

Effect of water safety and hygiene initiatives on diarrheal illnesses in children in San Cristobal, DR.

Vincent DeGennaro, MD, MPH

Medical Students in Action

1. Introduction

In the rural parts of the Dominican Republic, there is still a significant burden from diarrheal illness in children under five years of age. The diarrhea is caused by many of the same pathogens that are present in other developing countries: rotavirus, bacteria, and parasites. Children are particularly susceptible to these pathogens since they do not have as strong an immune response as adults. They are also often malnourished at baseline which is exacerbated by the food and water borne pathogens.

Medical Students in Action (MSA) takes annual week-long trips to the rural towns of the department of San Cristobal. They hold clinics that offer medical screening and basic treatment in a health fair style setting. The total population of the towns is between 5,000-10,000 people and roughly 2,000 are children under five years of age. 46% of the population lives in poverty based on the government's definition which includes quality of life and access to essential services. The infant mortality rate is 32 per 1000 and the under five mortality rate of the region is 40 per 1000, compared to 32 and 36 nationally, respectively.ⁱ In San Cristobal, 43% of households have toilets and 50% use latrines while 7% use neither. These numbers are significantly more skewed towards latrines and neither in the rural parts of San Cristobal where Medical Students in Action works. Roughly 58% of the population gets their fresh water from an aqueduct in or around their house, 18% from a public faucet, 12% from tanker trucks that bring in water, and the remainder from wells, rivers and rain-catching cisterns.ⁱⁱ Again, in the rural parts of San Cristobal, there were no aqueducts until 2008 and the population got their water from either a river that was as shallow as one foot in the dry season or from private wells.

Studies from other non-governmental organizations show positive medical impact for long-term interventions such as permanent clinics.^{iiiiv} The data is sparse as the effect of short term missions on population health. The work of Medical Students in Action falls somewhere in between medical mission and long term involvement given the medical clinics, educational classes, and infrastructural improvements.

2. Hypothesis

Given the annual medical, educational, and social interventions of Medical Students in Action and their community partners, we expect that there will be a decline in the rate of diarrheal illnesses in children under fifteen years of age. In order to reduce confounding effects of overall population health improvements and economic improvements of the last several years, we will compare the improvement in our small town to that of the country as a whole. We will compare the national government statistics on diarrheal illness in children from 2002 and 2007 with our data from 2004 through 2008. National data from 1996 showed only half the number of cases from 2002 and 2007 which leads us to believe that the collection or analytic methods were significantly different. Based on annual rates of diarrheal

illnesses, the towns that work with Medical Students in Action will have a greater change in the number of cases of diarrheal illness than the national averages.

3. Methods

Study Design

In 2004, Medical Students in Action partnered with the communities to build two wells and two latrines at the local public school which doubles as a community center. All families had access to the wells but the latrines were largely used during school hours. In 2008, we partnered to build a rain-water cistern in another of the towns that can be used for all purposes but drinking. Medical Students in Action also helped to repair the broken pump on one of the wells in 2007. Throughout this time period, we were distributing bucket filtration systems to families determined to be most at need and given the budgetary constraints of the organization. From the spring of 2004 through the spring of 2008, Medical Students in Action held weekly clinics in each of the four towns that we work with. During these clinics, educational classes on nutrition, hygiene and water safety were held. Not all patients participated in these classes but roughly 30% did. In addition, families whose children presented with diarrheal illness were educated individually by their medical provider about how to minimize the risk of disease transmission through hygiene and food and water safety.

Definitions

The clinics are general medical clinics that offer specialists in OB/GYN, cardiology, and dentistry and we typically saw 200-400 patients per day. We kept detailed records of the demographic and medical information of all the patients from the first year on and entered the data into a database. Medical students and physicians used clinical histories and physicals to diagnose the patients and it is their determination of what the illness is that we will be using for the study's purpose. Primary, secondary and tertiary diagnoses were written on the patient encounter forms by the medical staff. Some of the patient encounter forms were incomplete as to the age, sex, name of the patient. In such cases the patient's diagnosis was still entered into the database for our record keeping purposes. Unfortunately, there was no effort to standardize the diagnoses at the time of the clinics. We did, however, attempt to categorize diagnoses when they were first entered into the database in 2006 and on.

