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TREATED VS. UNTREATED DRINKING WATER:
CONSUMPTION MOTIVES IN SOUTHWESTERN ALASKA NATIVE COMMUNITIES
AND INTERVENTION STRATEGIES

Environmental Health

ABOUT THE COVER



In southwest Alaska, 82% of Alaska Native residents reported that at least some of their drinking water comes from untreated sources, even though their villages have treated drink-

ing water available from a centralized source. The authors of this month's cover feature, "Consuming Untreated Water in Four Southwestern Alaska Native Communities: Reasons Revealed and Recommendations for Change," sought to find out why residents choose to drink untreated water when treated water is available. The authors then recommend specific interventions—based on reasons given by residents—focusing on both the benefits of drinking treated water and risks from drinking untreated water.

See page 8.

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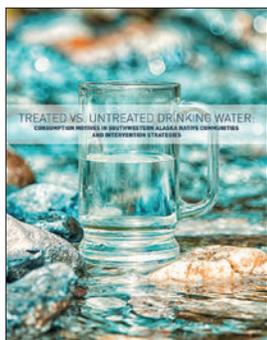
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Consuming Untreated Water in Four Southwestern Alaska Native Communities: Reasons Revealed and Recommendations for Change

Troy L. Ritter, PhD, REHS, DAAS
*Alaska Native Tribal Health Consortium,
 Division of Environmental Health
 and Engineering
 National Tribal Water Center*

Ellen D. S. Lopez, MPH, PhD
*Center for Alaska Native
 Health Research
 University of Alaska at Fairbanks*

Rachel Goldberger
*Division of Environmental Health
 and Engineering
 Alaska Native Tribal Health Consortium*

Jennifer Dobson, MPH, REHS
*Office of Environmental Health
 and Engineering
 Yukon Kuskokwim Health Corporation*

Korie Hickel, MPH, REHS, CHES
 Jeffrey Smith, MS, RS
*Alaska Native Tribal Health Consortium
 National Tribal Water Center*

Rhonda M. Johnson, MPH, DrPH
*Department of Health Sciences
 University of Alaska at Anchorage*

Andrea Bersamin, PhD
*Center for Alaska Native
 Health Research
 University of Alaska at Fairbanks*

Abstract In this article, the authors provide the first in-depth account of why some Alaska Native people drink untreated water when treated water is available. Their qualitative research was conducted in four Alaska Native village communities that have treated water available from a centralized distribution point. Most respondents ($n = 172$; 82%) reported that some of their household's drinking water came from an untreated source. Motives for drinking untreated water emerged from analysis of open-ended questions about drinking water practice and could be categorized into six themes: chemicals, taste, health, access, tradition, and cost. Importantly, some residents reported consuming untreated water because they both liked untreated water and disliked treated water. As such, interventions to increase safe water consumption should address this dichotomy by providing education about the benefits of treated water alongside the risks involved with drinking untreated water. Based on the findings, the authors provide specific recommendations for developing behavior change interventions that address influences at multiple social-ecological levels.

Introduction

Drinking contaminated water is a well-documented risk factor for infectious disease. Currently, more than half of the hospital beds in the world are occupied by persons affected by inadequate water supply and sanitation (Bartram, Lewis, Lenton, & Wright, 2005). While the highest burden of water-related disease is found in developing countries, unsafe water consumption continues to affect U.S. populations (Centers for Disease Control and Pre-

vention [CDC], 2008). Waterborne diseases cost the U.S. health care system an estimated \$900 million each year (Collier et al., 2012).

The treatment of drinking water is an important preventive measure for waterborne disease. Water treatment is the purification of water to make it suitable for drinking or other domestic use. The most common water treatment processes are addition of chlorine to denature pathogens and filtration to remove particles. Most major U.S. cities began provid-

ing treated drinking water in the early 1900s. This increased availability of treated water in the U.S. contributed to the dramatic decline in the crude death rate from infectious disease that occurred during the first part of the 20th century (CDC, 1999). Construction of water treatment systems in Alaska Native communities, however, did not begin until the 1960s. Water system construction in Alaska's Native village communities falls under the jurisdiction of either the Alaska Native Tribal Health Consortium (ANTHC), a nonprofit tribal organization that provides water, sanitation, and health services to Alaska Native people and communities across the state (see ANTHC's Web site, <http://anthctoday.org/about/index.html>, for more information), or the state of Alaska's Village Safe Water program. Funding for water infrastructure in rural Alaska is limited and communities must demonstrate strong support and capacity for their proposed projects to be funded. Once in place, ownership and operation of the infrastructure is transferred to a governing entity

