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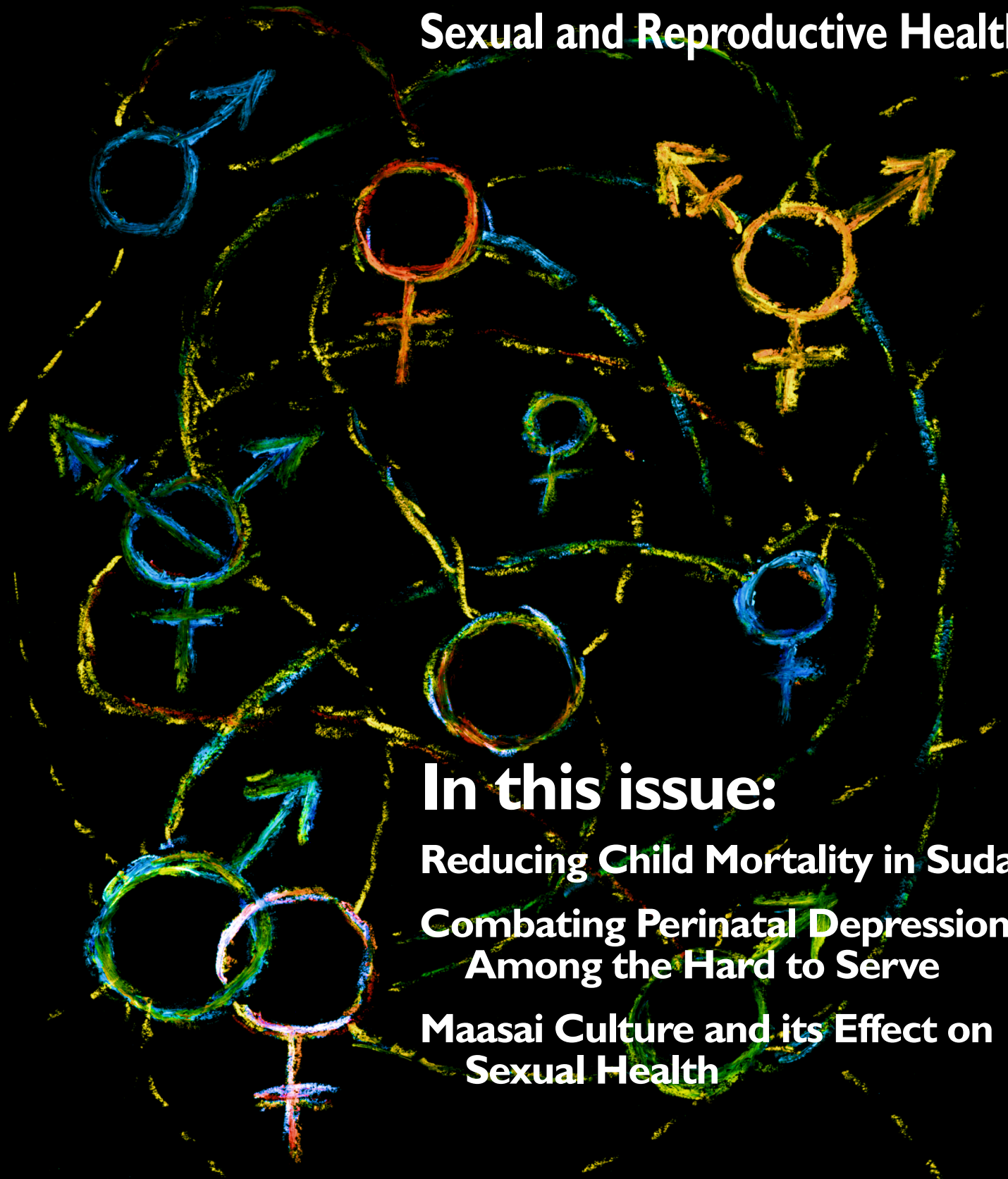
# The Journal of Global Health

## Sexual and Reproductive Health



## In this issue:

# Global Aspects of Sexual and Reproductive Health

Widespread discussion of sexual and reproductive health is a relatively recent development. Despite positive trends in the ways in which many people think about sexual health, the international organizations that determine the global heath agenda often lag behind, leaving crucial problems unaddressed. That the World Health Organization did not decide to remove homosexuality from its International Classification of Diseases until 1990 is only one example of this gap between health needs and response.

Even today, despite more open discussion of personal sexuality, this discussion needs to be further expanded to include global topics of sexual and reproductive health. In Volume IV, issue I of *The Journal of Global Health*, we focus on the challenges of addressing critical issues of sexual and reproductive health within diverse social, economic and political contexts.

Sexual and reproductive health encompasses a breadth of issues which profoundly affect all people throughout their lifespan and which are closely linked to ideas concerning identity, human dignity and freedom—the freedom of diverse forms of sexual expression without fear of coercion, violence or discrimination, as well as the capability to reproduce and the freedom to decide when, where and how to do so. Thus, any approach to sexual and reproductive health that effectively promotes both emotional and physical well-being requires openness to the needs of the people it aims to serve.

As *The Journal of Global Health* begins its fourth year of publication, we are proud to spotlight undergraduate voices within these discussions surrounding sexual and reproductive health. We hope that the issues raised here spark further dialogue concerning the implications and challenges of sexual well-being and the complex ways in which they manifest within our own communities as well as in global communities.

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## Perspectives



## Field Notes

# Reducing Child Mortality in Sudan by Preventing Diarrheal Disease

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**Sudan's rate of child mortality, measured as the number of deaths per 1,000 live births, decreased from 106 in 2000 to 73 in 2012. However, child mortality in Sudan far exceeds the global rate of child mortality, which was 48 in 2012. Contributing to this disparity is diarrheal disease, which is a leading cause of preventable death in Sudan. In this paper, we will examine diarrheal disease among children under five in Sudan through an analysis of the 2000 Sudan Household Health Survey. We conduct a retrospective investigation of the region now officially known as the Republic of Sudan, focused on possible factors related to diarrheal disease in the year 2000. We hypothesize that having access to clean water, improved sanitation facilities—defined here as any kind of latrine—and improved nutritional status through nutrient supplementation would, while controlling for confounding variables, lead to a dramatic decrease in the disease susceptibility of Sudanese children. Additionally, we tested whether maternal education level could alter the effectiveness of clean water and sanitation access.**

**Our results indicate that availability of household sanitation facilities, access to clean water and better nutrition were all associated with a lower incidence of diarrhea. Maternal education level had an ambiguous effect. Somewhat surprisingly, we found that communities with relatively better levels of sanitation access had higher levels of diarrhea incidence. We conjecture that this finding is due to individuals acting in self-interest as people do not adequately care for communal facilities. These behaviors may have a damaging effect on shared resources and, consequently, turn communal facilities from being beneficial to detrimental.[1]**

## INTRODUCTION

### Our Focus

Straddling North and Sub-Saharan Africa, Sudan has remained in the headlines over the past decade primarily due to its civil war, the crisis in Darfur and the recent secession of South Sudan in 2011. However, beyond the armed conflict, a profound tragedy is Sudan's child mortality rate, which was 73 per 1,000 live births in 2012 (Table 1), with roughly two-thirds of the overall mortality affecting infants (Table 2). In addition to diarrheal disease, common communicable diseases, such as malaria and tuberculosis, comprise the largest share of the disease burden in Sudan.[2] In this paper, we focus on diarrheal disease because it is generally preventable by simple, low-cost methods at the community and household level.[3]

It is important to note that we made our decision to conduct a retrospective study after we had selected our region and formed our hypothesis regarding diarrheal disease. This was largely driven by a lack of publicly-available, contemporary datasets. Given that we used a dataset from 2000, our findings may lack external validity over time. However, factors we found to have an impact on diarrhea in that point in time were quite surprising and might lead to new research directions. Additionally, a historical analysis can serve as a useful benchmark for future studies utilizing more recent datasets. One can investigate if similar effects are found in newer datasets and, if not, what factors changed.

### Diarrheal Disease

A leading cause of morbidity and mortality among children in Sudan in 2000 was, and continues to be, diarrheal disease, which occurs when the intestinal tract becomes infected by a viral, bacterial, toxic or parasitic agent. Rotavirus and *Escherichia coli* are the most common causes of diarrhea among infants and children globally, and there are approximately 1.7 billion cases of diarrhea each year. Unfortunately, young children are most affected.[4] For children under five, diarrheal disease was the second leading cause of death worldwide in 2013.[4] According to the Multiple Indicator Cluster Survey Report of 2000, 28% of children under the age of five in Sudan had experienced a diarrhea episode within the two weeks preceding the survey.[5] This is significant since under-five mortality in the Republic of Sudan is relatively high compared to neighboring countries (Table 1), and the World Health Organization estimated that diarrhea accounted for 13.1% of deaths among children under five in Sudan in a 2009 report.[6]

Diarrheal disease can spread easily and has serious physiological effects. It can be spread from person-to-person due to poor hygiene habits, but is more commonly spread through food and water sources that are contaminated with human feces. Areas that have open sewage drains and latrines are of high concern since people are more likely to be exposed to a pathogenic agent in the absence of suitable sanitation facilities.

Diarrheal disease often causes an intestinal infection in which the invading agent prevents intestinal cells from absorbing fluid and nutrients, thereby causing severe dehydration and malnutrition.[7] Treatment within 24 to 48 hours is critical for children because they are particularly susceptible to dehydration. Furthermore, a negative feedback cycle exists whereby malnourished children are more susceptible to an infection, and the illness itself causes severe malnutrition once the infection develops into diarrheal disease.

Diarrheal disease is preventable and treatable, but it continues to affect developing countries on a large scale for a multitude of reasons. Lack of access to safe drinking water, hand washing without soap and not receiving the rotavirus vaccine can all contribute to diarrheal disease in developing countries.[4] The most common treatment for diarrhea is an oral rehydration salts (ORS) solution, which is a simple combination of salt, sugar and clean water that aids in rehydration. Zinc supplementation is also a preferred treatment method that has been proven to reduce stool volume and duration of diarrheal episodes.[4]

There is evidence that preventative products are inexpensive and have high returns in mortality reduction for diarrheal disease.[8] Investing in household-level interventions will also help reduce the costs incurred by both individuals and healthcare systems for treating diarrheal disease.[9] As a concrete example, a randomized, controlled trial of children from over 300 households in squatter settlements in Karachi,

Pakistan, found that hand washing with soap has the potential to reduce episodes of diarrhea by thirty to fifty percent.[10] Furthermore, in a review covering 14 randomized controlled trials, the Cochrane Infectious Diseases Group determined that hand washing with soap also led to a 30% reduction in diarrhea for children and adults in low- and middle-income countries.[11] Preventing malnutrition is also a key component to fighting these diseases, as studies have shown that underweight children have an increased risk of dying from diarrheal disease.[12] The biggest challenge to large-scale adoption of these healthy practices is often lack of awareness.[13, 14] People might be unaware of the potential benefits of following such routines and making such investments, not know how to implement them effectively, or simply lack the necessary resources to put into practice the prevention strategies mentioned above.

Another promising prevention strategy involves sanitation. This effort requires greater investment in infrastructure and may have additional long-run costs such as educating people on how to best use and care for the infrastructure, but the benefits promise to be substantial. However, taking fiscal realities into account may mean that this kind of infrastructure project can only be implemented in high-population areas and with the aid of humanitarian organizations.

Based upon the existing literature surrounding diarrhea prevention, we hypothesized that our data would show that the most important elements in reducing diarrhea prevalence would be access to sanitation facilities, water cleanliness, nutrition and maternal education level. In the following section we use survey data and logistic regressions to determine the relative importance of these variables.

Table 1: Child Mortality Comparison for 2012[29]

| | Total Child Mortality *Thousands* | Mortality Rate *Per 1,000 live births* |
|---|---|---|
| Sudan | 89 | 73 |
| Egypt | 40 | 21 |
| Chad | 82 | 150 |
| Middle East & North Africa | 306 | 30 |
| Sub-Saharan Africa | 3,245 | 98 |
| Developing Countries | 6,463 | 53 |
| Developed Countries | 90 | 6 |
| Developed Countries | 90 | 6 |

Table 2: Child and Infant Mortality in Sudan for 2012[2]

| | Total Mortality *Thousands* | Mortality Rate *Per 1,000 live births* | Male Mortality Rate *Per 1,000 live births* | Female Mortality Rate *Per 1,000 live births* |
|---|---|---|---|---|
| Children *Under 5 Yrs. Old* | 89 | 73 | 79 | 67 |
| Infants | 60 | 49 | - | - |

Table 3: Summary Statistics

| Characteristics | Had Diarrhea in the Past Two Weeks | Did NOT Have Diarrhea in the Past Two Weeks |
|---|---|---|
| Rural | 29.19 | 70.81 |
| Urban | 26.61 | 73.39 |
| Female | 27.59 | 72.41 |
| Male | 28.98 | 71.02 |
| Mother Is Not Educated | 28.64 | 71.36 |
| Mother Has Education | 27.68 | 72.32 |
| Top 60% of Wealth Index | 28.32 | 71.68 |
| Bottom 40% of Wealth Index | 28.15 | 71.85 |
| Access to contained water | 26.96 | 73.04 |
| No contained water | 30.22 | 69.78 |

## METHODS

### Data Source: MICS2

Our dataset comes from the UNICEF-sponsored Sudan Household Health Survey (SHHS) conducted in 2000, the Multiple Indicator Cluster Survey-Round 2.[15] The MICS2 measures disease incidence, specifically the rates of diarrhea and fever incidence among children in the two weeks prior to the interview. This survey was conducted across fourteen regions of what was then Northern Sudan, now the Republic of Sudan, and each region was broken into 45 clusters. About 35 households were interviewed in each cluster, for a total of 25,200 household observations. From these households, data were gathered on 23,295 children under the age of five who will form the basis of our analysis.

### Regression Model

$$\Pr(Y_{i,d}=1) = \alpha+\beta_1 * X_{i,d} + \beta_2 * H_{i,d} + \beta_3 * I_{i,d} + \beta_4 * Cl_{c,d} + \beta_5 * R_{i,region}$$

For brevity, the above model has been compressed: each lettered covariate represents several covariates grouped by type. For example, $X_{i,d}$ is a group of variables that account for individual characteristics like age and gender, while $H_{i,d}$ groups household-level data such as access to a latrine and household socioeconomic status (strictly speaking, each represents a matrix of coefficients, while $X_{i,d}$, $H_{i,d}$, $Cl_{c,d}$, $I_{i,d}$, and $R_{i,region}$ are matrices of covariates). The full list of covariates has been reproduced in Table 4, and some of the more complicated covariates will be discussed in detail below.

The dependent variable in this model is whether a child under the age of five has had an episode of diarrhea within the last two weeks. Since the outcome variable is binary (0 for no diarrhea, 1 for a recent diarrhea episode), the type of regression we can use is somewhat constrained. Rather than using ordinary-least squares, we used a logistic regression analysis, which accounts for the lack of a continuous dependent variable.

While many of the covariates included in the model are straightforward, the inclusion of some variables might be confusing. We will review them and give explanations where necessary. The first group, $X_{i,d}$, includes dummy variables capturing gender, maternal education level (educated is considered anything beyond primary), nutrition quality and a categorical variable for age, while $H_{i,d}$ captures dummies for water quality, sanitation access, living in an urban environment, wealth index and a categorical variable for household size. We included maternal education rather than paternal, as studies have shown that mothers are more likely to be the child's primary caregiver.[16] We hypothesized that more educated mothers are likely better able to utilize resources and be more aware of how diseases are transmitted and so be better equipped to protect their children from diarrhea.

Additionally, we classified water quality in three ways: open, partially-covered and fully-covered. An open water source is typically a river, stream or pond, while partially-covered means a specific rain catchment or sand filtration system. A fully-covered water source means either water piped from a central authority or borehole. For sanitation, having improved sanitation is when the child has access to either a dug, covered latrine or a flush toilet.

Next, the matrix $I_{i,d}$ has relevant interaction terms that incorporate interactions between maternal education level and water quality, and again between maternal education level and sanitation access. This variable tells us the differential impact that maternal education level has on the effectiveness of clean water usage and sanitation access, under the assumption that education level has some impact on how facilities and water are used and cleaned. For example, a mother that is educated may be more likely to understand the need to keep a clean toilet to avoid disease transmittance than a mother that has not been educated.

Variable $Cl_{c,d}$ measures cluster level averages rather than simple individual levels. For example, a cluster level sanitation average of 0.8 means that eighty percent of the respondents in that cluster have access to improved sanitation facilities. Our rationale is that disease incidence is related not only to an individual's access to water or sanitation, but also to the aggregate levels in a cluster. Diarrhea is predominantly caused by communicable diseases passed between people, so there may be spillover effects from having a high or low level of sanitation in a cluster.

Finally, $R_{i,region}$ is a matrix of dummies that tells which region the child lives in. In the regions of North Sudan there are substantial sys-

tematic differences, primarily geographic (i.e. lush vs. arid) and political (some areas have been exposed to more conflict than others). Adding these covariates allows us to see which regions seem to be hardest hit by diarrhea.

