



Trends of Gastrointestinal Illnesses in Tribal Communities in EPA Region 8 (ND, SD, MT, WY, CO, UT) from 2000 to 2005

Draft Study Design

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Introduction: The rate of infectious diseases has decreased dramatically in American Indian and Alaskan Native (AI/AN) communities in the past 50 years¹. Public health programs such as mass vaccination, and bringing safe drinking water and basic sanitation to AI/AN communities have added in the reduction of infectious diseases in tribal areas¹. However, the percentage of AI/AN (12%) that are living without safe drinking water and basic sanitation is still disproportionately higher than the US population (1%)².

Many tribal communities are located in isolated areas that are served by small public water systems (PWS), 95% of all PWS in Indian land serve less than 3,300 people³. These small PWS lack the resources to perform regular drinking water standards monitoring that are required by the Environmental Protection Agency (EPA). Out of all the Total Coliform Rule (TCR) compliance violations in tribal PWSs from 1993 to 2006, only 15.78% were health-based violations where the PWS exceeded the TCR Maximum Contaminant Level (MCL). The rest of the violations were monitoring violations where the PWS failed to conduct the required water monitoring procedures. The association between drinking water standards violation and endemic waterborne diseases is unclear. This study is going to examine the relationship between drinking water quality and access to water and endemic AGI in tribal areas in Region 8. The findings from this study will further the understanding of drinking water standards and public health impact.

It is difficult to trend waterborne diseases because many cases are unreported due to the self-limiting nature of the illnesses⁴. The Indian Health Service (IHS) provides healthcare to 1.9 million AI/AN across the country. Their patients' health data are maintained in the Resource and Patient Management Systems (RPMS)^{5,6}. The information in the RPMS database may provide insight to the endemic waterborne disease burden related to drinking water quality and access in tribes. This study will link the PWS compliance and monitoring data from the US Environmental Protection Agency (EPA) with the IHS health data, in order to examine the association between the water quality and endemic gastrointestinal illnesses. Depending on the quality of the data and the available information, this study might also examine the association between access to safe drinking water and endemic illnesses in Indian land.

**Objectives:**

1. Describe and compare the gastrointestinal illness trends between tribes that are served by PWS with high rate of TCR MCL violation and tribes that are served by PWS with low rate of TCR MCL violation in EPA Region 8
2. Examine the association between water quality and endemic gastrointestinal illnesses between different tribes by looking at the TCR water quality monitoring data
3. Describe and compare the gastrointestinal illness trends for tribal communities that have access to piped water and tribal communities without access to piped water (possibly AZ, NW, and Navajo Nation)

Research Design: This pilot project will be a retrospective ecological study that describes the association between drinking water TCR MCL violations and GI trends; the association between the frequency of total coliform occurrence and GI; and the association between the access to piped water and GI. If findings are suggestive, then further research should be conducted for other tribes.

Tribes that were served by PWS with more than 10 TCR MCL violations from 2000 to 2006 will be categorized as the high exposure group. Tribes that were served by PWS with less than 5 TCR MCL violations will be categorized as the low exposure group. The criteria for drinking water standards can vary between different States, because States can implement their own standards as long as it is more stringent than the federal standards. Since the first part of the study is going to categorize exposure by using TCR violations data, we will only examine tribes that are located in states (ND, MT, CO) that adopted the federal TCR standard. The GI trends for the high exposure group and the low exposure group will be examined and compared.

The second phase of this study will examine the association between GI and the total coliform monitoring data. The exposed group will be tribes that were served by PWS with $>0.05\%$ positive TC samples per 1000 people within one year ($\%+ / 1000\text{-pr-yr}$) and the control group will be tribes that were served by OWS with $<0.05\%$ of positive TC samples per 1000 people within one year. We are going to use a person-time variable to identify the exposed and unexposed because the water sampling rate of a PWS depends on the size of its service population.