within the community, typically the tribal or city council. Sustainability can be a challenge. Local communities take on responsibility for daily operation and maintenance with training and limited on-site technical assistance provided through external programs. Revenue to pay for water system operation and maintenance is generated through user fees, but this does not always cover costs. Most village water utilities have no formal process for receiving and resolving consumer complaints or for educating consumers about water safety.

Currently, almost all residents of Alaska Native villages have access to treated drinking water. Yet for about one in four rural residents, treated water must be packed, or “self-hauled,” to their homes from a centralized water point. Self-haul water systems require residents to fill and carry several small containers of water from a central water point to their homes using sleds, snow machines, or four-wheel-drive vehicles.

Despite the availability of treated drinking water in Alaska Native communities, it is widely recognized that many residents drink untreated river water and rain. This is of particular concern because microbiological sampling of untreated water found numerous pathogens, including *E. coli*, *Cryptosporidium*, and *Campylobacter*, and that rooftop-harvested rainwater contained *E. coli* (Alaska Native Tribal Health Consortium & CDC, unpublished data). Two studies provide insight on why Alaska Native people with access to treated water continue to drink untreated water (Cassady, 2008; Marino, White, Scheitzer, Chambers, & Wisniewski, 2009). One study conducted in Alaska’s northwest Arctic region found that residents associated chlorine in treated water with the onset of cancer (Cassady, 2008). A 2009 study by Marino and co-authors revealed that residents in two Norton Sound region villages preferred the taste of untreated water to treated water and that they believed their untreated sources were superior in terms of health and safety. Study participants were wary of chemicals used in the water treatment process and preferred untreated water because they thought it was “more natural.”

Our study builds on the previous research in three ways. First, we use thematic analysis to identify and analyze participant-reported motives for drinking untreated water and describe the interconnections among them.

Second, based on our analysis, we provide recommendations for encouraging consumption of treated water only. Third, our research was conducted in Alaska’s southwest region, exploring perspectives that may differ from those found in previous studies in northwest Alaska, where residents may espouse different cultural and health-related values.

Methods

Setting

We conducted our research in four small remote southwest Alaska village communities. Each community was selected because of its participation in a larger study exploring the impact of inadequate water and sanitation on rates of infections. In 2010, the combined population was 1,403, with the vast majority of residents (93.9%) identifying with Alaska Native heritage (U.S. Census Bureau, 2010). These village communities ranked among the most remote in Alaska. With no external road system, access between communities and urban centers is possible only by small airplane, snow machine, and the occasional summer barge. The selected communities also experience extreme weather conditions, with winter temperatures dropping to -40°F. Subsistence activities, such as hunting, fishing, and gathering (berries and greens) hold cultural, social, and economic significance to these communities, where employment opportunities are limited and more than 40% of residents over age 16 are not in the workforce (U.S. Census Bureau, 2010).

Participant Eligibility and Recruitment

The study materials and processes were approved by the Alaska area institutional review board, the human subjects review committee of the regional tribal health consortium, and the four representative village councils. The research focused on the estimated 250 households with only self-haul water distribution. Recruitment comprised announcements made over VHF radio (a simple transmitting device used as a primary method of communication in this region), recruitment flyers, and other word-of-mouth methods.

Data Collection and Questions

The data presented here were collected as part of a larger semistructured, in-person survey focused on assessing the change in health status following provision of in-house piped water

and healthy water use promotion. In some cases, residents heard the VHF announcements and traveled to a community building to complete the survey. A majority of the surveys, however, were conducted in respondents’ homes. To facilitate this, a paid village resident field worker accompanied a research team member on visits to each eligible household. Surveys were primarily conducted in English. For participants who preferred to use their local language, Yup’ik, the field worker helped to translate questions and responses. Because our previous experience working in this region indicated that the presence of a tape recorder often negatively impacted participation and the quality of responses, surveys were not audio recorded. Instead, the researcher strived to transcribe participants’ responses to the open-ended questions as they were provided. Each household chose one member to complete the survey, and was offered \$40 in compensation for the time.