We ran four versions of the model when running our regressions: Model 1 has only individual level and household covariates; Model 2 adds in interaction terms; Model 3 incorporates spillover effects; and Model 4 finally adds in regional differences.

## RESULTS

Below we have reproduced the results from all four regression models for diarrhea incidence (Table 4). Across all four models, we found several covariates with significant effects: child's age, urban environment, regular use of any milk, whether the child is male and the size of the household. Interestingly, male children show higher levels of diarrhea incidence than female children. Though this difference is puzzling, determining the answer goes beyond the scope of this paper.

The coefficients on access to partially-covered water (-0.174) and fully-covered water (-0.164) show that better water quality decreases the likelihood of having diarrhea. Both coefficients are significant ($p<.001$) in the first two models. In Model 3, with the inclusion of community-level averages, these variables lose statistical significance. Instead, the same effect from Models 1 and 2 seems to be captured by community-level averages. This is a plausible outcome, as water quality is likely very homogenous at the community level, and so incorporating this variable decreases the significance of individual-level water quality by drastically reducing heterogeneity. Similarly, in Model 4, we lose any significance among all the water quality variables, as water quality is also strongly tied to regional differences.

The variable that captures the education level of the child's mother shows no statistically significant effect across all four models. However, the interaction term between maternal education level and having access to partially covered water is positive and significant ($p<.05$) in Models 2 (0.274), 3 (0.269) and 4 (0.255). Literature exists showing that more educated mothers are able to better protect their children from diseases, which makes this result confusing. This will be discussed further below.

Interestingly, we find no statistically significant effect from having access to a latrine or toilet in the first two models. However, the coefficients in Models 3 (-0.135) and 4 (-0.128) are negative and significant with $p<.05$. In contrast, the variable for community-average level of sanitation in Models 3 (0.273) and 4 (0.189) are positive and highly significant with $p<.001$. This surprising outcome, that the household-level and community-level sanitation effects are in opposite directions, will be discussed in depth in the next section.

Finally, Model 4 shows some interesting results with regards to regional differences. In particular, the coefficients on the regions of River Nile (0.574), Kassala (0.395), Blue Nile (0.77), Khartoum (0.594) and South Darfur (0.383) are strongly positive and significant with $p<0.001$, suggesting that children in these regions are particularly susceptible to diarrhea.

## DISCUSSION

### Sanitation

One of the most striking results is that community- and individual-level sanitation usage seem to operate in different directions: a high community average of sanitation access is correlated with higher rates of diarrhea, while a high individual level of access is tied to lower incidence of diarrhea when compared to no access to sanitation facilities. We take this as an indication that individual access to sanitation is beneficial, but community-level access is detrimental. That is, if many people in a community are sharing sanitation facilities, this can actually increase rates of diarrheal disease. We hypothesize two possible mechanisms for this occurrence. First, having many people share the same sanitation resources can facilitate the transfer of bacteria and parasites between hosts. With communal facilities, we conjecture that people are more likely to come into contact with bacteria or parasites due to poor management of the facility.[17] Second, individuals may not be invested in the upkeep of communal facilities due to lack of ownership, leading to the degradation of communal sanitation areas—a phenomenon known as the tragedy of the commons.[1] Regardless of the reason, this difference between the individual and community levels of sanitation will play a major role in our recommendations.

Our results indicate that the number of individual level facilities in Sudan should be scaled up, so that people can rely less on communal latrines and toilets. Since it is possible that communal facilities increase the danger of contamination, another possible strategy for reducing child diarrhea rates is increasing the presence of hand washing stations equipped with soap. Given the ongoing conflict in Sudan and lack of involvement by the central government in peripheral regions, much of this work would likely need to be implemented by non-governmental organizations.

Where the only available facilities are those for public use, it is critical that proper hygiene is maintained through hand washing with soap. To encourage this practice we suggest subsidies for soap so that it is made available at every sanitation facility. However, soap availability should be combined with education on proper hand washing techniques as well as hand washing stations, which are a key part of soap use.[18, 19, 20] These stations can be built with locally available products to reduce costs and increase implementation. UNICEF has implemented programs to educate and teach communities how to construct the stations through Community-Led Total Sanitation Programs (CLTS).[21] The feasibility of these programs depends on various factors, such as government support and a coordinated national strategy to improve sanitation. For example, the national governments of Zambia and Sierra Leone are actively scaling-up CLTS programs and including them in district health plans.[21] The CLTS model, which requires communities to design and build their own latrines using materials available locally in the hopes that this will maximize accountability and maintenance of the facilities, could be another effective strategy for reducing child diarrhea rates in the Republic of Sudan.

> There is evidence that preventative products are inexpensive and have high returns in mortality reduction for diarrheal disease.

### Education

The results of the mother's education variable seem to run counter to the literature and our expectations. Considerable research has been done linking levels of maternal education to a decreased diarrhea incidence but our findings show either no correlation or, in the interaction term, a positive correlation (Models 2, 3 and 4 in Table 4).[22, 23, 24] This seems to imply that a child with an educated mother and a partially covered water source will be more likely to experience diarrhea than a similar child with an uneducated mother. We would expect that a more educated mother would have both more information on prevention strategies and would be able to more effectively implement them. However, other studies such as Dargent-Molina, James, Strogatz and Savitz, have shown that the effect of maternal education on child diarrhea incidence is dependent on the mother's socioeconomic environment.[25] That is, while maternal education has a protective effect on infant diarrhea in economically advantaged households, there is no effect on child diarrhea incidence in socially and economically disadvantaged communities. In the study by Dargent-Moline et al., advantaged and disadvantaged communities were designated by access to community economic resources, level of household assets and availability of social mothers' groups, defined in this study as organized social gatherings that provide informal education on a variety of topics including health-related issues.[25]

It is possible that this type of economic advantage could be confounding our results. The variable we used to measure mother's education level was binary, with mothers broken into two groups, one of which had not attended secondary, while the other group had spent at least some time in secondary school. This lack of granularity makes it difficult to disentangle the effect of years of education from access to education, which itself could be tied to other factors (e.g. urban women are more likely to

have access to secondary schools). Without a stronger education variable, we cannot make any strong assertions about the channel through which a mother's education affects a child's diarrhea risk.

Additionally, most of the evidence in support of mother's education as diarrhea prevention is associated with targeted programs rather than general education. In North Sudan, it is possible that implementing targeted education programs rather than increasing formal education might be a more effective policy in reducing incidence of diarrhea. For example, a community education program may help to teach community members how to prevent and treat diarrhea. To target mothers, education programs or workshops could be implemented that specifically address practices pertaining to food safety and strategies to prevent diarrhea in the household. Programs with topics such as hand washing with soap could target school-age children, while workshops on the proper use of ORS could target households and communities where diarrhea incidence is high.[26] Another possible recommendation is to include UNICEF Water, Sanitation and Hygiene (WASH) programs into the school curriculum.[27] In this way, children can learn about the causes of diarrhea and how to prevent the disease through formal education.

## Regional Differences

In all four models, the negative and statistically significant coefficients on the urban environment variable suggest that children in urban settings are less likely to suffer from diarrhea than those in rural settings (see Table 4). The assumption we make is that urban environments tend to have more sophisticated and comprehensive water and sanitation infrastructure in place that reduce disease burden in the cities. At the same time, one would expect that since cities are more crowded, there should be an increased probability of transmission. It could be that we found a statistically-significant negative coefficient in all four models because either the effect from the improved infrastructure outweighs the increased likelihood of transmission or because the infrastructure is different. As explained above, we also found that latrines or toilets at a household level correlated with reduced incidence of diarrhea, while communal facilities were correlated with an increased risk. It could be that urban areas have a greater proportion of household-level facilities than rural areas.

The negative coefficients we found on the water quality variables in our models align with our expectations that higher water quality should be correlated with a reduced incidence of diarrhea. However, they are only significant in Models 1 and 2. It seems that the effect of water quality is subsumed by the aggregate coefficients added in Models 3 and 4 (community averages). These variables measure the average level of water quality in a community. In Model 3, these coefficients are in accord with the literature, as higher water quality is strongly associated with reduced rates of diarrhea.[28] However, water quality coefficients are no longer significant in Model 4, which incorporates dummy variables for regions. We assume this is because water quality is highly correlated with regional differences such as water infrastructure as well as access to well water or open water sources. More precisely, we expect that regions with better water delivery infrastructure, for example, would help deliver clean water to households, which would in turn have lower rates of diarrhea.

After comparing regional differences between the incidence of diarrhea and correlated factors, it is clear that certain regions fare much worse than others. Kassala, Al-Gadafir, the Blue Nile Region, Northern Kordufan, Southern Darfur and Western Darfur have among the highest levels of diarrhea as well as the lowest ratios of educated mothers, contained water and sanitation facilities. Interventions might be prioritized for these regions specifically. Programs targeting these regions must also take into account the pervasive conflict as well as the resulting displacement of people. For example, it might simply be too risky, both in terms of human lives as well as investment, to build large-scale sanitation infrastructure in areas where armed conflict continues.

## CONCLUSION

In our analysis of diarrheal disease in the Republic of Sudan in 2000, we found some surprising correlations between access to community sanitation systems, education and regional differences in the incidence of diarrheal disease among children under five years of age.

Table 4: Diarrhea Incidence Among Male and Female Children
Dependent Variable: *Had Diarrhea in Past Two Weeks*

| Diarrhea | Model I | Model II | Model III | Model IV |
|---|---|---|---|---|
| Age | -0.139*** (-12.89) | -0.139*** (-12.88) | -0.139*** (-12.88) | -0.139*** (-12.77) |
| Male | 0.0652* (2.13) | 0.0650* (2.13) | 0.0638* (2.09) | 0.0665* (2.16) |
| Household size | 0.0143** (2.62) | 0.0148** (2.70) | 0.0123* (2.22) | 0.00865 (1.54) |
| Lives in a city | -0.118** (-3.07) | -0.122** (-3.16) | -0.132*** (-3.34) | -0.148*** (-3.62) |
| First (Top) Wealth Quintile | 0.0536 (0.73) | 0.0561 (0.75) | 0.0867 (1.15) | 0.176* (2.23) |
| Second Wealth Quintile | 0.110 (1.70) | 0.109 (1.65) | 0.127 (1.91) | 0.229*** (3.31) |
| Third Wealth Quintile | 0.152* (2.49) | 0.152* (2.43) | 0.163** (2.60) | 0.252*** (3.86) |
| Fourth Wealth Quintile | 0.135* (2.25) | 0.136* (2.24) | 0.142* (2.33) | 0.180** (2.92) |
| Mother is educated | 0.0166 (0.46) | -0.122 (-1.45) | -0.144 (-1.70) | -0.101 (-1.18) |
| Water source is partially covered | -0.174*** (-3.37) | -0.247*** (-4.16) | -0.0596 (-0.69) | -0.0608 (-0.70) |
| Water source is fully covered | -0.164*** (-3.98) | -0.162*** (-3.43) | 0.0357 (0.46) | 0.0376 (0.48) |
| Eats meat regularly | -0.0148 (-0.34) | -0.0108 (-0.25) | -0.0233 (-0.53) | -0.00886 (-0.20) |
| Drinks milk regularly | -0.284*** (-7.01) | -0.285*** (-7.01) | -0.283*** (-6.95) | -0.269*** (-6.46) |
| Has improved sanitation facilities | 0.0137 (0.37) | -0.0241 (-0.55) | -0.135** (-2.61) | -0.128* (-2.44) |
| Educated Mother and Partially covered water | | 0.274* (2.47) | 0.269* (2.42) | 0.255* (2.27) |
| Ed. Mother and contained water | | 0.0314 (0.37) | 0.0348 (0.41) | 0.0341 (0.40) |
| Ed. Mother and improved sanitation | | 0.119 (1.62) | 0.138 (1.88) | 0.125 (1.68) |
| 'Village average for partially covered water | | | -0.296** (-2.93) | 0.0636 (0.59) |
| Village average for fully covered water | | | -0.304*** (-3.51) | -0.0524 (-0.58) |
| Village average for improved sanitation | | | 0.273*** (4.03) | 0.189** (2.65) |
| Lives in River Nile Region | | | | 0.574*** (5.35) |
| Lives in Red Sea region | | | | -0.0344 (-0.28) |
| Lives in Kassala region | | | | 0.395*** (4.30) |
| Lives in Al Gazira region | | | | 0.154 (1.47) |
| Lives in White Nile region | | | | 0.214* (2.15) |
| Lives in Blue Nile region | | | | 0.770*** (8.37) |
| Lives in Khartoum region | | | | 0.594*** (5.89) |
| Lives in North Kordufan region | | | | 0.148 (1.32) |
| Lives in South Kordufan region | | | | -0.191 (-1.83) |
| Lives in West Kordufan region | | | | 0.0307 (0.30) |
| Lives in North Darfur region | | | | 0.0900 (0.86) |
| Lives in South Darfur region | | | | 0.383*** (3.82) |
| Lives in West Darfur region | | | | 0.212 (1.95) |
| Constant term | -0.507*** (-5.33) | -0.484*** (-5.08) | -0.475*** (-4.82) | -1.029*** (-7.91) |
| *N* | 21466 | 21466 | 21466 | 21466 |

*t* statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Possible explanations for these results were proposed as well as policies and interventions that might lead to reduced rates of diarrheal disease in the Republic of Sudan. However, it is clear that there is a need for further investigation to establish or reject causality and gain a further understanding of the detailed dynamics underlying these results. To this end, we hope to extend our research to a more contemporary dataset.

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# An Ethnographic Approach to the Nutrition Transition in Ecuador

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***Objective*: To offer an in-depth case study of how diabetes is affecting one urban family and one rural family in Ecuador.**

***Methods*: In-depth interviews, observations and participation in food preparation were realized in one rural family and one urban family living in Ecuador who have at least one member suffering from diabetes; this is a disease understood as a consequence of the nutrition transition. Emphasis was placed on the socio-economic factors that shaped the two families' experiences with diabetes.**

***Results*: The nutrition transition can be defined as a global trend towards diets based on highly processed foods and the appearance of diseases related to such diet modifications, such as diabetes and heart disease. Nutrition transition theory links urban areas with higher incidences of nutrition transitions than rural areas. However, it appears that the rural family studied for this paper is shifting towards a diet high in processed foods that is suggestive of a nutrition transition. This is a situation that requires further research. While urban and rural dynamics were considered throughout this investigation, socioeconomic status was another major variable when analyzing how both families dealt with diet and diabetes. The socioeconomic status of members in each family also influenced their medical trajectory: the rural family, which maintains a lower socioeconomic status than the urban family, was less likely to follow a medical treatment plan for diabetes. In both the urban and rural families, the eldest generation has lived through many of the changes in food preparation and consumption associated with the nutrition transition, such as switching from manual to mechanical cooking techniques and from consuming naturally sweetened to sugar-sweetened beverages. Most members of the urban family benefited from the help of a domestic employee in food-related activities. On the other hand, many members of the rural family were for some period of time working as domestic employees; this allowed them to learn how to cook at an early age and was also a source of financial and medical insecurity in at least one case.**

***Conclusions*: This case study describes one rural and one urban family's diets and reported changes in diets; it was found that even the rural family was experiencing changes in dietary habits that suggest the presence of a nutrition transition. This singular case study could serve as a springboard for future rural nutrition transition research using more statistically significant samples. Further research could determine if this is a confined case or a widespread issue, and could explain how different rural locations in Latin America, and the world, may be experiencing the nutrition transition.**

## INTRODUCTION

The worldwide leading cause of death in 2011 was ischemic heart disease, a chronic condition also known as coronary heart disease. Cancer and diabetes—other chronic diseases—were also found within the top ten causes of death.[1] One interpretation of this unprecedented rise in chronic diseases is known as the nutrition transition, defined as an overall global trend towards diets based on processed foods containing more fat, sugar and salt, and fewer fresh, fiber-rich foods. These changes in food consumption promote a host of diet-related diseases, including diabetes and obesity.

The nutrition transition theory was developed by Barry Popkin, a professor of nutrition at the University of North Carolina at Chapel Hill, who has conducted population-level studies on the subject in Brazil, China, Japan, Mexico, Russia and the United States since the 1970s.[2] Popkin explains the nutrition transition according to three continuing historic shifts in dietary and lifestyle habits that took place in the last two decades of the twentieth century; they occur as countries become more urbanized and industrialized. First, a demographic shift from high rates of fertility and mortality, associated with intermittent famine, to low rates, associated with greater consumption of foods high in added fat and sugar; second, an epidemiological shift from high incidences of communicable diseases, such as tuberculosis and hepatitis, to high incidences of non-communicable diseases, such as diabetes and heart disease; third, a shift in the consciousness and behavior of individuals marked by healthier diet-related habits and efforts to prevent non-communicable diseases.[3]

Both epidemiological and demographic evidence suggest that Ecuador is undergoing a nutrition transition. Epidemiologically, Ecuador is experiencing high increases in non-communicable diseases, as indicated in Table 1; over the past ten years, non-communicable diseases have comprised the country's top killers. As stated above, one of the historic shifts that serve as evidence of a nutrition transition is a decrease in fertility. Ecuador is experiencing this shift: in 1960, the average number of children born per woman was 6.7 compared to 2.5 in 2010 (Table 1).[4]

The National Institute for Statistics and Census (INEC) reported that two of the principal causes of death in Ecuador were diseases related to hypertension and diabetes mellitus (which includes type 1 and type 2 diabetes).[5] For every 100,000 inhabitants in Ecuador, the incidence of diabetes rose from 80 in 1994 to 488 in 2010, and that of hypertension rose from 63 in 1994 to 652 in 2010. The coastal region records the highest rates for both diseases, women being more affected than men.[5] The fact that women living on the coast in Ecuador are experiencing higher incidences of hypertension and diabetes is a subject

that merits further research.