The last phase of this study is going to evaluate the gastrointestinal illness trends for tribal communities with piped water and tribal communities without piped water. According to the IHS fact sheet: *Safe Water and Waste Disposal Facilities* in 2007, AI/AN families with satisfactory environmental conditions, including access to safe drinking water, required $\sim 75\%$ less medical services⁷. The disease trends for these communities can provide insight on the potential public health impacts of access to clean drinking water.



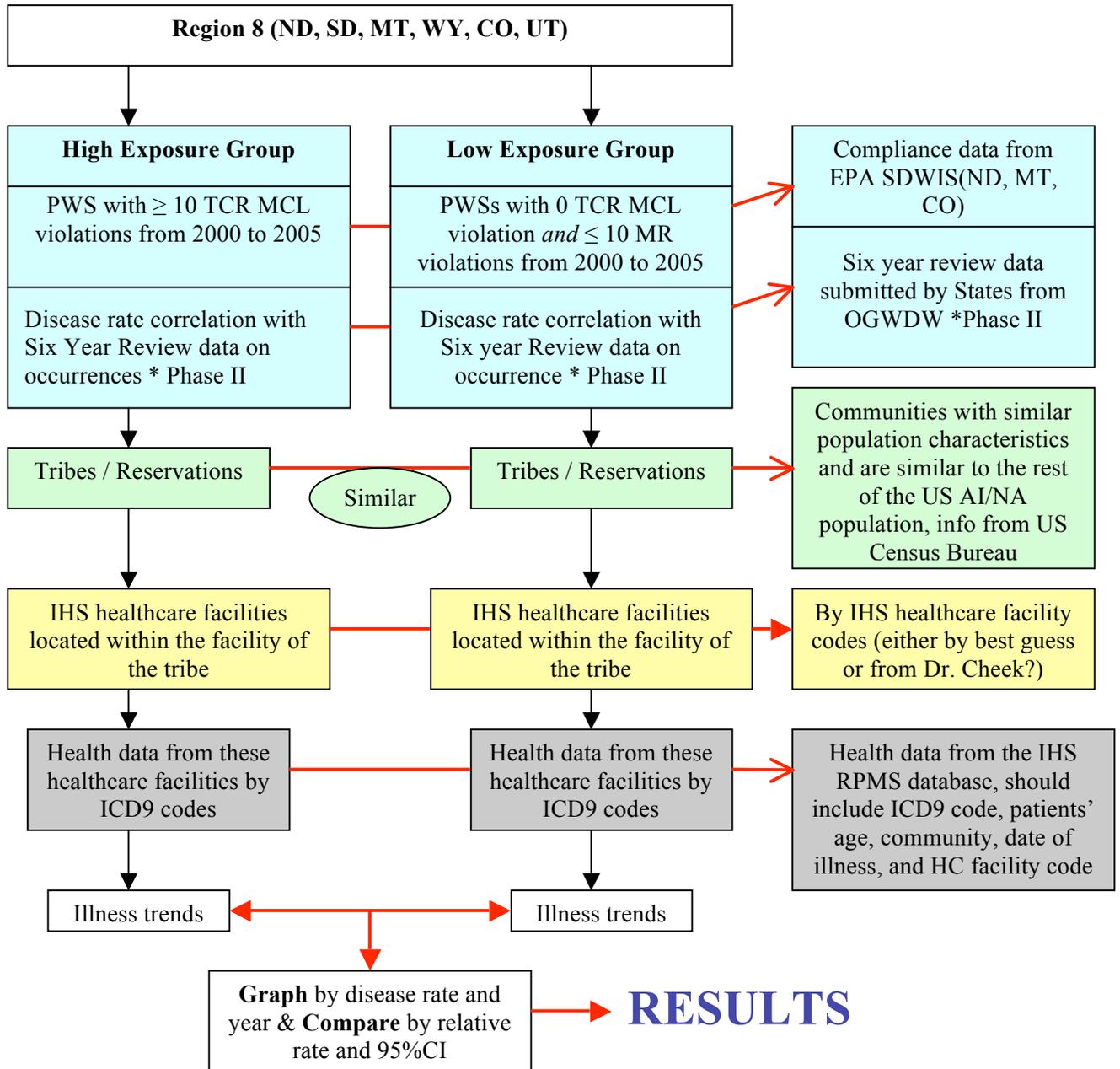
Study Population: The population selection will depend on the available data and the population characteristics of the tribes. Data quality is a concern because most TCR violations in Indian country from 2000 to 2005 were monitoring and reporting violations which may introduce non-differential exposure misclassification bias⁸. If a PWS did not monitor the water, then we will not be informed if there was a health standard violation. This should be addressed that statistical analysis. We will also try to limit other confounders by comparing tribes with similar social economic status. The criteria for community selection are:

1. The PWS have to have accurate drinking water monitoring and reporting data
2. The population characteristics (such as income, age distribution, etc) have to be similar to the rest of the AI/AN population in the US and other selected communities
3. Have to be a community that relies primarily on IHS for healthcare services
4. Communities without piped water will have to be in the sanitation deficiency level 5 or 4 of the Sanitation Deficiency System (SDS)
 - a. Level 5: Tribes or tribal communities that lack a safe water supply **and** a sewage disposal system⁹
 - b. Level 4: Tribes or tribal communities that lack a safe water supply **or** a sewage disposal system⁹

Study Significance: The findings from this study will provide insight to GI trends experienced by AI/AN that were served by different PWS. The results will further the understanding between endemic GI, and drinking water standard violation and the effects of the presence of total coliform. The GI rates comparison between communities with access to piped water verses communities without access to piped water will provide insight on the association between access to portable water, hygiene, and GI. If this pilot study demonstrates promising findings, then similar study should be conducted for other tribal areas in the United States. This project will also facilitate the development/creation of uniform tribal community identifiers between the EPA SDWIS database, IHS healthcare facilities, and the IHS SDS database. There is also potential to construction spatial data for tribal communities' locations, tribal PWS service areas, and IHS healthcare facilities.

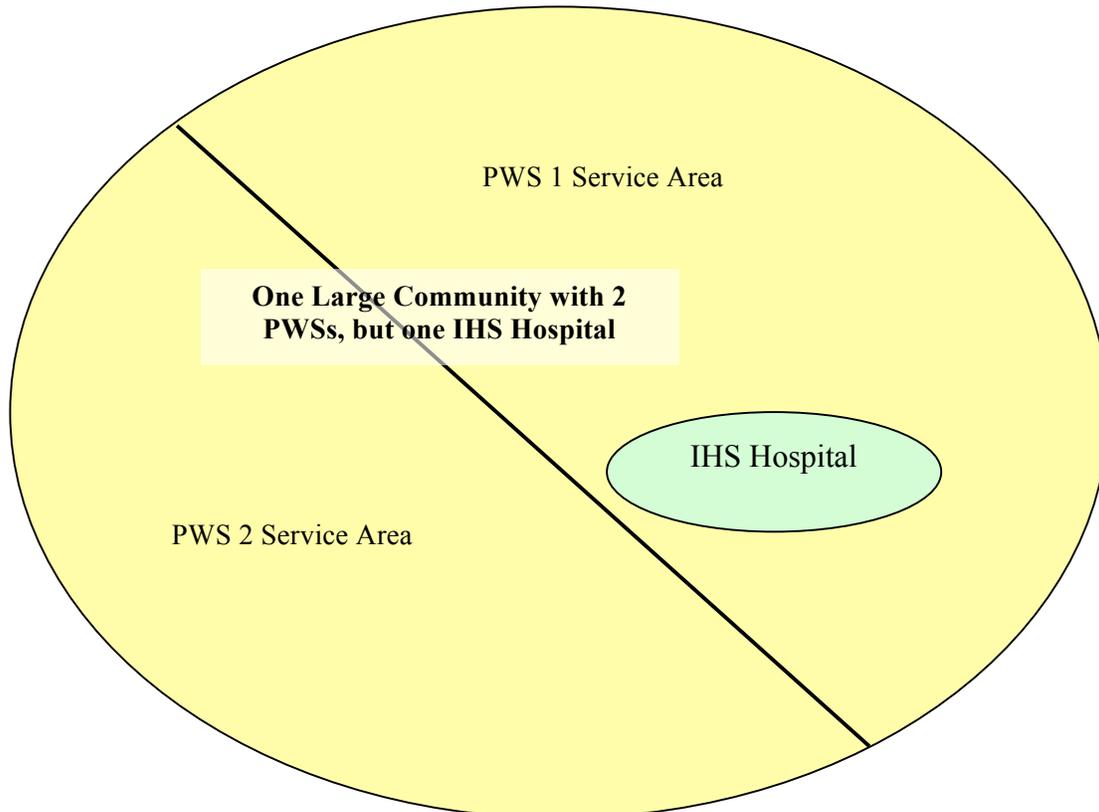
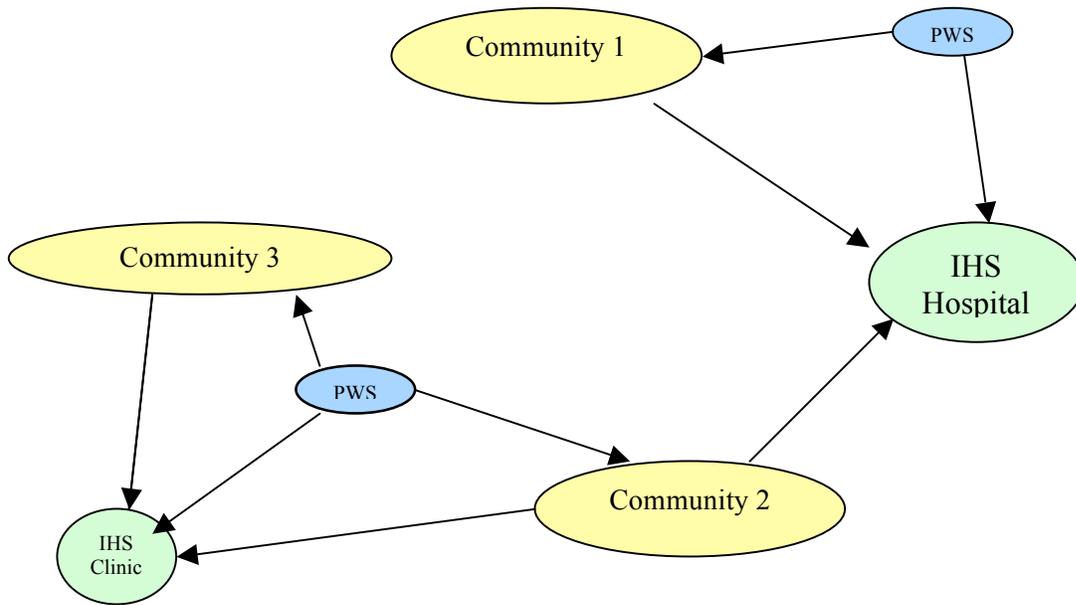


Methodology Flow Diagram:





Importance of the Spatial Relationship between PWSs, Tribal Communities, and IHS Healthcare Facilities





References:

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- ⁶ Indian Health Service. *Resource and Patient Management System*. Available at: <http://www.ihs.gov/Cio/RPMS/index.cfm?module=home&option=index> (Accessed 08/13/2007).
- ⁷ Indian Health Service. *Fact Sheet: Safe Water and Waste Disposal Facilities*. Available at: <http://info.ihs.gov/Files/SafeWater&Waste-Jan2007.doc> (accessed 08/13/2007).
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- ⁹ Indian Health Service. *The Sanitation Facilities Construction Program – Annual Report for 2000*. Available at: <http://www.dsfc.ihs.gov/Documents/SFCAnnualReport2000.pdf> (accessed 8/28/2007).