The survey interview opened with the question, “How much of your household’s drinking water comes from the (treated) water point?” Response options included “none,” “some,” “most,” and “all.” Participants who chose responses other than “all” were asked to elaborate by explaining their motives for consuming untreated drinking water. Data collected from this series of questions are the focus of this article.

Data Management and Analysis

Interview responses (both closed- and open-ended) were transcribed into an Excel spreadsheet. Qualitative data were analyzed using a four-phase process. Phase I involved having six individuals trained in environmental health review all of the transcribed statements from the open-ended survey questions. Two of these individuals had also been involved in data collection. They were asked to identify themes related to respondents’ reported motives for drinking untreated water. The reviewers collectively identified six motive themes. During Phase II, two researchers who had participated in Phase I worked collaboratively to develop a codebook that included the six motive themes and their operational definitions. During Phase III, the same two researchers independently coded each response to one or more of the six motive themes. Finally, during Phase IV, the researchers compared their coding and discussed any coding disagreements. This pro-

cess resulted in inter-coder agreement on 230 of 234 code assignments (98.3%). In the four instances where agreement was not achieved, data for the entire household were excluded from the data set.

Results

Sample Characteristics

Of the 250 eligible households, 210 (84%) completed the questions relevant to this report. Participating households comprised an average of 3.9 occupants (range = 1–10). Sixty percent of the surveys (n = 126) were completed by a male household member. The average age of the respondent was 48 years (range = 19–83).

Proportion of Drinking Water Obtained From an Untreated Source

A majority of participants (82%; n = 172) reported that at least some proportion of their household’s drinking water came from an untreated source. Untreated sources included river and rain water. The highest percentage of participants (39%; n = 82) reported their household obtained “none” of their drinking water from the water point while the lowest percentage (18%; n = 38) reported that “all” their drinking water came from the water point (Figure 1).

Motives for Drinking Untreated Water

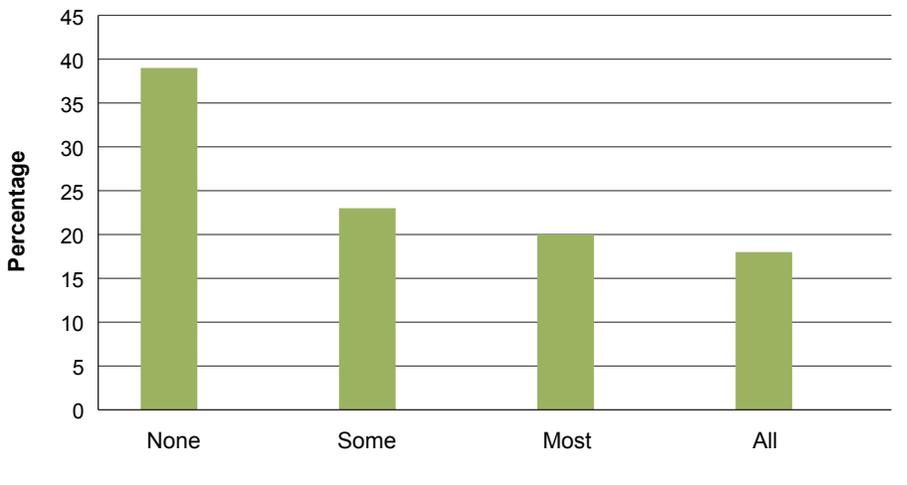
Of the 172 participants reporting that any of their household’s drinking water came from an untreated source, 153 (90%) answered the open-ended question to explain their motives for drinking untreated water. Data from four households were excluded during the coding process, leaving 149 respondents. Respondents offered multiple reasons for drinking untreated water, with a total of 204 separate explanations provided. The six identified motive themes include chemicals, taste, health, access to water, tradition, and cost and are discussed in detail below. Table 1 provides the number and percentage of households reporting each of the six motive themes along with illustrative quotations.