The outcomes are number of cases of diarrheal illnesses in children as reported by family or observed in the one week annual clinic. Diarrheal illness was defined at the time of the clinic visit by a doctor or med student. Alternatively, the medical student entering in the patient encounter sheet into the spreadsheet may have used the described symptoms and noted physical exam to give the diagnosis of diarrheal illness. Ultimately, the spreadsheets of the electronic database are what will be used for the purposes of the study and not the patient encounter forms. We will not differentiate between causes of diarrhea such as water borne bacteria, viruses or parasites, food borne illness, or illness caused by fecal-oral contamination of food, water or fomites.

For the national data, the Office of National Statistics keeps records of the number of cases of diarrheal illnesses recorded over a two week period immediately before the survey of health was done. The data

that are posted online are from 1996, 2002, and 2007. A diarrheal illness was defined as three episodes of loose stools in a twenty four hour period or a stool with more water than usual. In the national data, family members were who made the determination of whether the child had diarrhea or not. The intermittent nature of the surveys, defined time period for data collection, and survey format all make for a good basis for comparison given the methods of Medical Students in Action’s data collection was very similar.

Sample size

The Medical Students in Action sample size varied depending on the year. The patient population for the study includes 800 to 1,500 patients per week with the least number of patients having been seen in 2004 and the most in 2008. Over 75% of the patients are women and children under fifteen years of age and roughly 45% of the total were children. This means that from 360 to 675 children were sampled in any given year. The sample size in the three national surveys was 4,169 in 1996, 10,487 in 2002, and 10,186 in 2007. These were 15.7, 14.0 and 14.7 percent, respectively, of the total pediatric population surveyed.^{vi} We were unable to choose a given sample size for either the intervention nor the control group given that we were working with already existing data.

The overall study design is retrospective, non-randomized, longitudinal study. It could be considered a case control study on a population basis. The control would be the national population data. The control group is not matched for specific confounders and includes the case group.