Nutrition transitions are overwhelmingly linked to urbanizing areas. Those residing in urban sectors, Popkin argues, more easily acquire modern diets and sedentary lifestyles that make them more vulnerable in comparison to those residing in rural sectors, who often maintain traditional eating behaviors and higher physical activity levels.[6] However, this case study shows that family members residing in rural Ecuador are also experiencing a nutrition transition. Detailed interviews conducted with family members living in rural Ecuador indicate the presence of dietary habits consistent with the nutrition transition, namely the consumption of high fat and sugar foods and the presence of diabetes.

**Table 1.** The Ten Principal Causes of Death in Ecuador (2000-2010)

| | 2000 | 2005 | 2010 |
|---|---|---|---|
| 1 | Non-classified | Non-classified | Non-classified |
| 2 | Heart disease | Heart disease | Hypertensive heart disease |
| 3 | Cerebrovascular disease | Cerebrovascular disease | Diabetes mellitus |
| 4 | Diabetes mellitus | Hypertensive heart disease | Influenza and pneumonia |
| 5 | Hypertensive heart disease | Diabetes mellitus | Heart disease |
| 6 | External Causes | Pneumonia | Traffic accidents |
| 7 | Pneumonia | Ischemic heart disease | Cerebrovascular disease |
| 8 | Ischemic heart disease | Homicide | Homicide |
| 9 | Perinatal conditions | Traffic accidents | External Causes |
| 10 | Homicide | Perinatal conditions | Ischemic heart disease |

Source: Data from the *Instituto Nacional de Estadística y Censos* (INEC) (4).

Nutrition transition research has generally applied predominately-quantitative, population-level studies that analyze demographic and epidemiological statistics. The latest attempt to address the nutrition transition in Ecuador was a two-part article detailing population and diseases trends.[7,8] Yet, only a few first-hand accounts contextualize how individuals and families experience these transitions in circumstances that are unique to Ecuador. This paper provides a deeper look into the little-documented effects of the Ecuadorean nutrition transition.

Several factors contribute to this rise in non-communicable diseases. One such factor is the prevalence of improperly balanced diets. In Ecuador, balancing food groups is a challenge for the general population. This mainly occurs due to an over-emphasis on starches, such as rice, potatoes and plantains, and fats, such as margarines and butter, as well as an under-emphasis on proteins and vitamins from meat, dairy, legumes and vegetables.[9]

Government and industry-controlled food systems exert a large influence in shaping dietary habits. Global marketing strategies that push novel, hyper-processed foods generally lead to a rejection of more traditional, less industrialized fare.[10] Foreign food policy in Ecuador has historically favored imported cash crops, like wheat, that hurt the domestic production of similar crops; this puts food production in foreign hands.[11]

Evidence of a nutrition transition in Ecuador underscores the need for more investigation into the dietary changes associated with the rise of non-communicable diseases. Becoming more informed about the implications of nutrition transitions may help encourage public policies that promote robust prevention plans and response strategies in Ecuador. As evidence in this paper suggests, rural family members in Ecuador are experiencing diet and disease-related changes associated with the nutrition transition. This paper aims to determine how socioeconomic status affects the diet and disease state of the family members interviewed in Ecuador, detail how their eating habits have changed over time from information provided by interviews with older and younger family members and, finally, review new policies aimed at managing the rise in non-communicable diseases.

## METHODS

This case study took an ethnographic approach to the nutrition transition using careful observations, one-on-one interviews and time spent cooking and/or eating with each member of the two families interviewed. The criteria for choosing the two families stipulated that at least one member from each family have diabetes, that the families originate from different geographic locations and that they have differentiated socioeconomic statuses. All members of the urban family reported that their total monthly household earnings ranged from more than $1,001 to more than $3,000, while all members of the rural family stated that their total monthly household earnings ranged from less than $500 to no more than $1000. The rubric was taken from the five income categories designed by FLACSO-Ecuador.[12]

Ecuador's National Census and Statistics Center (INEC) determined these socioeconomic categories using the following dimensions: housing, education, economics, consumer goods, technology and consumption habits. Each dimension was given a set of points; according to the average points earned for each dimension, five socioeconomic groups were formed. From highest to lowest, the five socioeconomic groups were given the following classification: A, B, C+, C- and D.[13] According to the latest 2011 socioeconomic stratification survey performed by INEC, all members of the urban family would be placed in categories A and B, which are effectively the two highest socioeconomic classes; all members of the rural family, excluding one, were classified in categories C- and D, which are the two lowest socioeconomic classes.[13]

In order to locate families to be interviewed, diabetic associations were first contacted. Because this initial strategy did not produce results, friends, family members and colleagues were asked if they knew someone with diabetes. This second strategy successfully located two families. One family was from the capital city of Quito, located in the Sierra, and the other was from a small, rural town called Flavio Alfaro, located on the Coast. The family from Quito will be referred to as the urban family and the one from Flavio Alfaro is the rural family, though one member from the rural family now resides in Quito. The origins of the rural family can be traced to the northeast of the province of Manabí, in the town of Flavio Alfario. As of 2010, close to 40,000 people were residing in the biodiverse town of Flavio Alfario, where agronomy comprises the main economic activity.[14] Quito, the capital of Ecuador, is a bustling city with a little over two million habitants. Public and private administration and commerce, along with health, education and social service industry activities, compose the largest economic sectors.[15]

Five members from each of the two families, spanning three different generations, were interviewed for a total of ten interviews. In the rural family, the eldest interviewee was an 85-year-old grandmother, who had a 58-year-old daughter and three granddaughters, ages 42, 39 and 36. It should be noted that these granddaughters share different fathers. Because the 91-year-old grandmother in the urban family could not be reached, an interview with her daughter was conducted that followed the same questionnaire used in all other interviews. The other members of the urban family included the grandmother's 58-year-old son and his wife, as well as their two daughters, ages 31 and 27.

The urban family had one member, a 61-year-old from the second generation, who suffered from diabetes. The rural family had two members, a 58-year-old female from the second generation and a 36-year-old female from the youngest generation, who suffered from diabetes. It should be noted that the 36-year-old female moved to Quito at the age of 17, though she affirmed that she largely maintains a traditional diet which reflects the kinds of food eaten in her rural hometown, Flavio Alfaro.

The field research began in March 2012 and was concluded in September 2012. Each interview lasted an average of two to three hours, and extra time was spent observing living conditions and participating in cooking-related activities. The main categories included in the interview questionnaire were: organization of food shopping and cooking; food and shopping before and after onset of diabetes; changes/difficulties/novelties related to diabetes; consumption habits on weekdays, weekends, at work, outside the home, during holidays and during special events; learning how to cook; healthcare services; exercise/physical activity; and opinions about nutrition in general (Table 2).

All of the interviews were conducted in Spanish with the exception of the eldest daughter from the urban family, as she preferred to speak in English. After being recorded, each interview was transcribed. The research was conducted under the norms for ethical social research established by FLACSO Ecuador.[16]

## RESULTS

The nutrition transition noticeably impacted both the families. Over the three generations interviewed in both families, a change in consumption from less processed foods to more processed foods was reported. Notably, results from the interviews conducted showed that socioeconomic status and access to quality medical care were influential variables in determining how family members responded to diabetes. Members suffering from diabetes with higher socioeconomic status had more success in managing their diabetes than those with lower socioeconomic status.

One intriguing result was related to the role of domestic employees. In Ecuador, domestic employee services are commonplace in a large number of middle and upper class families. Approximately 300,000 individuals participate in this profession, and women comprise 95% of this workforce.[7] Interestingly, while most members of the urban family who were interviewed for this case study have at one time employed or currently employ such services, all members of the rural family who were interviewed for this case study at one time worked or are currently working as a domestic employee. Consequently, the urban family reported greater ease in preparing and eating meals at home. Members of the rural family reported learning how to cook traditional Ecuadorian recipes at an early age. The connection between domestic employees and the nutrition transition and/or disease is one that could be further explored in Ecuador, as very little research has been conducted on the subject.

Socioeconomic status was found to be a major contributor to the way that both families live, eat and manage their diabetes. The rural family had a history of socioeconomic insecurity, evidenced by very low levels of education, unstable employment and income and little access to quality medical care. Ecuador maintains a social security system that champions free healthcare for all, yet offers reportedly unreliable services in rural parts of Ecuador. Poor quality healthcare complicates the status of patients suffering from non-communicable diseases. For example, the quality of healthcare coverage in Flavio Alfario was reported sub par. As the 58-year old female suffering from diabetes pointed out, "The town hospital is free because of the State, but it takes one to two months to give back the results."[17] Because of this delay, she feels forced to visit clinics – but at $40 to $60 per exam and often an over one-hour long bus ride, it is a significantly burdensome and time-consuming expenditure. Consequently, she does not regularly visit the doctor. Her daughter, the 36-year-old who has lived in Quito since she was 17 and also suffers from diabetes, reported similar behaviors as a consequence of the lack of economic resources available to manage her diabetes.

Both members of the rural family, including the 36-year-old who suffers from diabetes, reported that their doctors provided no comprehensive information regarding dietary modifications for disease management; they were simply told to avoid sugar and fried foods. As a result of insufficient dietary interventions, both maintained a diet that over-emphasized refined carbohydrates, fried meats and fish, and minimal consumption of high-fiber fresh vegetables. This has also resulted in the continuance of symptoms related to diabetes for both members.

On the other hand, most members of the urban family received a college education and all reported stable employment and income. Almost all reported having access to both private and public healthcare services, implying extensive health security. As a result, the 58-year-old father with diabetes visits his doctor and follows a strict diet regimen.

In response to the father's diabetes diagnosis, the urban family dealt with the disease by decreasing the amount of refined carbohydrates and increasing the amount of legumes, fresh vegetables and salads in their diet, and also restricting the consumption of soda and fried foods. As a result, the father reported that his hemoglobin A1c percentage, a three-month average of his blood glucose levels, has been under control since he started making appropriate dietary modifications. This change was facilitated by the guidance of their daughter, who was studying as an undergraduate for a career in nutrition at the time of her father's diagnosis, though his regular doctor visits and access to quality medical care were other factors contributing to his diabetes management.

After analyzing the interviews from three distinct generations in both families, the older generations reported consuming fewer processed, industrial foods than did the younger generations. As the grandmother from rural Ecuador recalls, "We used to pick, toast and grind coffee beans by hand. Now, everyone I know drinks instant coffee."[18] It was reported that the eldest member of the urban family, at age 91, transitioned from eating mostly baked goods and drinking mostly fresh fruit juice in her youth to consuming a large amount of soda and packaged sweets today; she also used fresh butter before and now relies more heavily on oil and processed margarine. Similarly, she rarely ate out growing up and now eats out at least once a week, frequenting fast food restaurants more often. The eldest member of the rural family, at age 84, reported similar dietary transitions. She cited changes from manually grinding coffee and peanuts to mechanically grinding them to discontinuing the process altogether and buying them prepackaged; she also mentioned reluctantly switching from butter to margarine and oils.

The youngest generation of the urban family, two women ages 27 and 31, reported a high consumption of processed foods in their diets due to time constraints. One reports eating breakfast on the go while driving. They admitted to preparing sauces from packets instead of from scratch and freezing whole meals, practices that both women's mothers would never have condoned for fear of compromising quality. The youngest generation of the rural family, ages 36, 39 and 42, also mentioned dietary changes evidencing the nutrition transition: higher meat consumption, the use of oils, a greater presence of refined carbohydrates and the use of more kitchen appliances than their mother and grandmother. Testimonies of shifting food habits over three different generations provide insights into the various diet-related changes associated with nutrition transitions.

These ten food histories comprise a microcosm of how dietary changes, and ultimately disease, have evolved over time.

## DISCUSSION AND CONCLUSION

Limitations of the present ethnographic investigation include the fact that the sample size was small by design, the urban family had a member who was a nutritionist and the rural family had one member with diabetes who grew up in a rural area, but now resides in an urban area. However, the ethnographic methodology used in this investigation has been particularly useful in portraying a richer account of the nutrition transition at the family level by entering the homes and observing the eating habits of each family member interviewed. Recording and reporting personal stories is a qualitative method that provides highly valuable testimony and insight into eating habits over time. The interviews performed with family members over three generations culminated in interesting food histories of both the urban family and rural family. These ten food histories comprise a microcosm of how dietary changes, and ultimately disease, have evolved over time in two families in Ecuador.

After conducting interviews with both urban and rural family members, it is apparent that any setting, urban and rural alike, can experience the changes in diet and lifestyle attributable to nutrition transitions. Fieldwork should be continued in rural areas, presenting an interesting opportunity for future research.

One major observation noted by this case study was the difficulty that the rural family members had in accessing quality healthcare and managing their diabetes. The set of socioeconomic circumstances that guide the rural family's diet and health-related behavior can be interpreted through the phenomenon that Brazilian nutrition expert and professor Dixis Pedraza deems "obesity in poverty"—except that here "diabetes

in poverty" is observed.[19] This theory explains that those populations in Latin America with the lowest levels of education and lowest socioeconomic status have a greater risk of becoming obese. A "diabetes in poverty" approach could help explain how the economic instability of the members of the rural family may be a hindrance to proper disease management.

As previously mentioned, all Ecuadorians are eligible to receive the state-sponsored social security healthcare program, yet inadequate medical attention in Flavio Alfaro has been reported. The insufficient attention paid to the rise in non-communicable diseases may also be compounded by the fact that Ecuadorian public health policy has only recently responded to this rise. The Public Health Minister (Ministerio de Salud Pública) has enacted two national strategies that are still in the beginning stages. The first is a strategic plan for the prevention and control of chronic, non-communicable diseases), whose elements and objectives are comprehensive and achievable.[5] They include capacity-building, education, research, communication and community participation. The second outlines a specific set of protocols that doctors are expected to follow when treating chronic, non-communicable diseases; it provides a step-by-step guide that doctors can use for a more attuned and thorough treatment process.[20] While both strategies are promising steps forward, their principles and protocols must be adopted in everyday practice, especially in places like Flavio Alfaro.

## RECOMMENDATIONS

Future prevention and response plans to the nutrition transition must include a broad analysis of information in order to address the root causes of and manage the rise in non-communicable diseases. Several projects and theories are already approaching nutrition from a variety of disciplines in an effort to more effectively solve the issues associated with non-communicable diseases.

Food sovereignty, a growing new alternative in agriculture, is a movement dedicated to constructing a more just and equitable food system by empowering producers and consumers to take greater ownership of their food culture. Food sovereignty approaches the problems related to food production and consumption from a number of perspectives that include policymaking, farming, public health, the environment and gender.[21] Facing complex nutritional dilemmas such as diabetes and obesity will require responses that include community action and encourage consumers to understand how, where and by whom their food is produced. This is especially important in Ecuador, where twenty-seven percent of its population is employed in the agricultural sector.[22] Farming communities in the northern region have recorded some of the highest rates of acute pesticide poisonings in the world. This situation is largely due to a market dominated by pesticide industries and a government that offers farmers little education about proper pesticide use.[23] New research has linked pesticide use to insulin resistance and type 2 diabetes.[24] Policies that encourage food sovereignty could include diversifying crops and rewarding farmers who produce organic and native fruits and vegetables. Local authorities and health experts could assist in encouraging consumption of Ecuadorian-grown produce. This would not only deliver health benefits for consumers, but also create economic and social benefits for producers.

One way to create more connected communities is to develop more individual- and family-level responses to the nutrition transition, responses that Suárez-Herrera et al, specialists in social participation, detail and defend.[25] The authors argue that traditional population perspective approaches taken in response to the nutrition transition have undermined individual and family perspective responses to the nutrition transition. They propose greater social participation as a more inclusive means to responding to the nutrition transition. This can be feasibly achieved through community nutrition assessments and programs.

The integration of social participation campaigns could take on many forms. For example, Ecuador would benefit from public nutrition education in order to correct what has been described as a pervasive overemphasis of refined carbohydrates.[15] Campaigns and events that involve and invite community participation could take the form of healthy cooking demonstrations, food label education, grocery store tours that educate individuals about healthy and affordable options, healthy food tastings, Community Supported Agriculture (CSA) programs and free community nutrition classes at public libraries or in public parks. With donations and funding from the private sectors and grants from the public sector, these interactive education programs can become sustainable solutions. Moreover, student volunteers, university professors, public health professionals, nutritionists and members of the community could be recruited to jumpstart and manage such programs.