Chemicals

The use of chemicals in the water treatment process was the most common reason provided for choosing to consume untreated water (Table 1). Most respondents who expressed

FIGURE 1

Reported Proportion of Drinking Water From the Treated Source, Alaska (N = 210)



concerns about chemicals specifically named chlorine as the source of their opposition. Respondents explained that people disliked the taste and smell of chlorinated water, were concerned about the potential negative health effects caused by chlorine, and viewed chemical water treatment as a western practice that conflicted with the widely held preference for things produced naturally. Some respondents associated chlorine taste and smell with poor water treatment system operation and maintenance. Even though fluoride is not added to the treated water in any of the four villages, a few participants expressed concern that fluoride in their treated water may produce negative side effects.

Taste

Many respondents explained that they simply disliked the taste of treated water. According to participants, treated water tasted “weird,” “salty,” “yucky,” and even “slimy.” The themes taste and chemicals overlapped substantially, with 31 of the 67 respondents (46%) reporting both as reasons for consuming untreated water. Most respondents who mentioned taste emphasized their dislike of chlorine. Six respondents specifically noted that “chlorine doesn’t go good with coffee,” an observation also made in Marino’s study (2009). Respondents also characterized treated water as unpalatable due to high iron content, which

gives the water a rusty taste. Dislike of the taste of treated water was not the only taste-related motive, however. Many respondents explained that they enjoyed the taste of untreated rain and river water, describing it as “crisp,” “clean,” “sweet,” and “fresh.”

Health

Health emerged as a motive for consuming untreated water. While a few respondents believed that untreated water offered health benefits, more than a quarter of respondents, or 40 of 149, associated treated water with health problems such as stomachaches, diarrhea, headaches, allergic reactions, dry skin, and even death. Most common were concerns regarding gastrointestinal problems experienced by young children, older residents, and honored Elders. Of the 40 respondents who mentioned health as a motivator, 18 (45%) also discussed their negative opinions of chemicals, so there was frequent overlap in the first three categories. Chlorine was the chemical that participants most commonly associated with their health concerns. Respondents also associated the yellow, brown, and rust color that often results from iron in treated water with health problems, even though ingesting iron at levels found in drinking water is not a known health risk.

Concerns related to improper or inadequate water system operation and maintenance influ-

TABLE 1

Motives for Drinking Untreated Water When Treated Water Is Available, Alaska, 2008

| Motives (# and Percentage of Households Reporting Motive) | Illustrative Participant Quotations |
|---|--|
| Chemicals (<i>n</i> = 69; 46%) | <p>"If pump water has too much chlorine we go to the creek." "We don't like chemical water." "I don't like chlorine." "I don't trust the chlorine that much."</p> |
| Taste (<i>n</i> = 67; 45%) | <p>"Chlorine doesn't go good with coffee. Creek water tastes sweeter." "Sometimes water at the water point tastes too much like chlorine." "Sometimes [treated water] tastes like rust." "[Untreated water] doesn't have a taste like slimy treated water."</p> |
| Health (<i>n</i> = 40; 27%) | <p>"River water builds immunity." "Too much [treated water] will kill anybody." "Treated water has chlorine and fluoride so it might have side effects." "Chlorine makes my dad sick in his stomach."</p> |
| Access (<i>n</i> = 25; 17%) | <p>"No transportation to haul [treated] water." "[Rain] is right outside." "Water points are too far from home." "Rain falls from the sky to my bucket."</p> |
| Tradition (<i>n</i> = 13; 9%) | <p>"I grew up with river water." "That's what we've always had." "I've never tried treated water." "That's how we were born and raised."</p> |
| Cost (<i>n</i> = 12; 8%)* (<i>n</i> = 12; 18%)** | <p>"You have to have money to buy treated water." "Can't afford [treated water]." "Water from the river is free." "[Drinking rain] saves money."</p> |
| *Includes all households (<i>n</i> = 149). | |
| **Includes only households in two villages where a charge for water existed (<i>n</i> = 65). | |

enced participants' drinking water choices. Several participants blamed faulty operation and maintenance for the taste and smell of chlorine, the color associated with iron in their treated water, and the potential for health problems. As one respondent stated, "I've seen the water tank. I think it needs to be cleaned."

