NEW MEXICO

CATHERINE D. TORRES, M.D., CABINET SECRETARY

June 28, 2012

Emory University
Institutional Review Board
1599 Clifton Road, 5th Floor East
Atlanta, GA 30322

Emory University IRB Office:

As New Mexico BRFSS Coordinator, I have given Shawna Feinman permission to use the 2007 Behavioral Risk Factor Surveillance System data gathered by the New Mexico Department of Health (NMDOH) for her Master's thesis at Emory University.

NMDOH has communicated with Ms. Feinman and understand the scope of her research, and how she will be using the data. The data Ms. Feinman has requested will not include any identifiable information and all information gathered will be done in a confidential and appropriate manner.

Should you have any questions, please feel free to contact me at 505-476-3569 or lori.zigich@state.nm.us.

Sincerely yours,

Lori Zigich

Lori Zigich, MPH
New Mexico BRFSS Coordinator

NEW MEXICO CENTENNIAL 1912-2012

Epidemiology and Response
1190 St. Francis Drive, N1350 • Santa Fe, New Mexico • 87502-6110
(505) 827-0006 • FAX: (505) 827-2110 • http://www.nmhealth.org

Appendix E: Emory Institutional Review Board Study Exemption Notice

EMORY UNIVERSITY | Institutional Review Board

July 20, 2012

RE: Determination: No IRB Review Required
"Private Well Water Use and Associated Gastrointestinal Illnesses in New Mexico**"**

Dear Shawna Feinman:

Thank you for requesting a determination from our office about the above-referenced project. Based on our review of the materials you provided, we have determined that it does not require IRB review because it does not meet the definition(s) of "research" involving "human subjects" or the definition of "clinical investigation" as set forth in Emory policies and procedures and federal rules, if applicable.

Based on the information included in the submission, you will be using a telephone survey completed in 2007 called "New Mexico for the Behavioral Risk Factor Surveillance System (BRFSS) to determine the relationship between primary sources of drinking water and AGI and ARI. The PI has received approval from the New Mexico Department of Health to access this data set. This survey information has been de-identified and, as such, insures that the subjects cannot be identified. Such a study does not represent "human subjects" based research. As such, the IRB has determined that this study does not constitute "Research" under the foregoing definition.

This determination could be affected by substantive changes in the study design or subject population. If the project changes in any substantive way, please contact our office for clarification.

Thank you for consulting the IRB.

Sincerely,

Aric Edwards, BA
IRB Analyst Assistant
This letter has been digitally signed

Emory University
1599 Clifton Road, 5th Floor - Atlanta, Georgia 30322
Tel: 404.712.0720 - Fax: 404.727.1358 - Email: irb@emory.edu - Web: http://www.irb.emory.edu

Appendix F: New Mexico Department of Health Guidelines for Race/Ethnicity Data

NMDOH Guidelines for Race/Ethnicity Data (12/13/12)

1. NMDOH will collect race and ethnicity data based on the Office of Management and Budget 1997 Standard groupings.[4]

2. NMDOH will collect ethnicity data before collecting race data for an individual.

2. NMDOH will collect race data using these five major categories:

   White
   Black or African American
   American Indian or Alaska Native
   Asian
   Native Hawaiian or Pacific Islander

3. NMDOH will collect multiple race data

4. NMDOH will collect tribal subpopulation data. At a minimum all NM tribal affiliations should be collected.

5. NMDOH will use self-identification (or proxy identification) rather than observer identification or some other mechanism as the preferred basis for data collection

6. When possible, health and health services data provided by NMDOH should be presented by race/ethnicity in order to assist in the identification and tracking of disparities in health status and access to services. The use of race/ethnicity as a social and cultural construct should also be noted when possible.

7. For the purposes of presentation, race and ethnicity will be presented using the following five major categories/labels and in alphabetical order:

   American Indian or Alaska Native
   Asian or Pacific Islander
   Black or African American
   Hispanic
   White

   When data are sufficient, the single category, Asian or Pacific Islander, can be presented as two categories, 1) Asian and 2) Native Hawaiian or Pacific Islander.

---

[4] Federal Register Notice October 30, 1997, Office of Management and Budget. Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity. http://www.whitehouse.gov/omb/fedreg_1997standards/.

8. When small numbers[5] preclude the presentation of data by all of five racial/ethnic categories this should be noted.

9. Because many data are not collected by these exact five racial/ethnic categories and race and ethnicity are frequently collected separately, the following rules should be followed when moving data into the racial/ethnic categories:

    - Persons designated as Hispanic ethnicity will be categorized as "Hispanic"
    - None of the five race/ethnicity categories presented above will be combined into an "other" category

10. Presentation of missing/unknown race and ethnicity data. The number or percentage of missing/unknown values should be reported as one category.

11. Presentation of multiple race. Presentation of multiple race is database dependent. The number or percentage of multiple race persons should be reported. If multiple race is bridged, the bridging method should be described.

12. Presentation of race and ethnicity together in the same table. Race/ethnicity will be viewed as a single social and cultural construct. Persons designated as Hispanic ethnicity, regardless of race, will be categorized as 'Hispanic'. Persons not designated as Hispanic will be categorized by their single race ('Black or African American', 'American Indian or Alaska native', 'Asian or Pacific Islander', 'White', or 'Other').

[5] The Epidemiology and Response Division has developed guidelines for the suppression of small numbers in order to protect the confidentiality of individuals and yet provide as much information as possible. A copy of the rule may be found on http://ibis.health.state.nm.us/docs/Standards/NMSmallNumbersRule2006.pdf.