All of the solutions mentioned above can take place both in urban and rural settings. Extra emphasis must be placed on implementing these solutions in rural areas of Ecuador, that have already been impacted heavily by the nutrition transition, and which could suffer even more without sufficient measures in place to manage nutritional challenges. Such solutions are important not only in Ecuador, but also at a global scale, as the nutrition transition is a worldwide phenomenon. More generally, countries must prioritize public health nutrition education and intervention strategies that empower individuals and communities to make dietary and lifestyle choices that prevent non-communicable diseases.

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# South Africa's Return to Primary Care: The Struggles and Strides of the Primary Health Care System

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**Primary health care has a unique history in South Africa, where efforts to provide holistic health care to rural communities began in the early 1940s. The racial and social inequalities brought by apartheid caused this progression in medical care to be reversed until South Africa's liberation in 1990. Since then, the nation has attempted to adopt a health care system with its main focus on primary care and prevention. However, given the numerous other economic and political issues the government faces, the establishment of a strong primary care network has proven difficult. In May and June 2013, the author traveled to Cape Town, South Africa and volunteered at a large public primary health care facility. By discussing the current challenges of the South African health care system from personal experiences in the clinic, this paper highlights the central problems that continue today and suggests areas for improvement within primary health care in the post-apartheid nation.**

**This case study describes one rural and one urban family's diets and reported changes in diets; it was found that even the rural family was experiencing changes in dietary habits that suggest the presence of a nutrition transition. This singular case study could serve as a springboard for future rural nutrition transition research using more statistically significant samples. Further research could determine if this is a confined case or a widespread issue, and could explain how different rural locations in Latin America, and the world, may be experiencing the nutrition transition.**

## The Effect of Apartheid on Primary Care: An Overview

In 1990, South Africa's oppressive system of apartheid was removed, leaving the nation with high hopes but also great difficulties. The years of severe inequality for non-whites under the former system of government had impacted every facet of society, including the health care system. Apartheid had left many non-white South Africans without access to adequate primary care.[1] Here, primary care refers to the first line of health care that a patient receives, including the treatment of disease by regular medical visits, referral to more specialized care if needed and prevention by health education aimed at individuals, families and communities.[2] The deficiency of primary care for non-white South Africans during apartheid led to disproportionately high serious health problems in this population, manifested in higher infant mortality rates and lower life expectancies compared to the white upper class.[3] The numbers are shocking: in the 1960s, the average life span was about 65 for white men and 72 for white women, but only 51 for black men and 59 for black women.[3] While the post-apartheid government has since developed a model of primary-centered health care aimed at all South Africans, the political, economic and social legacy of apartheid continues to affect the quality of primary care in the nation today. Currently, primary care in South Africa is challenged by two major problems, as witnessed by the author, which are rooted in the underlying socioeconomic inequalities that were implemented during the apartheid era: (1) the differential burden of disease and (2) the inequality between private and public health care. Before delving into the current challenges the country faces with regard to primary care, a brief history of the nation's health care system over the past 70 years will be provided to develop a context of the nation's current health care system.

## Background: Before and During the Apartheid Struggle

Prior to the institution of apartheid, grassroots efforts for a health care system centered on primary care were spreading throughout South Africa. In 1940, the Pholela Health Center model of community-oriented primary care (COPC) was developed by the South African Health Ministry as a response to limited access to medical care in rural Natal.[1] Since this system would provide easier access to health care, the hope was that more individuals would be able to see health care providers, thereby allowing better management of existing conditions and facilitating the prevention of more serious diseases. Two major figures behind the COPC movement, Drs. Sidney and Emily Kark, furthered the focus on primary care by using epidemiological analyses of the communities with which they worked to determine the medical needs of certain regions and to predict how they would change with time.[4] The couple's emphasis on community care was effective, as more people—providers and patients included—became involved in the management of health care and more primary care units were set up across the country.[1,5,6]

Following the introduction of apartheid principles with the National Party's rise to power in 1948, however, the primary care-centered model quickly deteriorated. Not unlike the Jim Crow laws in the United States, apartheid policy imposed severe legal restrictions based on race, leaving non-white peoples with little freedom. The values associated with apartheid extended to medicine, as the new party in power did not support the tax burden that the white upper class would have to face if a primary care model such as the National Health Care Center program had been implemented.[7,8] When Drs. Kark, who had been among the strongest supporters of primary care, left South Africa in 1959, the PHC movement lost significant leadership and was open to further attack by apartheid policies.[7]

Under apartheid control, the South African health care system was strikingly different from the COPC model that had been prominent for nearly a decade, and severe inequality between whites and non-whites emerged. The most significant change with apartheid was

the deregulation of public health care. By removing public health care, the private sector expanded, which made health care more expensive and prevented the non-white lower classes from being able to afford such care; this in turn added to the National Party's restriction of the non-whites and helped to ensure their goal of white supremacy.[1,9] The daily conditions that non-whites faced brought additional challenges to their ability to attain health care. For example, apartheid policy forced black South Africans to live in areas known as Bantustans, which were expected to organize their own system health care separate from the apartheid government.[1] Despite many efforts of dedicated health care providers, these conditions could not support a strong health care network, and as a result, the burden of disease increased in these regions.[1]

Health care worsened in the 1960s and 1970s, when the state began seizing control of the missionary hospitals responsible for providing most health care to the people living in the Bantustans during apartheid.[10] Without the missionary hospitals, the doctor-to-population ratio in the Bantustans was reported to have dropped to almost nine times lower than that of the rest of the nation.[11] The lack of health care providers forced doctors and nurses who remained in the Bantustans to move their focus to patients with more serious conditions, making it difficult to implement a resource-intensive model of primary-centered care. Because of this shift towards higher level care, only 11% of funding for public health care was used for primary care under apartheid policy, severely affecting the quality of the nation's health care system.[12] Until the termination of apartheid in 1990, the highly segregationist policies remained and the health of non-white South Africans continued to be jeopardized.

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## The End of Apartheid: Strides and Struggles of a Re-emphasis on Universal Primary Care

Since the end of apartheid, the South African government has aimed to improve the health care situation by outlining a clear model with primary care at the base. The election of Nelson Mandela of the African National Congress (ANC) in 1994 spurred the creation of the National Health Plan, which laid out goals for a universal public primary care-centered system.[10] In 2002, additional legislation was passed in the form of the National Health Bill with standards to provide "comprehensive primary health services" to all (Section 27.2.k) by promoting "health and healthy lifestyles" (Section 27.2.s) and "community participation in the planning, provision and evaluation of health services" (Section 27.2.t).[13] Some of these aims have been effective: since standard protocols were established, over one thousand new clinics were built, and the public has been educated on important preventative measures such as immunizations and the dangers of smoking.[10] The government also provides free primary care for all citizens and special cost-free community health centers for pregnant women and children under the age of six.[10]

However, while certain gains have been made towards a primary care-centered and community-based health care system, much work still remains. The nation has been reported to spend 8.3% of its GDP on the health care industry,14 which in 2009 was the highest of any middle-income country in the world.[10] Despite such expenditure, infant mortality rates have been on the rise, making South Africa one of only a handful of countries where such a discrepancy exists.[14] Today, most problems with providing satisfactory primary care can be attributed to (1) the divide between private and public health care and (2) an increasing burden of long-term diseases. Both of these issues are augmented by the historical struggles of apartheid that South Africa has faced in regard to its economy, politics, and societal structure. The next two sections will describe these current challenges and relate them to personal experiences at Tafelsig Clinic, a public primary care facility located in the township of Mitchell's Plain in Cape Town, South Africa, where the author worked for twenty days in May and June of 2013. Since the clinic was located in a relatively large facility, with an average of 500 patients per day, many challenges of the primary care system could be observed. Since other clinics across the country may face similar issues, it is important to understand the nature of these problems so that areas of improvement can be addressed and solutions can be identified to improve the primary care system in South Africa and achieve the nation's vision of health for all.

## The Divide: Private vs. Public Health Care

Most South Africans utilize the free public health care services provided by the government. However, while private health care is used by only 14% of the nation, it has been reported to account for up to 60% of national health care expenditure.[10] Patients choose private care for a number of reasons, including shorter waiting times, more personal care and increased confidence in the quality of health care.[15,16] However, in recent years, the private sector has been criticized due to its increasing costs of care along with their tendency to provide more services than are necessary, which also increases prices for patients[17]; both of these concerns may cause more patients to move towards the public health care system in the future. While most South Africans currently use either public or private care, 16% of patients use a mix of both sectors.[17] These individuals commonly use the private sector for primary care and public care for more specialized health care, such as hospital visits,[18] This is likely because health care at the public primary care level tends to be the most overburdened among the health care sectors, and so individuals will avoid it if they are able to afford private care. Thus, public primary care is used mostly by poor non-white South Africans, and as a result, there is little crossover of patient demographics between public and private primary care.

In addition to the disparate patient populations between private and public care, the number of health care providers within each system is also disproportionate. The World Health Organization estimates that only 30% of all South African physicians work in the public sector, despite the fact that it serves over 80% of the nation's population.[18] The lowered number of health care providers along with the increased volume of predominantly poor patients in the public health care system causes public care to be overburdened in comparison to the private sector. In turn, public health care workers are spread too thin and are left unable to provide all of the personalized services of the private sector which would require more time per patient.[19]

Additionally, the economic divide between the rich and the poor, which continues remnant of the apartheid era, also contributes to the persisting inequality between private and public health care. For example, in 2007 South Africa had the world's tenth highest Gini index at 0.578, a measure of income inequity among a nation's population,[20] The economic divide has translated to a separation within the nation's health care system which has created a marked discrepancy between the resources used by public health care and the private sector and is evidenced by the high expenditure and low volume of patients in the private sector as compared to the public system. Furthermore, it has been reported that the development of private-public partnerships, which result in the transfer of funds from public to private sector services in order to increase efficiency and delivery within the South African health care industry, have decreased the public health care sector's budget but kept the demand for their services largely unchanged.[21] Because the gap between the rich and the poor is so wide and public primary care centers are overburdened as the major source of health care for South Africans,[18,19] effective primary care is difficult to attain at the national level.

As a public health care facility, one of the most defining features of Tafelsig Clinic was the high volume of patients seen each day. According to the facility's records, nearly 500 patients cycled through the clinic daily and faced long waiting times, a number consistent with reports from other South African public primary care facilities.[22]

Some patients had to come two or more days in a row if they were not seen the previous day, and many had to come in to the clinic weekly if they were on certain treatment regimens (e.g. for TB). As a result, many patients missed work or were unable to keep a regular job. Additionally, most patients did not have efficient modes of transportation and were forced to walk to the clinic, creating more missed time from work and missed appointments. As a whole, the clinic lacked the number of health care providers that would be necessary to fulfill the personal, community-based values of the PHC model outlined in the National Health Bill.

## An Increased Burden of Long-term Diseases

Along with the economic divide, another defining characteristic of South Africa's public primary health care system is the wide array of long-term diseases that providers must treat, taking time away from other aspects of primary care such as counseling and prevention. Transmittable diseases like HIV/AIDS and TB are still widespread and treated at the primary care level, but non-communicable diseases including hypertension and diabetes are also rising to prevalence.[23] With more chronically ill patients, public clinics are unable to dedicate sufficient resources for assisting all patients.

Currently, South Africa's biggest public health problem is its combined HIV/TB infection rate.[24] In 2011, the prevalence of HIV among South Africans ages 15-49 was 17.3%, which is among the highest in the world.[25] Furthermore, because HIV/AIDS results in a compromised immune system, affected individuals are more susceptible to other opportunistic infections, such as tuberculosis (TB), that healthy people are more easily able to combat. In fact, people who are HIV positive are ten times more likely to develop TB,[26] and in 2014, TB was the leading cause of death in South Africa.[24] Methods to treat TB exist, but they consist of strict treatment regimens that can last up to six months and require visits to a clinic five times a week.[26] The large amount of time required for TB treatment increases the burden of transmittable diseases on primary care facilities and also makes patients less likely to complete their recommended course.[24]

Post-apartheid political leadership has also contributed to the growing HIV/TB problem, specifically with regard to propagating misconceptions of the disease. Thabo Mbeki, who served as the nation's president from 1999 to 2008, denied a causal relationship between HIV and AIDS and recommended that South Africans not use anti-retroviral therapy (ART). He insisted that the treatment was dangerous and could even cause death, despite scientific evidence supporting the effectiveness of such treatments.[27] As a result, HIV rates have remained among the highest in the world, with the South African public largely under-concerned about the severity of the infection.[28] However, as a transmittable disease, HIV can be more directly targeted through primary care than non-communicable diseases, which have a broader range of causes. When HIV is managed sufficiently well, clinics will be able to spend more time promoting health awareness and disease prevention rather than strictly providing treatment.

At Tafelsig Clinic, the lack of health care providers and its effect on the burden of chronic disease was evident. Although a quarter of examination rooms were reserved for individuals with non-communicable diseases such as diabetes and hypertension four mornings per week, patients would often leave and come back later, or patients with more immediate concerns such as open wounds or breathing problems would come in and need to be seen, causing the appointments to be delayed until the afternoon. As a result, the nurses and physicians who planned to see the non-communicable disease patients were often spread too thin, and they were unable to provide the government's ideal of administering personalized, community-oriented care.

In addition to low numbers of providers, Tafelsig Clinic was also overburdened by the high incidence of TB. One section of the clinic was dedicated to providing TB treatments, where two to three nurses would work as a unit to deliver medicines, monitor patient compliance, and record information. The nurses explained that a major problem they face was that some patients begin to feel better before completing their treatment plans and do not realize they may still be infected, causing many of them to default. The WHO reports that up to 25% of patients default from TB treatment,[29] which in turn creates an additional burden on the nation's health care system because patients eventually may develop multi-drug resistance and make their conditions even harder to treat.[26] Some of the patients who came in for TB treatment did admit that they had formerly stopped treatment and were on their second or third regimen, which they had had to begin anew. Since TB remains the number one killer in South Africa, it would be useful to educate patients at the primary care, community-based level so that people understand the risks involved and the importance of receiving and completing treatment before they develop more serious problems and must receive more specialized care.

## Evaluating the Challenges

Today's major challenges of the public primary care system lie largely in the fact that HIV/AIDS and TB are the top burdens of disease but appear to be undertreated at the primary care level.[30] In 2007, a study by Bradshaw et al. was conducted that profiled the major primary care complaints in the country. The researchers found that the nation's largest burden of disease, as estimated using an approach known as disability adjusted life years, was from HIV/AIDS and TB.31 However, when Mash et al. (2012) analyzed the data from nurses and doctors working in public primary health care settings sampled from 31,451 patient encounters within four provinces in the country, they found that HIV/AIDS and TB were not the top reasons for primary care visits. Instead, they found that the number one reason for patient visits to the clinic associated with chronic care was for cardiovascular concerns, at nearly ten percent. Tuberculosis and HIV were fourth and fifth on the list, at 2.8% and 2.2%, respectively.[30] Mash et al. (2012) suggest a reason for this seemingly low number may be that HIV and TB are also treated in specialized clinics outside of basic primary care facilities. While specialized treatment programs provide a step in the right direction for managing South Africa's HIV/AIDS epidemic, they are not without flaws. For example, Howard and El-Sadr (2010) set up HIV/TB clinics in

South Africa and found that the effectiveness of such programs was hindered by problems integrating the new programs into existing ones at local primary care clinics. Thus, the researchers argue for the tailoring of HIV/TB clinics to the needs of an individual community,[32] an idea in line with the PHC model pioneered nearly seven decades ago.

Understanding the differences between the diseases that South Africa faces and those faced by other nations can also be useful in evaluating the nation's primary health care system. In addition to elucidating the reasons for primary care visits, Mash et al. (2012) compared the top diagnoses in South Africa with those of other countries, which especially shed light on differences in the treatment of mental health issues. In South Africa, depression and anxiety only accounted for 0.2% and 0.1% of all diagnoses made at the primary care level but, interestingly, these concerns were among the top 25 diagnoses at primary care clinics in the Netherlands, Poland, Japan, and the U.S.[30] Furthermore, it has been reported that in 2009, 16.5% of the nation's population had one or more mental disorders, but only 25% of patients were treated for their concerns.[31] One potential reason for the lowered rates of mental health diagnoses may be due to differences in cultural values. However, given the fact that up to 80% of the population uses public primary care, it is likely that factors such as decreased numbers of providers and the burden of other diseases in the public health care system also contribute to the relatively low diagnosis of mental health concerns in South Africa compared to other nations around the world.

Since violence and injury together comprise the second leading cause of death in South Africa, it is important for health care to address mental and emotional health issues that may arise from such societal effects on health.[34] It has been observed that sociocultural influences such as alcohol and drug abuse and patriarchal views of male toughness increase mental health issues such as anxiety and depression in South Africans.[34] Further, high unemployment rates and lack of effective governmental leadership to enforce non-violence have heightened the number of people who are estimated to suffer from mental health disorders.[34] Thus, by incorporating treatment of mental health issues at the primary care level, South Africa may be able to better address violence and crime as a method of prevention as well as improve the overall health of its individuals.