Access to Water

Self-hauling treated water from the water point, a difficult and time-consuming process, was described as a barrier to consuming treated water when untreated water could be obtained in closer proximity to the residence. Respondents noted that rainwater was particularly accessible because it could be harvested on site with no need for packing and hauling. Lack of transportation to haul treated water was reported as another barrier. In addition, having to obtain tokens for the coin-operated water points was described as a "hassle" that further deterred treated water consumption.

Not surprisingly, accessing treated water was a barrier for residents with physical- or age-related limitations. One older respondent offered that she drank treated water in the winter and rainwater in the summer. When asked to elaborate, she explained that her son hauled treated water for her in the winter, but during summer he was away from the village at fish camp, leaving her to consume the more easily obtained rainwater. A respondent living with paraplegia described a similar reliance on others to fetch his water.

Tradition

Treated drinking water became available in the four villages in 1962, 1968, 1981, and 1985, well after most U.S. communities. Until then, residents had no choice but to consume untreated water. Many respondents described consuming untreated water as the social norm. In fact, a few participants admitted that they had never even tried the treated

water available to them. Those who attributed their use of untreated water to tradition tended to be older (average age = 55).

Cost

The cost of treated water emerged as a motive among respondents in the two communities that charged a fee for treated water. Respondents in those communities noted that untreated river water and rain are free but that treated water incurs a charge. These respondents further explained that for some people with limited economic means, drinking untreated water is not a choice, but a necessity brought about by inability to pay.

Discussion

Understanding why Alaska Native people continue to drink untreated water when treated water is available is essential to designing effective and culturally responsive behavior change strategies toward water-borne disease prevention. In our study, we explored motivations for drinking untreated water in four southwest Alaska Native village communities that had access to treated water via a self-haul water system.

Qualitative analysis of data revealed six motivation themes for drinking untreated water: chemicals, taste, health, access to water, tradition, and cost. Among those six motivations, chemicals, taste, and health stood out in terms of the frequency at which they were reported; together, they accounted for 117 of the 204 (57%) statements provided by respondents, and those who cited one of them often cited the others. Further, these three motivation themes were related to the presence of chlorine in treated water. Most respondents who mentioned taste as a motivation focused on their dislike of chlorine, while respondents who mentioned health were concerned about the safety of chlorine in treated water. These concerns about chemicals, taste, and health are similar to those reported in a study conducted in northwest Alaska (Marino et al., 2009) as well as in studies conducted with non-Alaskan populations (Doria, Pidgeon, & Hunter, 2009; Patel, Bogart, Uyeda, Rabin, & Schuster, 2010; Saylor, Prokopy, & Amberg, 2011; Turgeon, Rodriguez, Theriault, & Levallois, 2004).

The motives described by participants in our study highlight the relationship between individuals and their environments (social, built, and policy). These findings attest

to the need for strategies that respond to issues and concerns occurring at multiple levels of the social-ecological framework. Public health interventions that take a social-ecological approach are particularly relevant to the environmental health profession because this approach acknowledges the importance of the environment in shaping individual behavior (Glanz, Rimer, & Viswanath, 2008). The three supra-individual levels of the social-ecological framework (family, community, and policy) are directly applicable to at least three different kinds of environments (social, built and policy), as will be illustrated below.

Structural modifications to the built environment, such as providing houses with piped water service, are often beyond the capacity of public health interventions. Nevertheless, such strategies fall within the scope of environmental health practice. Social ecology provides a framework for taking full advantage of the unique capacity held within the environmental health profession. Here, we use the social-ecological framework to suggest intervention strategies that are specific to the findings from this research and possibly transferrable to other populations, settings, and topics. Specifically, we discuss recommendations for the individual and the social, built, and policy environments. The individual and the social, built, and policy environments were deemed relevant to our study because our data suggested that they were areas where interventions could bring about the desired changes in behavior.

Individual Level

In our study, personal factors such as knowledge, attitudes, beliefs, and perceived barriers influenced residents' decisions to drink either treated or untreated water. For example, respondents expressed their concern about the taste and health consequences associated with chlorine (motive themes: chemical, taste, health). A strategy for addressing this concern would be to develop an education campaign. While health promotion materials may be available, it is important that the processes and materials of the campaign are adapted and contextually tailored to the specific circumstances, culture, and setting of the target population (Figueroa & Kincaid, 2010).