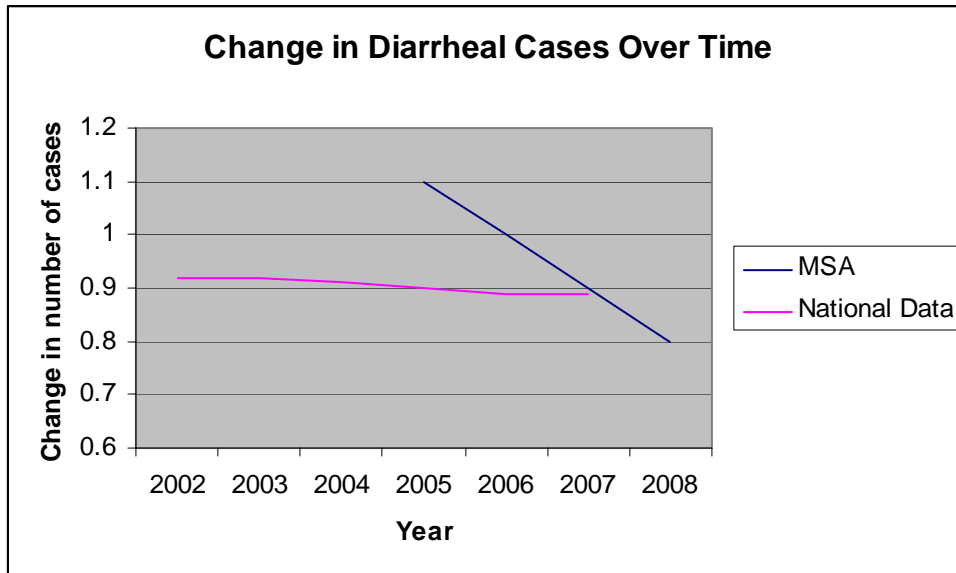
Statistical Analysis

For statistical analysis, we decided to compare the change in diarrheal illnesses in children under fifteen years of age over time in the two groups. After entering the absolute number of cases of children with diarrhea each year for five years, we have a slope that shows the rate of change over the course of the five years. Using the national data from 2002 and 2007 that have an absolute number of cases of children with diarrhea, we were able to calculate a slope of the rate of change. Both slopes were divided by the absolute number of cases in order to give a change as a proportion of the total number of cases for better comparison between the two years. Using excel, we were able to calculate the confidence intervals of the slope in the National Data group. If the slope of the MSA data lies outside the confidence interval of the National Data, then we can conclude that the interventions of MSA have made a significant impact on decreasing the rate of diarrhea in children. (Of note, the numbers on the MSA side are estimates based on two years data and do not represent the actual five years of data. Aggregation of all the data is still pending.)

With an alpha of 0.05 and standard deviation of 0.0057 given the values of change in slope used and sample size of five measurements, the 95% confidence interval of .0287 +/- 0.00462 or 0.0154 to 0.0246. With higher sample sizes this will decrease and with a larger standard deviation this will increase. Since the 95% confidence interval of 0.0154 to 0.0246 does not include the rate of change in the MSA group of

Year	MSA	National Data
2002		0.92
2003		0.92
2004		0.91
2005	1.1	0.9
2006	1	0.89
2007	0.9	0.89
2008	0.8	

0.1, we can conclude that there is a significant difference in the rate of change of cases of diarrheal illness between the national data and the MSA intervention group.



4. Subjects Selection

The subjects were all-comers to the clinics during one week in March of 2004 through 2008. The inclusion criteria were any patient seen in the clinic or on house calls during one of the medical trips as long as a patient encounter form was recorded. Overall, an overwhelming majority of the town's children visited the clinic during the week long clinic. While all children were not present, more than enough to signify a representative sample of the pediatric population. The few home visits that were done were less likely to have patient encounter forms but were also much less likely to have children that needed to be seen. There were always a few patients that did not come early enough to be seen by the medical team and these patients were therefore excluded. Also excluded are any patients that did not come to the clinic because they or their caretaker were too ill or were working or otherwise not physically in the catchment area at the time of the clinic. Those who work in Santo Domingo or other areas and may have seen their doctor before the clinic started or after it ended. Some people came to the clinic while they or their children were not sick solely to be seen by an American physician. Women and children are overrepresented in the study because they used the clinic more often than the men. The patients are all certainly vulnerable and subject to possible coercion if a non-medically necessary intervention were performed. Since the data we are using is after the time of the clinic and the interventions were performed as independently necessary, we did not obtain informed consent. Also, the data we are using at this point is anonymous and should not require the patient's consent.

5. Miscellaneous

If we were to design the trial from the start, we might select a similar population in another set of towns that could serve as the controls which would make the study a true case control study. The subjects are compensated with free medical care. Many minors are involved in the study and their parents consent

to their medical care and their use of the well water or water filters. Parents are usually present during educational classes as well.

ⁱ "Perfil Sociodemográfico Provincial" Oficina Nacional de Estadística, 2008

http://www.one.gob.do/themes/one/dmdocuments/perfiles/Perfil_san_Cristobal.pdf

ⁱⁱ VIII Censo Nacional de Población y Vivienda. Organización Nacional Estadística, 2002

ⁱⁱⁱ Gellert, GA. "Non-governmental organizations in international health: past successes, future challenges." Int J Health Plann Manage. 1996 Jan-Mar;11(1):19-31

^{iv} "The growing influence of non governmental organisations (NGOs) in international health: challenges and opportunities." J R Soc Health. 1998 Apr;118(2):107-15.

^v Encuesta Nacional Demográfica y de Salud. Centro de Estudios Sociales y Demográficos (CESDEM). 2007

^{vi} Encuesta Nacional Demográfica y de Salud. Centro de Estudios Sociales y Demográficos (CESDEM). 2002