Another issue to address is education for providers about the need for a focused, universal public primary care system. In 2009, legislation was passed to make family medicine a specialty; prior to the passing of this law, a study by Naidoo et al. (2009) was conducted to examine the opinions of primary care providers toward the proposed legislation. The researchers surveyed sixty South African general health care providers, and while they found that most physicians did support the new law, others disagreed with it because they did not see a need for such a designation or believed it would increase competition among doctors.[35] While it is unrealistic to expect all physicians and other providers to agree upon every aspect of primary care, it is important that they share the common vision on the vital role that primary care, and family medicine in particular, plays in health care. The study by Naidoo et al. (2009) is an important reminder that South Africa has come a long way but still must work on increasing awareness—providers included—of the utility of a community-based, primary health care-centered model for the nation's health care system.

## Concluding Remarks: Opportunities for Growth

It is clear that much work remains to be done to reach the primary-centered model of care and attain health for all within South Africa's health care network. However, several options exist for improvement. Most importantly, South Africa must increase its number of public health care providers by making public care a more attractive working environment. Currently, public primary care centers such as Tafelsig Clinic are understaffed and overburdened by the number and scope of treatments they must provide. One study found that the movement of health care workers from the public to private sector was influenced most by high levels of stress and low satisfaction with their work in the public health care system rather than under-compensation.[36] This suggests that that the implementation of the occupational specific dispensation (OSD) in 2007, which essentially created structured salary packages for public health care workers, was effective in decreasing the movement of workers out of the public health care system.[36] Thus, by focusing efforts on increasing the quality of work in the public system, the South African government may be able to further expand and retain its public health care force.

In order to create these changes, there must be some health care providers who are initially willing to move from the private sector to the public system of health care. This recruitment process can be carried out by initiating campaigns directed towards nurses, physicians, pharmacists and other providers that explain how the current divide between the sectors is exacerbating the socioeconomic gap among South Africans today, which in turn impedes progress to attaining better health across the country. By making such problems known and applying them to the lives of the providers directly, health care workers may be more motivated to assist their nation's situation, either by remaining in or moving to the public health care system.

While the expansion of the public health care workforce would certainly improve the situations of the providers, it is also important to understand how this change would better patients' lives. More providers means more opportunities for patients to be seen, which would decrease the long waiting times that are often common in public primary care facilities. Efficient use of time at the clinics would allow patients to both receive treatment fairly quickly and not have to miss work. Patients would also be able to receive more personalized care under a public system with more providers, in accordance with the model of primary care set out in the nation's health care plan.

In addition to increasing the number of providers in the public sector, the burden of transmittable disease should also be targeted. By focusing on the prevention of HIV transmission through methods such as directed educational campaigns and strong political leadership, the burden of transmittable disease such as HIV/AIDS and TB can be decreased. Some of these tactics already exist in South Africa; for example, the community-oriented programs loveLife and Soul City provide media coverage targeted at teens and adults to help curb the HIV epidemic and promote healthy lifestyles.[1] Both programs have been shown to be effective in increasing HIV awareness, as it was reported that 92.5% of the population knew of such campaigns in 2006, and exposure to more than one of these programs resulted in a greater positive influence on people's ideas regarding HIV/AIDS.[37] Still, without sufficient numbers of doctors and nurses working in the public sector, such campaigns have little value in effecting actual change.[2] Thus, it is important to once again note that awareness campaigns should be targeted at providers as well as patients so that providers understand how essential they are to improving South Africa's primary care system.

Altogether, by focusing on (1) expanding the public health care workforce through awareness campaigns targeted at providers and improved working conditions and (2) lowering the rates of HIV/AIDS and TB, the public primary care system will be strengthened, allowing more personalized care, expansion of preventative health education, and improvement of the overall health of individuals and communities. Preventative programs including health education may in turn lessen the cases of chronic diseases and especially non-communicable diseases such as hypertension and diabetes, which are also on the rise and are among the most prevalent issues seen by primary care providers today. As South Africa continues to evolve as a democracy, there will surely be additional challenges the nation will have to face in establishing a robust health care network, as witnessed through personal observation. However, if the private and public sectors are better organized and long-term disease well-managed, health for all is a real possibility in South Africa's future.

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# Reducing Perinatal Depression Among the Hard to Serve

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**Perinatal depression is a prevalent condition that can adversely affect maternal health and functioning, family dynamics and infant development. However, in low and middle-income countries (LMICs) women suffering from perinatal depression rarely have their condition diagnosed and treated. This paper analyzes the problem of perinatal depression in LMICs, including risk factors and potential outcomes, then critically examines one intervention—The Thinking Healthy Programme (THP)—as a model from which to draw recommendations for future programs and studies. The THP is a cognitive behavior therapy-based intervention that was incorporated into the maternal and child health services provided by community health workers in rural Pakistan to reduce perinatal depression and improve infant health. Analysis shows that strengths of the THP include its use of a strong supervision model and application of a psychosocial approach to ensure cultural appropriateness and participant engagement. However, weaknesses in sample selection, limitations of evaluation methods, the extensiveness of formative research and concerns about sustainability and large-scale feasibility illustrate opportunities for improvement. Future interventions to address perinatal depression in low-resource settings should target the most vulnerable women, incorporate more rapid assessment procedures, utilize multiple methods for evaluating child health and development and ensure program sustainability through refined supervision processes and mechanisms for maintaining morale and motivation of CHWs.**

## INTRODUCTION

Perinatal depression is the presence of moderate to severe depressive symptoms at any time during a woman's pregnancy (prenatal depression) or the first year after giving birth (postpartum depression). Possible symptoms include depressed mood, loss of interest or pleasure in activities, sleep problems, loss or increase in appetite, lack of energy, irritability, anxiety and suicidal thoughts.[1] While many of these symptoms may seem mild in comparison to those of other conditions, perinatal depression can have serious adverse effects on maternal health and functioning, family relationships and infant development. Evidence-based, cost-effective and sustainable interventions are needed to address this common and disabling condition, particularly in low and middle-income countries (LMICs) where it is rarely diagnosed and treated.

Both psychosocial (for example peer support and counseling) and psychological (cognitive behavioral therapy and interpersonal therapy) interventions have been found to be effective in reducing perinatal depression symptoms, as well as in improving various maternal, infant and family outcomes.[2] In a systematic review of nine different trials, cognitive-behavioral therapy (CBT) produced the most significant reduction in relative risk of these forms.[2] CBT is based on the theory that one's thoughts are connected to feelings and actions, and if these can be modified then beliefs and behaviors will change as well.[3] In CBT, clients work with clinicians to identify their maladaptive thinking styles (such as fatalism, inability to act and somatization) and replace these with more positive thoughts, building their capacity to address their own problems and fostering their sense of self-worth. CBT is one of the only forms of psychotherapy that has produced significant results in trials in LMICs.[4] To enable implementation of CBT and other treatments in LMICs, the treatments must be proven effective, as well as cost-effective and capable of being integrated into existing health systems with limited resources.

In the largest randomized controlled trial for maternal depression in a LMIC, Rahman, Malik, et al. implemented a cognitive behavioral therapy-based intervention called the Thinking Healthy Programme (THP) using community health workers (CHWs) in the poor, rural district of Rawalpindi, Pakistan.[5] The THP provided a promising model because it integrated evidence-based psychotherapy into existing maternal and child health services provided by non-professional CHWs. The THP had several features that have been found critical for success in psychological interventions for perinatal depression by CHWs in LMICs, including: incorporation of delivery into the routine maternal and child health services beginning in the antenatal period and continuing into the postnatal period, extension beyond the mother to engage other family members in the process and adaptation for cultural and contextual relevance.[6] In meta-analysis of interventions for perinatal mental disorders, this intervention had the largest impact in the 14 trials reviewed, which was attributed to psychotherapeutic content, number of sessions and staff training and supervision practices.[7] Because of the strength of this model, the THP will be critically examined to evaluate which components should be applied to other interventions to address perinatal depression in LMICs and additional features that should be considered.

## BACKGROUND

### Prevalence

Depression is the largest cause of non-fatal disease burden worldwide, responsible for almost 12% of overall years of disability.[8] The risk of depression in women is about twice what it is in men, and women are particularly vulnerable while pregnant and shortly after giving birth because of hormonal changes and parenting stressors.[9] In high-income countries, the prevalence of perinatal depression and other common perinatal mental disorders is 10% antenatally and 13% postnatally. However, in LMICs, these rates are significantly higher—15.6% antenatally and 19.8% postnatally.[10] Prevalence is highest among the most economically and socially disadvantaged women in crowded households of rural areas.[10] For example, in the two rural areas of Pakistan in which the THP was implemented,

where most families rely on subsistence farming and the average household has 6.2 members, the prevalence of perinatal depression is 25% antenatally and 28% postnatally.[5,11]

### Contributing Factors

Risk factors for women experiencing perinatal mental disorders in LMICs include the following: socioeconomic disadvantage, unintended pregnancy, being younger, being unmarried or having poor marital relationships, being of a religious minority, experiencing intimate partner violence, lacking intimate partner empathy and support, having a history of mental health problems and in some cultures having a female (rather than male) infant.[10,12] Protective factors include higher educational attainment, permanent employment, being of the ethnic majority, having access to sexual and reproductive health services, having a trustworthy partner and healthy relationships with other family members.[10]

### Outcomes

Perinatal depression can have numerous adverse outcomes related to maternal health and functioning, infant health and development and social relationships (Table 1). For mothers, perinatal depression has been associated with pregnancy complications and other health problems, parenting difficulties and dangerous thoughts and behaviors. Perinatal depression can also hurt children, causing death, delivery complications or immediate health problems as well as long-term delays in cognitive, physical and emotional development. In developing countries, children of mothers with depressive symptoms are more likely to be underweight or stunted, and the more severe the depression, the greater the growth deficit.[9] Effects can continue across generations, as mothers who lacked an affectionate and trusting relationship with their own mother are at increased risk for perinatal depression.[10]

### Access to Care

Despite evidence of the negative impact of perinatal depression on the health and functioning of both mothers and infants, pregnant women in low-resource areas rarely receive mental health support. In fact, nearly 90% of all depressed individuals in LMICs do not have access to psychological treatment.[18] Typical barriers to implementing maternal mental health interventions in LMICs include limited resources, weak health systems and the shortage of skilled workers.[16,19]

For example, in rural areas of Rawalpindi, Pakistan, a Basic Health Unit, consisting of a doctor, midwife, vaccinator and 15-20 community health workers called Lady Health Workers (LHWs) provides primary care to about 20,000 people. The district has no psychologists in the public sector and only three psychiatrists. Consequently, the vast majority of mental health conditions go undiagnosed and untreated.[11]

### Task Shifting

Task shifting skills from professional health care providers to non-specialist community health workers (CHWs) has emerged as an efficient and cost-effective way to improve accessibility of health and mental health services where human resources are scarce.[6] CHWs have been found effective in improving numerous health outcomes including reducing neonatal mortality and child mortality attributable to pneumonia and malaria, as well as promoting health behaviors such as exclusive breastfeeding, childhood immunization and early prenatal care usage.[20,21] CHWs have also effectively delivered mental health interventions. In thirteen trials in which community health workers in LMICs addressed common perinatal mental disorders specifically, meta-analysis of standardized effects showed depression was reduced by 38% among mothers in the intervention groups compared to controls (pooled effect size for maternal depression was -0.38). Intervention benefits to children included improved mother-infant interaction, better cognitive development and growth, reduced diarrhea episodes and increased immunization rates.[7]

## The Thinking Healthy Programme

### METHODS

The Thinking Healthy Programme (THP) is a cognitive behavioral therapy-based intervention that was delivered by community health workers to perinatally depressed women in two rural areas of Rawalpindi, Pakistan. Married women aged 16-45 in their third trimester of pregnancy who had been diagnosed with perinatal depression were eligible. Mothers were diagnosed by a psychiatrist trained to administer the structured clinical interview for the Diagnostic and Statistical Manual of Mental Disorders IV diagnosis, which has been used extensively in cross-cultural epidemiological and treatment studies of perinatal depression. Women with serious medical conditions or pregnancy-related illnesses, substantial physical or learning disabilities and psychosis were excluded.

Rahman, Malik, et al. randomized participants from 40 Union Council clusters (the smallest administrative unit in Pakistan) to intervention (N=463) or control groups (N=440).[5] In the intervention group, Lady Health Workers (LHWs) were trained to deliver the psychological intervention in 15 sessions over the course of 11 months; in the control group, untrained health workers made an equal number of visits to depressed mothers. Researchers trained the LHWs using a manual with directions for each session and provided them with a copy to use as a reference. The THP curriculum has five modules that focus on three areas relevant to mother and infant health during pregnancy and after childbirth—the mother's personal health, the mother-infant bond and the psychosocial support of others.[22] LHWs working with the treatment group used CBT techniques of active listening, collaboration with family, guided discovery (a method of questioning to probe for existing beliefs and stimulate alternative ideas) and homework assignments.

The study aimed to assess the effect of the THP on perinatal depression in women and to test the hypothesis that treatment of perinatal depression would lead to improved nutrition and other health outcomes in the infant. The outcome measurements included: 1) infant weight-for-age and height-for-age at 6 and 12 months, common indicators for children's healthy physical development; 2) maternal depression symptoms and severity, functioning levels and perceived social support, which was assessed by psychiatrists at 6 and 12 month follow-ups using the Hamilton Depression Rating Scale, the brief disability questionnaire, the global assessment of functioning scale and the multidimensional scale for perceived social support; 3) whether mothers were exclusively breastfeeding at 6-month follow-up (as self-reported); 4) the number of diarrheal episodes in the infants in the previous two weeks at 12-month follow-up (through use of a questionnaire); 5) the completion of infant immunizations (through assessing records); 6) women's use of contraception at 12-month follow-up (as self-reported); and 7) the time allocated by both parents for playing with infants (as self-reported).

### RESULTS

At both six and twelve month follow up points, mothers in the treatment group had lower levels of depression (adjusted mean difference (AMD)= -5.86 at 6 mo. and -6.65 at 12 mo., p<.0001), lower levels of disability (AMD= -1.80 at 6 mo. and -2.88 at 12 mo., p<.0001), better overall functioning (AMD= 6.85 at 6 mo. and 8.27 at 12 mo., p<.0001) and greater perceived social support (AMD= 6.71 at 6 mo. and 7.85 at 12 mo., p<.0001), than the women in the control group (See Appendix A for full Tables of Results).[5] Families in the treatment group also reported higher use of contraception at 12 months (adjusted odds ratio (AOR)=1.6, p=.002) and more frequent play with infants at 12 months (AOR=2.4 among mothers and 1.9 among fathers, p=.0001). Infants in the intervention group had fewer bouts of diarrhea (AOR=.06, p=.04) and were more likely to have completed their scheduled immunizations (AOR=2.5, p=.001). However, their weight-for-age and height-for-age measurements did not significantly differ from controls.

### DISCUSSION

The THP contained several elements that made it amenable to integration including strong training and supervision supports, cultural appropriateness, incorporation into the routine work of CHWs so as to prevent additional burden and a child-focus to ensure participation of families and avoid stigmatization.[16] The THP used a psychosocial approach, as opposed to a biomedical, which addressed perinatal depression in the environmental context and facilitated flexibility in service delivery, cultural acceptability and family en-

gagement. However, the THP had weaknesses in its sampling and evaluation processes. Further, the lack of methods for sustaining staff and the extensiveness of formative research undertaken present challenges with regard to sustainability and large-scale feasibility. Each of these components will be discussed in turn to provide recommendations for future programs aiming to address perinatal depression in low-resource settings.

## SAMPLE

The THP had a robust sample of women (463 women in the intervention group and 440 in the control group) who were primarily recruited through the registries LHWs kept of all pregnant women in the area. In addition, the researchers asked local midwives and LHWs to identify any women that may be missing. As the common practice in studies of perinatal mental disorders in LMICs is to recruit participants through primary care clinics, the THP methods would have generated a strong sample that included pregnant women who may have been socially isolated and difficult to access.[10]

However, only married women were included in the sample. While social taboos in this community make would make it very uncommon to find a pregnant women who was not married, it would nevertheless be important to include these women in the intervention, and it is critical to target them in future interventions implemented in less conservative cultures. Studies have shown that the two most consistent predictors for perinatal depression are poor partner relationships and lack of social support.[17] Married women are more likely to have a partner to help provide income and childcare as well as increased social support from in-laws, which may reduce their stress and lead to lower likelihood of perinatal depression.

Moreover, mothers with serious medical conditions, physical or learning disabilities and psychosis were excluded; these women may have had more severe and difficult-to-treat forms of depression and would have also likely been dealing with additional risk factors for depression including social isolation, limited educational attainment and unstable income. Therefore, the most extreme and challenging cases might have been excluded. Other studies may wish to explore the potential impact of interventions for perinatal depression on the most vulnerable cases, including single mothers and others who are socially isolated or women with debilitating physical or mental health conditions.