Social Environment

The social environment includes the individual's family, community, culture, and social norms. In our study, respondents described drinking untreated water as a long-standing traditional practice (motive theme: tradition). Activities to intervene must honor traditional practices while bringing forth new evidence-based health information. One strategy is to use participatory methods, such as those suggested by Fisher and Ball, where respected Elders and others are invited to be involved in all phases of community-level intervention, including development, implementation, and evaluation; this would help to ensure community acceptance, cultural sensitivity, and credible avenues of information diffusion (such as through community presentations, school classroom projects, and water treatment facility tours) (Fisher & Ball, 2002).

Built Environment

The physical environment comprises surroundings that are natural and built. Together they provide the setting for water source decision making and opportunities for intervention. In our study, participants reported limited access to treated water (motive theme: access). In the case of these four communities, this could be addressed by constructing piped water distribution systems that provide a convenient and plentiful supply of treated water to the home. Modifying the built environment offers the best solution for those who drink untreated water due to physical- or age-related disabilities and live in communities where construction of a piped water system is feasible. Marino and co-authors (2009) observed that residents with piped water service were more likely to drink treated water than those who self-hauled water. This was true even though both groups preferred untreated sources. Unfortunately, piped water systems may not be constructed in every community due to engineering and economic limitations. Environmental health practitioners are uniquely positioned to collaborate with colleagues from other disciplines to develop alternatives to piped water systems. In fact, at the writing of this article, the state of Alaska had called for the formation of multidisciplinary teams that pair environmental health professionals with experts from other fields such as engi-

neering, health education, and economics to come up with innovative alternatives (<http://watersewerchallenge.alaska.gov/>).

Policy Environment

The policy environment includes legislative, regulatory, policy making, and ordinance actions that affect water source decisions. The policies most relevant are those that determine the fees that grant residents access to treated water, along with the payment structures developed to cover these fees. Two common methods of charging for water include metered rates and flat rates. With metered rate structures, households pay for water on a per-unit basis. With flat rate structures, households pay a set monthly fee for unlimited water use. Metered rate structures are widely used to promote water conservation while flat rate structures promote liberal use (Gaudin, 2006). As long as paying for water poses a continuing challenge for residents in these economically limited village communities, flat rate structures should be adopted to address the motive theme of cost. Implementing payment systems to incentivize consumption of treated water is important and possible.

These recommendations are provided to inform the design and implementation of a behavior change program to reduce consumption of untreated water in these four village communities. The recommendations are based on a social ecological framework and sound principles and longstanding standards of environmental health practice.

Conclusion

Consuming untreated water is a universally recognized risk factor for infectious disease. As such, strategies for encouraging and supporting consumption of only treated water are critical. This study found that 82% of surveyed households were drinking at least some untreated water even though treated water was available in their community. Interventions addressing the motives described by respondents have the potential to decrease the use of untreated water and increase the use of treated water in these village communities. While our findings are specific to a unique population and setting, they corroborate those from studies conducted in other regions of Alaska and outside of Alaska.

While this article reported on the motives causing residents of four small, predomi-

nantly Alaska Native communities to consume treated or untreated water, we suggest that usefulness of this research extends beyond the topic, population, and setting in two ways. First, we use qualitative data collection and analysis, an approach that is underutilized in the field of environmental health. In fact, a review of 3,155 articles published between 1991 and 2008 found that even though qualitative data are rarely published in traditional environmental health journals, nearly all studies that did include these data reported increased scientific understanding (Scammell, 2010). Environmental health professionals may want to consider a qualitative approach as presented here in designing their future targeted intervention strategies. Second, our recommen-

dations for behavior change are based on a social-ecological framework, a framework that we suggest has particular applicability within the environmental health profession because of how it acknowledges and applies the role of the environment in shaping individual behavior. While we provide recommendations to address the risks associated with consuming untreated water, the social-ecological model could be applied to a range of topics in environmental health, such as encouraging food service workers to wash hands, promoting seatbelt usage among drivers, and increasing compliance with environmental regulations, or any issue that acknowledges the important role of multiple environments on human behavior. 🐼

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Corresponding Author: Troy L. Ritter, Applied Sciences Manager, Alaska Native Tribal Health Consortium, 3900 Ambassador Drive, Suite 301, Anchorage, AK 99508.
E-mail: tlrutter@anthc.org.

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