## SUPERVISION MODEL

The THP used an apprenticeship model of training and supervision that has proven effective and draws upon broader dissemination and implementation literature.[23] The apprenticeship model uses three groups: trainers who are experts in the intervention, but typically from outside the project area, supervisors who are locals chosen for an advanced role and counselors who provide direct psychological support to clients. In the THP, local Lady Health Workers who understood the unique beliefs and resources in the community provided therapy and were supervised regularly by others that had been trained by expert members of the research team. The initial training was short (three days), but Lady Health Workers continued to receive intensive group supervision for a half day each month throughout the three years of the project duration, with emphasis on "experiential learning," through the use of role playing and critique of case studies, during which researchers highlighted key techniques and principles employed to achieve success and LHWs problem-solved together.[18] Research suggests that trainings should use these types of active and experiential methods and confirms that post-training supervision is vital to the success of clinical interventions.[23] Meta-analysis of interventions for perinatal mental disorders indicates that the THP's use of continuous supervision may have significantly contributed to its impact.[7]

However, potential challenges in sustaining quality supervision could jeopardize long-term sustainability and feasibility of replicating of the program. Training for the THP was provided by experienced members of the research team, which would require additional experts should the model be scaled up. Also, the apprenticeship model relies on local supervisors, which can present a challenge if staff turnover is high.[23] Rahman, Malik, et al. suggest that this issue could be overcome if supervision was instead provided through peer groups in which health workers from each area met regularly to share experiences and lessons learned.[5] This revised model would maintain experiential and continuous supervision, but there would be no experts available should significant challenges arise that the CHWs could not overcome through peer support. Further, the researchers facilitated ongoing supervision groups very actively—providing feedback on successes, key techniques and principles— and it would be challenging to create this dynamic learning experience without a leader with expertise and strong interpersonal skills.

Systematic review of the determinants in scaling up and sustaining CHW programs in LMICs illustrates the most frequently cited barrier was insufficient pay or incentives for CHWs relative to other employment opportunities.[21] Another common barrier was the lack of acknowledgement and reward for those in supervisor roles.[21] Mechanisms for maintaining the morale and motivation of CHWs and supervisors should be built into the intervention and can include both material and social incentives such as community recognition, in-kind gifts, exemption from community labor requirements and other incentives.[21] Future iterations should account for real resource limitations and the challenge of CHW burnout and supervisor atrophy to see if this is a model that can be brought up to scale.

## FORMATIVE RESEARCH

Formative research over five years using mixed methods helped ensure that the THP was culturally appropriate and seen as necessary and relevant. All four stages of the Medical Research Council framework for cultural adaptation were employed (modeling/theoretical development, formative research, piloting and evaluation).[24] Crucial steps reported in this process include data synthesis by systematic triangulation of findings from multiple methods, data sources and theories; review of the synthesized data by panel of experts; in-depth interviews with 30 poor, perinatally depressed mothers; focus groups with 24 Lady Health Workers; interviews with six primary care staff; data from another epidemiological study being examined for psychosocial risk factors for pre and postnatal depression; and quantitative evaluation with LHWs.[6]

## THE PSYCHOSOCIAL APPROACH

The psychosocial approach takes into consideration an individual's experience of an illness in the context of her environment, including other factors that may promote or prohibit her health. In formative research, the THP examined the many psychosocial risk factors for perinatal depression (i.e. economic insecurity, partner relations and poor social support) and employed methods to address these in treatment delivery. Key themes from formative research that were incorporated to a psychosocial program design included suggestions to focus on maternal and infant health rather than maternal depression; to make it participatory, empowering and integrated into the health care system and to apply a home-based and culturally adapted model.[11]

Flexibility in the THP design enabled the LHWs to also apply a psychosocial approach to their work. They were attuned to the needs of individual mothers and changed the intervention delivery accordingly, shifting the emphasis from empathic listening to infant care, physical health and nutrition or interpersonal relationships.[11]

## CHILD FOCUS

The decision to make infant health and development the primary focus and maternal mental health secondary enhanced acceptability, reduced stigma and engendered greater family engagement, resulting in improved perceived social support and increased time devoted to play with children. Formative research showed that many in the community did not view maternal depression as a problem requiring intervention nor did they believe that improving mothers' mental health through therapy was a real gain, necessitating this alternate approach.[11] Involving families and communities in interventions can mitigate psychosocial risk factors such as poor self-efficacy, pejorative gender stereotypes, lack of financial autonomy and negative intimate partner relationships.[7] Systematic-

**Table 1: Adverse Outcomes Associated with Perinatal Depression**[9,10,13,14,15, 16,17]

| Outcomes for Mother | Outcomes for Child |
|---|---|
| ***Health*** | ***Health*** |
| Gestational hypertension | Spontaneous abortion |
| Preeclampsia | Preterm delivery/ Operative delivery |
| Spontaneous abortion | Neonatal growth retardations |
| Preterm delivery/ Operative delivery | Fetal death |
| Bleeding during gestation | High cortisol levels |
| Chronic health problems | Low birth weight |
| | Stunted growth |
| | Malnutrition during the first year of life |
| | Higher rates of disease (infectious and diarrheal) |
| | Hospitalization |
| | Reduced immunization |
| ***Mental Health*** | ***Mental Health*** |
| Low self-esteem | Increased risk for mental health conditions |
| Suicidality | |
| ***Behavioral/Functionality*** | ***Behavioral/Functionality*** |
| Lack of adherence to medical care recommendations | Irritability |
| | Hostility |
| Sleep problems | Erratic sleep patterns |
| Poor nutrition | Enhanced stress response |
| Poor functionality | Impaired language learning |
| Inhibited decision making capacity | Reduced educational attainment/ performance |
| Substance abuse | Reduced economic productivity |
| | Lifelong behavioral problems |
| ***Parenting/Attachment issues*** | ***Attachment issues*** |
| Reduced attachment | Lack of secure attachment to mother, which may perpetuate across generations |
| Reduced child bonding | |
| Poor parenting | |
| Nonresponsive caregiving | |
| Lower likelihood and shorter duration of breast feeding | |
| ***Social Relations*** | |
| Damage to marital bond | |
| Damage to social relations | |

review of interventions for perinatal mental disorders suggests that interventions that directly address infant health (rather than as a secondary outcome) and integrate maternal and infant components have more significant effects on infant growth and development, neonatal mortality rate and infectious disease rates.[7]

## CULTURAL ADAPTATION

Although CBT has been found cross-culturally applicable, psychiatric labels and conceptualizations of illnesses vary considerably, necessitating cultural adaptations to intervention design and execution.[7] Adaption of evidence-based mental health treatments for the cultural contexts in which they are being delivered can lead to increased acceptability, patient satisfaction and effectiveness.[24] Modifications to the CBT model for the THP included: translating materials into the local language and replacing technical jargon with common terms, pairing therapists and patients based on their home community and language, using pictorial guides, de-emphasizing components of the intervention found inappropriate and involving family members in the process.[6,18] These activities were done to increase understanding, adherence and engagement of participating families and thus the likelihood of achieving successful outcomes. For example, the term "depression" was never used and was instead replaced by terms like "burdened" and "stressed" to avoid medicalization of the condition and reduce stigma.[11] Matching providers with participants by community and language would have facilitated trust, an essential component for any psychological treatment.

However, tailoring the THP to each community is costly and time consuming. The potential for implementing and scaling up effective mental health services in LMICs may be substantially limited if they are dependent upon lengthy and in-depth ethnographic assessments and treatment development.[25] Rapid Assessment (RA) procedures may have been a more efficient method of gaining the knowledge necessary to effectively implement the THP. This is a more rapid, cost effective and pragmatic method than traditional ethnographic research, which is used to generate information on a specific health or social problem and aid in the design of culturally appropriate interventions.[26] In RA, interviews or focus groups are conducted with small samples of key informants and respondents using directive questions (probing) in a short period of research.[27] While assessing context is critical because mental health interventions are influenced by the social, economic, cultural institutional and gendered environments in which they operate, Belkin et al. suggest that the THP may have been improved by drawing upon local "home-grown" methods based on familiar practices and social strategies rather than adapting treatments based on Western research and practice.[25] RA with key informants may have uncovered alternative models.

## EVALUATION

The THP evaluation included key outcomes and utilized validated and reliable procedures. Previous quantitative and qualitative studies done in a rural sub-district of Pakistan found perinatal depression correlated with high rates of infant malnutrition, diarrhea and reduced uptake of immunization, all of which were tracked to determine program gains.[5] Other factors that had been found to protect against perinatal depression such as access to contraception and father engagement were also included.

However, the study failed to find significant results for improving infant malnutrition and missed opportunities to measure other critical factors including the mother-infant bond and infant development gains. Simon suggests that the intervention's failure to produce significant growth gains could be explained by the relatively small difference in standard deviations of growth between children of depressed and non-depressed mothers (0.6 SD) yielding clinically significant but undetectable results for a study with this power (or sample size).[28] The THP authors acknowledge that the high prevalence of underweighted infants likely reflected the sustained effect of untreated maternal depression in both intervention and controlled groups and indicate that longer follow-up might have shown significant impact of the intervention.[5] Additionally, the program effect may have been negated if the control group experienced unintended gains as a result of LHWs providing more structured and monitored care than is usual in the community.

Extending the evaluation period and tracking additional outcomes may have produced more significant results for multiple outcomes. Depression and growth outcomes were measured at only 6 and/or 12-month follow-ups and the number of diarrhea episodes was only reported for the two weeks prior to follow-up. However, clinical trials for treating common perinatal mental disorders in LMICs evaluate outcomes as much as three years later and other early interventions in HICs show results up to 15 or 20 years later.[7,29] The THP could have tracked infants' cognitive and emotional development using one of the many validated developmental screening tools, as well as infant and caregiver attachment—a critical element in infant development and one threatened by perinatal depression. For example, Cooper et al. tracked gains of an intervention to improve mother-infant relationship and security of infant attachment using the strange situation procedure (whereby young children are observed alone, interacting with a stranger and reuniting with a primary caregiver) and using an established, reliable parent/caregiver involvement scale (that measures the responses of the mother to her infant's needs and initiations).[30] Alternatively, the THP authors could have explored local practices and methods for examining the infant-mother relationship and developmental gains.

Finally, the evaluation did not assess which of the intervention's numerous strategies and components contributed most significantly to successful outcomes. The THP Curriculum has five modules. The intervention employs numerous strategies including child health education, activating social networks, psychoeducation, psychostimulation, cognitive restructuring and problem solving.[6] Intervention success was attributed to improved maternal knowledge, caregiving skills, sensitivity and responsiveness enhancing the mother-child interaction, maternal self-efficacy and satisfaction.[7] However, no efforts were made to determine which strategies produced the greatest results. Post intervention quantitative evaluations were conducted, which showed LHWs were strongly in favor of the intervention, but these did not include perceptions of program or activity efficacy. Future iterations should explore the effectiveness of the various strategies and components.

## SUSTAINABILITY AND SCALABILITY

Because increased work pressure, potential burnout, low motivation and high staff turnover among CHWs are common challenges that inhibit sustainability and feasibility of psychological interventions for perinatal depression when taken to scale, the authors should explore simplifying their curriculum.[6] Pallas et al. recommend that interventions should appropriately design the scope of a CHW's work to fit with the levels of financial and human resources available for training, supervision and incentives in order to maintain CHW morale and motivation.[21] Because of the complexity of this model and the training and supervision necessary for its implementation, it may be beneficial to determine if a simpler version may still provide significant results. Further, as scalability is a common challenge in psychological interventions for perinatal depression by non-specialist health workers in LMICs, an assessment of the intervention's cost-effectiveness would be critical for advocating for its expansion or replication.[6] A simpler version may be more cost-effective, sustainable, feasible and readily accepted by policymakers in LMICs.

## CONCLUSION

Because of perinatal depression's high prevalence and burden of disability and low rates of diagnosis and treatment, interventions are urgently needed to provide cost-effective and sustainable mental health support to pregnant women and new mothers in LMICs. Interventions should target the most vulnerable populations, including single mothers, the socially isolated and women in crowded households of rural areas.

Analysis of the Thinking Healthy Programme identified critical processes for success. The THPs used a psychosocial approach to adapt the therapeutic intervention for context, facilitate family engagement and address individual needs. This contributed to its effectiveness in reducing maternal depression, improving functioning and increasing perceived social support among mothers in the treatment group. The formative research and continuing supervision components were also very strong, though these processes may be difficult to sustain and scale up. However, the intervention's failure to achieve significant results with regard to infants' healthy development suggests the possibility of biases and the need for additional and extended evaluation methods including of mother-infant attachment and infant development. In addition, incentives should be provided to bolster CHW and supervisor morale and motivation and reduce the likelihood of turnover. Finally, steps should be taken to measure and potentially improve the cost-effectiveness of the THP model, such as utilizing more rapid assessment procedures to dictate adaptations, modifying supervision processes and/or simplifying the design to eliminate less vital components.

Nevertheless, the THP provided multiple benefits to a poor, rural community and illustrates successful methods for psychological interventions to address perinatal depression. This model for implementing an evidence-based, culturally-adapted psychological treatment in a resource-poor setting provides great promise to the field of global mental health. With some adjustments, it could be scaled up to support the health and development of many women and children worldwide.

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# "Sehat Ka Insaf": A Model for Overcoming Polio in Pakistan

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## INTRODUCTION

Poliomyelitis, more commonly known as polio, is a highly infectious disease caused by poliovirus. The virus enters through the mouth or nose and colonizes the gastrointestinal tract, spreading primarily through feces, unclean hands, contaminated drinking water and improper sanitation. The condition primarily affects children under the age of five and induces damage in motor neurons, triggering a variety of symptoms including fever, fatigue, headaches, vomiting, stiffness of neck and pain in limbs.[1] In approximately one in 200 infections, the virus enters the central nervous system, leading to irreversible paralysis.[2]

In 1988, when a startling 350,000 cases of polio were reported worldwide, the World Health Assembly resolved to eradicate poliovirus and launched the Global Polio Eradication Initiative.[1] Although the global eradication plan has reduced the number of cases of polio from 350,000 in 1988 to 223 reported cases in 2012, the final endemic reservoirs of resistance in Nigeria, Afghanistan and Pakistan have provided the greatest hardships for public health authorities.[2] In these countries, polio persists at the margins of society where critical health services are lacking or even nonexistent. As a result, the greatest challenge for workers has been to vaccinate enough children to drive immunity levels above a threshold percentage, whereby herd immunity is achieved. Herd immunity is a form of immunity that occurs when a substantial percentage of a population is immunized from a virus, making those who are not immunized protected, because the virus cannot spread from person to person as easily. For the poliovirus, the herd immunity threshold percentage is between 80–86%.[3]

India was previously considered one of the most resistant countries to polio eradication efforts due to its poor sanitation, high population density and migrant communities. However, since India's strategies to eliminate polio proved successful in 2012, their novel techniques have been adopted in polio campaigns around the world, including in neighboring Pakistan. Despite Pakistan's efforts to modify their strategies based on India's model of success, Pakistan has not been able to completely interrupt polio transmission. The World Health Organization (WHO) writes that when proven eradication strategies, such as those of India, are fully implemented, polio transmission is halted.[2] Yet, it is ironic that Pakistan continues to struggle brutally in the fight against polio, despite having used proven techniques from India.

Upon closer examination, it becomes evident that Pakistan needs a more personalized strategy to eradicate polio. Unlike India, Pakistan faces a unique obstacle: terrorism. In recent years, Pakistan has witnessed several targeted murders of polio health care workers and targeted bombings of polio vaccination stations. To continue providing vaccination services despite the intentional killings of polio workers, the Pakistani health care authorities have enacted a new campaign, "Sehat Ka Insaf", which has shown to be a resounding success in the polio stronghold of Peshawar and must be modeled throughout Pakistan and other terror-ridden strongholds of polio. Specifically, "Sehat Ka Insaf" is a blanket method of administering the polio vaccine along with eight other vaccines, hygiene kits and vitamin A drops in order to circumvent polio-specific terrorist attacks in Pakistan. This article will first explore India's proven strategies to provide a comparison for the "Sehat Ka Insaf" campaign strategy and subsequently will examine polio-specific terrorism in Pakistan, culminating in an argument that the "Sehat Ka Insaf" model should be replicated nationwide in Pakistan until polio is completely eradicated.

## PROVEN STRATEGIES IN INDIA

India, which was declared polio-free in February 2012, was originally hypothesized to be the last country in the world to end polio given its densely populated communities defined by poor sanitation and often migrant members.[4] After failing twice to meet the eradication goals of 2000 and 2006, health care workers in India realized that more robust tactics were necessary to rid the virus in its most aggressive reservoirs.[5] Normally, multiple doses of the polio vaccine are necessary to successfully immunize a child; however, healthcare officials had trouble accessing the geographically isolated areas native to India. Making frequent trips to these remote, mountainous communities was labor-intensive and required proper maintenance of vaccines during long trips.[4] The greatest challenge in the preservation of vaccines was keeping them refrigerated at -20 °C in areas that were hard to reach and often lacked electricity. The shelf life of the vaccines also had to be closely monitored. For instance, while the oral bivalent types 1 and 3 poliomyelitis vaccine have a shelf life of 24 months at -20 °C, the World Health Organization advises that opened vials of the vaccine should only be used for up to 28 days.[4] In addition, the mobile and migrant communities native to India made it difficult to keep track of which communities had yet to be vaccinated.[4] Many populations were constantly on the move, searching for seasonal jobs or new shelter due to displacement by floods.[6]

In order to confront the nation's hurdles, India used a combination of innovative, micro-scaled techniques, including dispatching small teams of polio workers, marking children's fingers with enduring ink to assist in locating missed children in larger public venues and chalking houses to indicate unvaccinated children.[4] In addition, when parents declined vaccines for their children, a second team of polio workers and highly-respected local villagers were dispatched to convince the parents that the vaccine would protect their children. Each new outbreak was monitored through intense surveillance tactics, and immediate action was taken when outbreaks occurred. If a number of outbreaks occurred within a certain community or city, an increasing number of health care workers were dispatched to vaccinate any unprotected members in the surrounding populations, and the outbreak was continually monitored on a map. Through accountability at all levels, India went from having 741 cases of polio in 2009 to zero cases in 2012.[7] The 2.3 million vaccinators involved in the eradication effort provided 900 million doses of the oral polio vaccine for India's hoi polloi.[1] Not a single case of polio has been reported in India since January 2011.[7]

Ever since the global landscape witnessed India's triumph over polio, many countries, including Pakistan and Nigeria, have adapt-

ed India's micro-scaled and data-driven approach. While polio still remains endemic in Pakistan, Nigeria and Afghanistan, Pakistan is the only country experiencing a rise in the incidences of polio from 58 cases in 2012 to 83 cases in 2013.[8] The increasing number of incidences in Pakistan can only be understood under the light of polio-specific terrorism and how it may be hindering polio eradication efforts.

## TERRORISM IN PAKISTAN

Misconceptions held by Pakistani militants and some of the Pakistani public against the polio vaccines have complicated efforts to wipe out polio in Pakistan. Many Pakistanis believe that the polio vaccination drives are a cover-up for Western plans to spy on Pakistan or a scheme to induce sterilization in the recipients of the vaccine.[9] Suspicions about Western ambitions to spy on Pakistan through polio eradication efforts originated in 2011, when American troops used the assistance of Pakistani physician, Dr. Shakil Afridi, to collect DNA samples to track down Osama bin Laden under the guise of a polio vaccination effort.[10] Subsequently, militant leaders in Pakistan enforced a ban on vaccinations in North and South Waziristan, limiting access to an estimated 260,000 children.[11] "As long as drone strikes are not stopped in Waziristan there will be a ban on administering polio jobs... Polio campaigns are also used to spy for America against the Mujahideen (holy warriors), one example of which is Dr. Shakil Afridi," a militant group said in a statement.[12]

Further momentum against the polio vaccination drives was gathered when Islamic militant leaders, such as Maulana Fazlullah, now the chief of a militant group allied to the Pakistani Taliban, stated that to accept the polio vaccine would be considered haram (forbidden) in Islam.[13] Fazlullah further claimed that those using the vaccine and submitting themselves to impotency were infidels of Islam.[13] In addition to militant leaders, even the general Pakistani hoi polloi raised doubts against the polio vaccine. Some Pakistanis inquired why the government was visiting door-to-door supplying polio vaccines when there were no equivalent free programs for other chronic diseases.[13]

Due to the misconceptions that the vaccination efforts are either a Western plan of spying on Pakistan or that the vaccines induce sterilization, Pakistani militants have resulted to terrorism in an attempt to halt polio vaccination drives.[9] This terrorism has had a calamitous effect on the vaccination effort; since July 2012, 31 polio vaccination workers have been murdered in terrorist attacks.[14] In the city of Peshawar, which was declared the largest reservoir of polio in the world and has accounted for 90% of all polio cases in Pakistan, a bomb recently exploded on February 17, 2014 at a polio vaccination station. The following day, armed gunmen kidnapped six WHO anti-polio workers.[15,16]

Despite the tremendous momentum toward the eradication of polio, the deliberate attacks on polio workers in Pakistan threatens to reverse decades of progress in the global eradication of the virus. The WHO writes that, "as long as a single child remains infected, children in all countries are at risk of contracting polio. Failure to eradicate polio from these last remaining strongholds could result in as many as 200,000 new cases every year, within ten years, all over the world."[2]

## PAKISTAN'S INGREDIENT TO SUCCESS: THE "SEHAT KA INSAF" MODEL

In the face of a Taliban ban on polio vaccinations, Pakistani health authorities have taken a unique approach to continuing polio vaccination campaigns despite the risk of being targeted by terrorists. Instead of focusing on a polio-specific drive, a new Pakistani model campaign, known as "Sehat Ka Insaf," aims to be an all-inclusive method for treating all types of preventable diseases in order to use a blanket method of administering the polio vaccine.

The "Sehat Ka Insaf" campaign was developed by the government of a province in Pakistan known as Khyber-Pakhtunkhwa.[13] The campaign began on February 2, 2014, and it will take place in Peshawar for twelve Sundays.[13] Depending on its success rate, the "Sehat Ka Insaf" model may be extended to other districts. Every Sunday, the campaign lasts from 9am to 3pm and will continue until April 20, 2014.[13] The projected expenditure of the entire campaign is Rs.124 million and is being paid by the World Health Organization and UNICEF.[17]

Since militants oppose the polio vaccine only, the "Sehat Ka Insaf" campaign offers eight other vaccines to preventable diseases including tuberculosis, diphtheria, pertussis, tetanus, hepatitis B, haemophilus influenza, pneumonia and measles.[13] In addition, the health campaign provides vitamin A drops and hygiene kits, which include soap, toothpaste, toothbrushes and towels.[13] By expanding the types of vaccines, toiletries and dietary supplements offered, "Sehat Ka Insaf" serves as a protection mechanism to administer polio vaccines without being targeted.

To safeguard against terrorist attacks, the campaign was designed to be completed in a very short period of time, during which motorcycle riding is prohibited, thousands of police officers are put on guard and cellular phone service is suspended.[18] Unlike past polio-specific vaccination drives that mimicked India's strategies, the campaign works under a much briefer window of time to make health workers less vulnerable to a militant attack. Finally, to prevent vaccination refusals, the polio workers travel with religious clerics to convince parents that the vaccinations are not forbidden in Islam.

While previous polio-specific vaccination drives run by the federal government took up to two weeks, the "Sehat Ka Insaf" program achieved a comparable number of successful vaccinations within six hours. Success stories of the campaign are already circulating in Pakistani news reports. Pakistan Today wrote that, "according to the data collected by the KP health department, 362,004 children were vaccinated against polio in 45 union councils of Peshawar in the first round; 455,906 in the second round; 547,093 in the third; 560,881 in the fourth, while 650,405 children were vaccinated in the fifth round of the campaign."[18] Despite the fact that the program is in its beginning stages, over 2.5 million children have been vaccinated against polio during "Sehat Ka Insaf" vaccination days in Peshawar using 12,500 volunteers.[19]

The "Sehat Ka Insaf" campaign has not only proven to be successful and efficient, but also realistic. Earlier campaign ideas provided by the Melinda and Bill Gates Foundation proved to be unsuccessful due to polio-specific campaigns that were unrealistic in the face of terrorism.[17] However, "Sehat Ka Insaf" has successfully managed to combat terrorism through a blanket mechanism of providing a broad spectrum of vaccines and supplements and through specific security measures to prevent violence. The Khyber Pakhtunkhwa province's Minister for Information, Shah Farman, said, "the reality is that this programme has been lauded internationally while other provinces are now trying to replicate Sehat Ka Insaf."[17] The reason why India's proven strategies did not work for Pakistan is because India's model was based on aggressive long-term monitoring. However, in the face of terrorism, Pakistan needed a more personalized strategy that would allow health care workers to quickly get in and out of high-risk environments. Thus, by proving to be successful, efficient and realistic, the "Sehat Ka Insaf" model is a promising way of combating the final reservoirs of polio in terror-ridden Pakistan.

## CONCLUSION

As of April 7, 2014, Pakistani officials have extended the "Sehat Ka Insaf" model to other districts in Pakistan, such as Mardan, Charsadda and Swabi.[20] However, a major concern is that, as the Peshawar provincial for Health, Shahram Tarakai, stated, after three more rounds of the campaign in Mardan, Charsadda and Swabi and after the culmination in Peshawar on April 20, 2014, the government will revert back to previous polio-specific campaigns.[20] Shahram Tarakai stated, "this programme was started to tackle a spiral in polio cases, I mean the issue of Peshawar being the polio reservoir. We will run routine polio campaigns in Peshawar after the remaining two rounds."[20]

Contrary to Shahram Tarakai's plans, Pakistan should not, under the present terror-ridden circumstances, revert back to "routine polio campaigns," because health workers would, once again, become vulnerable to attack under the previous polio campaign structure, and targeted attacks on health workers would likely resume.

Considering the successes of the "Sehat Ka Insaf" campaign, Pakistani government and health officials must mass replicate this model and utilize it throughout strongholds of polio-specific terrorism in Pakistan until polio is completely eradicated. In the face of targeted killings, the "Sehat Ka Insaf" campaign presents a brilliant, multifaceted strategy for delivering vaccines in a region of the world gripped by fear of terrorism and distrust of healthcare workers. The campaign provides more than just polio vaccines to circumvent the militant ban on polio vaccines. In addition, it provides a myriad of unique security measures to prevent violence. Most importantly, the campaign has proven to be a model of efficiency, achieving comparable vaccinations in a matter of hours, as opposed to previous campaigns that lasted a couple of weeks.

If modeled properly, mass replications of the "Sehat Ka Insaf" campaign will be the final ingredient to successfully overcome the hurdles that terrorism in Pakistan has created. To fully eradicate polio, Pakistan should not revert back to "routine polio campaigns," but instead should continue replicating the "Sehat Ka Insaf" model until the finish line.

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# Poppin' the Prophylactics: an Analysis of Antibiotics in Aquaculture

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**This paper will focus on the problems associated with the use of prophylactic and therapeutic antibiotics used in aquaculture internationally. Aquaculture can, in theory, be a beneficial way of sustainably harvesting fish—but only if done correctly. This paper will provide a background of scientific analysis as to how and why antibiotics are used and detail the problems associated with excessive use, including antibiotic resistance, residues found in human food and accumulation of antibiotics in the environment. Current use and regulation of antibiotics in differing nations will be analyzed, with an emphasis on the countries of Norway and Chile. Norway has proven to be a successful model by decreasing antibiotic usage drastically while still maintaining plentiful yields, as opposed to Chile, a nation that uses an abundance of antibiotics. Alternative approaches will be explored, such as vaccination to prevent disease outbreaks and the use of probiotics and bacteriophages. Finally, proposed policy recommendations and solutions will be examined.**

## INTRODUCTION AND BACKGROUND ON AQUACULTURE PRACTICES

Aquaculture is defined as the farming of fish that intensify production for human consumption under controlled conditions, including breeding, containment, feed and medications.[1] The negative impacts of aquaculture are not limited strictly to the environment but also involve public health. Aquaculture can produce fish that have higher levels of natural and synthetic toxins, such as pesticides and persistent organic pollutants.[2] This result is due to contaminants in fish feed as well as improper location of aquaculture facilities where there exist high levels of natural containments such as arsenic.[2] Antifungals, disinfectants, antiparasitic pesticides and anesthetics are often used illegally in aquaculture and many are banned in places like the European Union (E.U.) because of concerns of carcinogenic and mutagenic properties.[3] This paper will focus specifically on the use of prophylactic and therapeutic antibiotics in aquaculture internationally and on how abuse can have adverse health effects in human populations. Antibiotic abuse is a known problem and there are ways to prevent and solve this issue.

Aquaculture is growing in prominence as an alternative way of obtaining seafood. Production is currently increasing 9.25% per year and it is estimated that aquaculture will account for half of all seafood consumed in the world by 2020.[4] Because aquaculture is heavily increasing, it is imperative that current practices are safe and sustainable and do not have negative human health implications. The increase in efficient aquaculture starting in the 1960s was driven by the newfound ability to control for disease with improved pen water quality, more nutritious feeds and genetic manipulation to aid selective breeding.[2] Because of depletion of wild fish stocks, aquaculture is viewed as an alternative and efficient way to replenish and produce fish.[2,5] Aquaculture's other benefits include, but are not limited to, wetland preservation, agricultural and human waste control and desalinization of lands.[6] Drawbacks include, but are not limited to, demolition of natural habitats, the release of effluent, introduction of fish diseases and escape of farmed fish into wild populations, causing disease transmission and impacting genetic diversity.[6]

A background of scientific analysis as to how and why antibiotics are used will be discussed, as well as the problems associated with excessive use, including antibiotic resistance, residues found in human food and accumulation of antibiotics in the environment. Current use and regulation of antibiotics in differing nations will be analyzed, with an emphasis on the countries of Norway and Chile. In countries such as Chile, China and several Asian-Pacific nations, there is a lack of regulations as well as weak enforcement on how many and which specific antibiotics can be used.[4,7] Norway has proven a model of success by decreasing antibiotic usage drastically while still maintaining plentiful yields. Alternative approaches will be explored, such as vaccination to prevent disease outbreaks and the use of probiotics and bacteriophages. Finally, proposed policy recommendations will be examined.

## PART A: ANALYSIS OF THE SCIENTIFIC DATA

### How and Why Antibiotics are used in Aquaculture

Antibiotics are defined as "drugs of natural or synthetic origin that have the capacity to kill or to inhibit the growth of micro-organisms" and are non-toxic to the host, used in order to serve as treatment for disease.[8] Prophylactic antibiotics refer to antibiotics given in order to prevent disease, as opposed to therapeutic antibiotics, which are given in order to treat disease[5] In the U.S., infectious disease among aquaculture is a top limiting factor that accounts for 45.4% of losses in aquaculture.[9] A wide range of bacteria creates major setbacks in production and antibiotics aid in effectively eliminating these diseases from spreading.[4]

Antibiotics are necessary in aquaculture due to a lack of sanitation in dense, overcrowded pens where there are no barriers to properly isolate healthy fish from infected ones. This issue is most prominent in developing countries in the Asian-Pacific region and other counties like Chile, where 90% of world aquaculture production occurs. In these countries, regulations are lax and antibiotic usage is abundant compared to countries such as the U.S. and Norway.[4,7] When an outbreak occurs, the farmer is pressed for time and because of limited resources, he or she often uses antibiotics inappropriately due to "ill-informed decision-making based on a rushed diagnosis."[10] The farmer, not wanting to waste valuable time, will then often quickly administer antibiotics regardless of the correct dose or even the correct antibiotic, in order to save as many fish as possible.[10] In addition to a lack of cleanliness as a factor, the fish are often stressed and therefore more susceptible to disease. For these reasons, their immune system response is slower and prophylactics aid in the ability to keep the fish from attracting a variety of diseases.[7] Prophylactics also increase digestion efficacy and conserve energy in the fish.[8] The antibiotics kill harmless endemic pathogenic bacteria in the fishes' intestines, which causes an increase in the absorption of nutrients.[8] Because of this, the nutrients fed to the fish are more efficiently absorbed with less energy expended, thus achieving growth promotion.[8]

On average, countries use roughly seven to thirteen different kinds of antibiotics.[5] Prophylactic antibiotics are often given through medicated feed and, less commonly, by injection and baths.[7] Although the

medicines given to fish aid in combating the spread of infectious diseases, they are merely a palliative to the problem of limited resources. High densities of fish, a lack of barriers to isolate infected fish from healthy ones and general unclean pens result in high rates of infections.[7,11] Due to the negative consequences of antibiotic use, the use of prophylactics is not warranted since they pose potentially grave threats to human health, including increased antibiotic resistance and residues found on consumer seafood. Therapeutic antibiotics in all countries should only be issued sparingly, when appropriate, and should be monitored heavily by governmental oversight agencies. For example, in the U.S., 11 agencies are responsible for directly and indirectly regulating aquaculture.[2] The National Fish Hatchery System and U.S. Geological Survey are examples of two of these agencies that aid in disease reduction.[2]

## Negative Impacts of using Antibiotics in Aquaculture

*I. Antibiotic Resistance*

Antibiotic resistance is the primary detrimental effect of administering prophylactic and therapeutic antibiotics to fish in aquaculture. Owing to the presence of antibiotics in aquaculture, antibiotic resistance has risen and therefore may be a possible contributing factor of antibiotic resistance in human populations.[5] Although in most developed nations the antibiotics that humans use are not used in aquaculture, antibacterials common in aquaculture sometimes overlap with human medicine, thus creating resistant bacteria that will not respond to antibiotics used in human treatment.[10] Fish pathogens' resistance can be indirectly transferred through horizontal gene transfer to human pathogens because of the possibility that the pathogens have resistant genes and a constant presence of residues of antibiotics in the fish's bodies.[3] Antibiotics in aquaculture are most likely creating bacterial strains that are resistant to several different kinds of antibiotics. According to the Center for Disease Control and Prevention (CDC), resistant strains of *Escherichia coli* and *Salmonella spp* have been traced back to antibiotic usage in animals.[8] Resistance can occur in non-pathogenic bacteria, which can then transfer their resistant genes to pathogenic human intestinal bacteria, leading to illnesses in humans that are not treatable by antibiotics.[1] It has been observed that after only two years of an antibiotic reaching the market, even if it is a new class, resistance begins to occur.[12] Since the discovery of antibiotics in 1962, many new classes of antibiotics have been found, but in recent years this number has slowed dramatically.[12] Although efforts such as using a combination of different antibiotics are effective at combating disease, they only slow the trend of resistance and do not stop it.[12] Currently, animals account for half of all antibiotic consumption worldwide.[12] Scientists believe ,although there is some controversy, that antibiotic usage among animals is the cause for resistance in humans.[12] A team of Korean scientists from the Research Division for Industry and Environment, Korea Atomic Energy Research Institute, performed a study analyzing four freshwater aquaculture farms in Jeollabuk-do, Korea and found bacteria resistant to multiple antimicrobials in 58.3% of the tested strains and bacteria resistant to individual antimicrobials in 41.7% of tested strains.[13] In addition, 100% of bacteria tested showed resistance for ampicillin.[13] Similarly, a study in Australia from the School of Pharmaceutical and Medical Sciences at the University of South Australia, uncovered single and multi-resistant bacteria collected from different areas in Australia. Results showed that bacteria showed some level of resistance to 18 of the 19 antibiotics. Because no antibiotics are officially listed in Australia, it would be incorrect to state that the resistance is due directly to antibiotic use. Yet numerous studies conducted in countries where antibiotics are known to be used have data very similar to the data found in this study; thus, it can be concluded that in aquaculture species and environments, antibiotic resistance is fairly common.[4]

These studies are only a small sample of the several publications suggesting that the abuse of antibiotics in aquaculture is creating strains of bacteria resistant to antibiotics used by humans. In many developed countries, prophylactic use has been banned and only limited therapeutic use is allowed.[7] However, this is not the case for much of the developing world.[7] For example, quinolones, which are heavily used in human medicine as an effective antibiotic, are used without restriction in Chile and China.[7] It has been found that 100-110 metric tons (MT) of quinolones are used for animals (the vast majority being aquaculture) while 10-12 MT are used in human medicine. [7] In addition, several studies have cited populations of antibiotic-resistant bacteria either directly underneath or around aquaculture habitats. One such study showed populations of bacteria resistant to tetracycline, quinolone and penicillin in the sediments around its fish farms.[3] Additionally, comparisons of bacteria before and after antibiotic treatment showed dramatically higher levels of antibiotic-resistant bacteria and antibiotic resistance genes within a fish after treatment.[5] Although we cannot assume a causal relationship between antibiotics and antibiotic-resistant bacteria, the overwhelming evidence has made this theory widely accepted among scientists.[5]

*II. Antibiotic Residues*

Antibiotic residues from the excessive use of antibiotics in aquaculture can accumulate in the tissues of farmed fish and shellfish, thus causing possible adverse health effects in humans. For instance, individuals who are very sensitive to certain antibiotics can have allergic reactions from trace residues and efficient diagnosis of what the patient was allergic to may be hindered by a lack of knowledge of what antibiotic was ingested or even which food triggered the allergic reaction.[7] Allergies are most common with those who administer the antibiotics and work with large concentrations of it. Workers in aquaculture facilities in Thailand and the Philippines reported sometimes administering prophylactic antibiotics daily.[5] Many do not have proper gear for handling antibiotics, nor do they know of the potential toxicity and health risks of the chemicals to which they are being exposed.[5] Aquaculture workers are at risk when they inhale, ingest and come into contact with dust aerosols that contain antibiotics used to medicate and feed fish.[11] This contact can result in altering their intestinal flora by increasing selection for antibiotic resistant bacteria.[11] Allergy and toxicity are also critical problems that workers face when administering large quantities of antibiotics in food mills.[7,5] This situation is especially of concern since certain antibiotics have direct poisonous properties.[5] In addition, workers can be exposed to microbes that can cause harmful diseases and infections, including fish pathogens that have been demonstrated to be contagious in humans.[2] In fact, there was a reported case of four different workers in a tilapia farm becoming infected with a pathogen previously never found to have infected humans.[2]

An additional health problem for humans is that intestinal microflora, which sustain a healthy gastrointestinal tract by preventing pathogenic bacteria from growing, can be disrupted from long exposures to these residues.[10] Resistant pathogenic bacteria can proliferate in the gut, endemic bacteria already in the gut can increase uncontrollably and increased susceptibility to entering pathogens such as *Salmonella spp*. can occur.[10] On the other hand, use of some antibiotics has been shown to leave no long-term residues. For example, a study demonstrated that no residues were found on shrimp tissues after 25 days of withdrawal of using oxytetracycline.[14] Yet one popular antibiotic, chloramphenicol, creates immediate danger of residues because of its toxic and probable carcinogenic properties. Although the chance of direct toxicity from consuming antibiotic fed fish is very low, chloramphenicol is an exception to this rule; studies have illustrated that this particular chemical leaves direct residual traces in human food and is highly toxic.[8] In human medicine, this antibiotic is used as a "last-resort" drug for conditions such as meningitis and conjunctivitis and therefore is still important in therapeutic cases.[10] Yet this drug making its way into human food poses significant public health risks. Since even trace residues can be associated with bone marrow depression and can induce a fatal form of human aplastic anemia, a ban on use in animals used for food consumption was instituted in the E.U. as well as in other countries.[1] However, as stated above, chloramphenicol is still one of the most widely used antibiotics worldwide in aquaculture and its use is posing a threat to human health.

Similarly to chloramphenicol, nitrofurans are another popular broad-spectrum group of antimicrobials. Although now outlawed by the E.U., illegal use is still rampant.[1] Nitrofurans are an antibiotic class that when used inevitably result in residues absorbed into the body that do not break down, even when the food is fully cooked.[15] Other antibacterials such as malachite green, fluoroquinolones and gentian violet also leave behind residues and have been seen to have carcinogenic properties.[16] Some of these drugs, such as fluoroquinoles, are very important, effective and powerful antibacterials used in human medicine. However, they must be administered with caution and care in incidences where they are warranted, and should not appear in food meant for human consumption.[16]

Although certain toxic and probably carcinogenic antibiotics have been banned in the U.S. and several countries in Europe, their use in

developing countries (such as Chile, China and several Asian-Pacific nations) is widespread because of lack of regulations and enforcement and therefore residues continue to be a problem.[4,7] There is often a delay in response to detecting chemicals like chloramphenicol and nitrofurans in imported seafood, leading to contaminated seafood products being sold and consumed.[10]

*III. Persistence and Accumulation of Antibiotics in the Surrounding Marine Environment*

Many farms, such as salmon aquaculture in open water pens, are environmental hazards: not only do they accumulate waste, diseases and chemicals, but the wild fish populations nearby also ingest the antibiotic loaded food pellets. This occurrence leads to remains of antibiotics like tetracycline and quinoles in wild fish populations.[1] Both wild fish and harvested scavengers (such as crab) near Mediterranean fish farms have been found to have levels of antimicrobials that exceeded the safe limit for consumption.[3] It has been estimated that 70-80% of fish antibiotics have been released into the environment.[13] In addition, antimicrobials are often non-biodegradable and can be released through urine and feces into the aquatic surroundings in an unmetabolized form, paving the way for significant contamination.[7,13]

Currently the risk of direct toxic effects, to low levels of pharmaceuticals in aquatic habitats, is unlikely; more research should be conducted to evaluate the risks and probable chronic effects of having low levels of antibiotics in marine environments spanning long periods of time.[17] In addition, considerable underestimation of risk is highly plausible since studies do not typically analyze the interactions that pharmaceuticals have with each other.[17] Although the antibiotics used in aquaculture are indeed present in the aquatic environment, their concentrations are at very low levels. However, precautions should still be taken so that even low levels do not pose a deleterious threat to human health in the future.

## Conclusion of Scientific Evidence

While aquaculture is a modern tool that has the potential to succeed and thrive as a sustainable, profitable business, the misuse and unrestricted use of antibiotics creates public health problems such as strains of antibiotic-resistant bacteria, residues in food and accumulation of pharmaceuticals in the environment. These consequences counteract the progressiveness of aquaculture as a practice. With the implementation of a stricter set of regulations, mandatory guidelines and effective enforcement, the development of a more sustainable way of farming fish is very plausible. Regulations, alternatives, recommendations and proposed policy solutions will be discussed in Part B. Currently, some countries such as Scotland, Canada, Norway and the U.S. have moved away from antibiotic usage and doing so was in no means an inhibiting factor toward successfully farming salmon.[7,11,18] Unfortunately, the vast majority of aquaculture farms administer antibiotics liberally and for the reasons laid out above, it is crucial that governments work to execute policies about antibiotics that protect human health.

# PART B: REGULATIONS, ALTERNATIVES AND RECOMMENDATIONS

## The Problem to be Addressed

With heightened sanitary and hygiene tactics and the implantation of vaccines in aquaculture industries by governmental agencies, tighter controls on antibiotics have ensued and have lead to a dramatic decrease in antibiotic usage in countries such as the U.S., the E.U. and Norway.[7] This reduction was accomplished without hindering productivity, thus demonstrating that it is indeed financially possible for these countries to create an aquaculture industry that does not heavily rely on antibiotics.[4,19] The problem to be addressed is that although there are preventative and alternative approaches to antibiotic use, there is a lack of policy enforcing antibiotic use restriction in aquaculture industries worldwide.[4,19] Furthermore, a lack of resources in developing nations makes it difficult to transition to sustainable and healthy forms of aquaculture production. Although feasible in Norway and other countries, this approach can be more difficult for other less affluent countries.

## Current Use and Regulation of Antibiotics in the U.S. and Abroad

Regulation of antibiotics through the use of policy and legislation vary from country to country and are overseen by governments and various regulatory agencies.[3] These regulations are complex and oversee several practices ranging from food supply, feed safety, choice of farm location, water quality and pollution control.[2] The International Office of Epizootics (OIE), the Food and Agriculture Organization (FAO), the World Health Organization (WHO) and the Committee for Veterinary Medicinal Products (CVMP) (a European regulatory committee), are a few of the many organizations that are involved with aquaculture and have voiced concern regarding the public health threats associated with the misuse of antibiotics globally.[3] Since regulatory practices differ substantially both between and within countries, efforts have been made to homogenize these practices.[2] For example, the Hazard Analysis and Critical Control Points (HACCP) program is an active and required program in the E.U. and U.S. that works to assure appropriate safety for both domestic and imported aquaculture goods.[2] The WHO and FAO both support this program and have made detailed reports recommending how other international markets can institute a similar HAACP program.[2] Movements have been created for national governments to support this program, which would thus greatly facilitate standardized international policy on aquaculture production.[2]

In the U.S., the use of antibiotics in aquaculture is heavily restrictive; it must be FDA approved and may only be used for treatment.[9] With this restriction, the use of antibiotics has decreased due to a number of reasons including antibiotic resistant bacteria concerns, the usage of prevention and health management instead of treatment, vaccines as an emerging practice and FDA limitations.[9] Restrictions internationally among countries who sought to reduce antibiotic treatments include almost complete eradication of prophylactics and prohibition of therapeutic antibiotics that are currently used for human medicine.[7] Maximum residue levels (MRL) and acceptable daily intake (ADI) are already mandatory by several regulatory agencies and the E.U. in order to protect consumers.[3] MRLs were established in the belief that ingestion of "low-level doses" of these residues for long time periods can possibly increase antibiotic-resistant bacteria.[3] However, not all countries have such laws or enforcements and there is no standardization of MRLs internationally.[3] Efforts must be made to create uniformity since different agencies choose to set their own MRLs.[3]

Quinoles are one such class of antibiotics that have been banned in the U.S. and Norway due to their popular use in human medicine, accumulation in sediments and ability to create cross-resistance; yet in Chile and China, quinole use has increased dramatically.[7] In Chile, the National Fisheries Service recently proposed a monitoring program to address this problem, since fluoroquinoles are used in human medicine and are on their last generation.[11] Since each subsequent generation has a broader spectrum of activity against bacteria compared to the previous generation, when an antibiotic is on its last generation its ability to combat bacteria is limited, posing serious issues to people trying to fight bacterial infections and diseases. The abundant use of antibiotics is primarily concentrated in developing countries such as in the Asian-Pacific region and Chile where regulation is weak with regard to which and how many antibiotics can be administered.[4] In addition, many countries have sparse data on the quantity and amount of antibiotics used in their fish farms, so accurate estimates of how much each country contributes to total use of global antibiotic usage cannot be estimated with accuracy.[20] Regulations and enforcement vary substantially between countries and are dependent on local governments.[20]

## Antibiotics are Unnecessary to Production: A Focus on Norway and Chile

*Comparing Norway's and Chile's Antibiotic Input and Fish Yields*

A comparison of countries that differ with antibiotic treatment demonstrates that antibiotic usage does not correlate with better yields of fish, nor does using fewer antibiotics reduce profit.[11] This fact is important to note since several countries, such as the U.S. and Norway, are able to produce thriving aquaculture farms with minimal antibiotic use, especially prophylactics. Although China is the leading producer in aquaculture worldwide and most aquaculture is produced in Asia, Chile will be discussed and compared to Norway since both countries farm salmon, which is a very distinct fish from fish farmed in other countries.[5] In addition, Chile is ranked as the 10th top producing aquaculture country in the world and Norway is 11th— thus they are similar in total production.[5] Although the conclusions drawn from salmon farming can aid in providing general recommendations to other fish

species, the diversity of fishes can require different approaches because what works for one species may or may not work for another. Regardless, it is still useful to examine what Norway has been able to successfully accomplish.

In 2007, Chile used up to approximately 385 metric tons of antibiotics to produce a yield of 300,000 metric tons (MT) of Atlantic salmon as opposed to Norway, which produced 820,000 MT of salmon with less than one metric ton of antibiotics.[5,6] In fact, the amount of antibiotics used in Chile is in geographical area about one fourth of that in Norway.[5] In 1987, Norway used 48 tons of antibiotics; today, it only uses about one ton per year.[18] Chile is using antibiotics at a rate 1400 times that of Norway with less yield.[11] (The potential for confounders such as an increased use of vaccinations or hygienic measures were not discussed in the article.) The importance of this comparison illustrates how abstaining from antibiotics did not inhibit the successful farming of salmon in Norway. High yields were obtained with minimal usage through less harmful, alternative approaches that did not have detrimental effects on the environment and human health. In Chile, the bacteria *P. salmonis* has caused devastating economic losses to the salmon aquaculture industry and there is no vaccine that prevents the spread of this disease.[11] *P. salmonis* is also endemic to other regions of the world including Norway, Scotland and the U.S., where antibiotic usage is limited and measures to control this pathogen through hygienic procedures have proven successful without antibiotic usage.[11] This particular pathogen is an opportunist and does not infect healthy fish. It is only problematic among stressed fish raised in improperly managed environments, thus a feedback loop is created. When fish are kept in unsanitary conditions they become more susceptible to disease, thus disease becomes common, thus causing more unsanitary conditions and more disease. Therefore, the use of prophylactic antibiotics to control for *P. salmonis* is unnecessary and easily avoidable with careful and sanitary husbandry techniques.[11]

*Norway as a Successful Model*

Norway has successfully created an aquaculture industry through implementation of a management program that controls and limits antibiotic usage. Norway simultaneously increased yields and decreased antibiotic inputs, which is attributable to the implementation of hygiene standards, a tight monitoring system of antibiotics and fish vaccinations.[11] Mass vaccination was one of the biggest contributions to combating disease in the Norwegian farmed salmon industry. Furunculosis, a devastating salmon disease, is the primary reason for abundant antibiotic usage.[18] A vaccine was created in response and within only two years went from a research trial stage to being used by 99% of salmon farms.[18] In addition to vaccination, zoo-sanitary measures for disease control, zoning controls and selective breeding of salmon for disease resistant traits were established.[18]

A centralized regulatory agency closely monitors the amount of antibiotics and prescriptions at the site of aquaculture facilities.[11] Because of this extremely close monitoring, 1) the use of antibiotics is strictly limited, 2) abuse of antibiotics, such as prophylactic use, is identified early and 3) infections and epidemics are discovered early and containment measures such as isolation are quickly performed to prevent disease spread.[11] In order for therapeutic antibiotics to be used in Norwegian aquaculture farms, they must be prescribed by a veterinarian or an authorized feed mill and the veterinarian must fill out a lengthy prescription form with details regarding location, reason for illness, species of fish, etc.[21] However, as successful as Norway was, it was difficult for the country to change its entire system around. Norway was able to do this through combined efforts from the governmental organization, the National Veterinary Institute and the Norwegian fish farming industry.[18] A 3% levy on national vaccine sales for animals was used to fund research on vaccines as well as various benefits to the veterinary pharmaceutical companies.[18] Since resources and efforts to produce a vaccine are risky for companies, risks were lowered by the government, which incentivized companies to make development of new vaccines possible.[18] Paul Midtlyng and his colleagues write "there is a lesson that extraordinary problems and challenges require extraordinary measures" and we cannot rely on simple methods to accomplish this, for they "will not be sufficient to resolve epidemic health problems."[18] Lastly, although Norway teaches us that it is possible to create a preventative system against disease, when disease does spread, alternatives must be used to combat disease from spreading. Moreover, although Norway has proven its ability to effectively minimize antibiotic usage without decreasing yields, this tactic may not necessarily work in other nations due to factors such as differing water temperature, dissimilar diseases, etc. Since salmon is the only type of fish cultured in Norway, as opposed to in other countries that have a diversity of fishes, effort, research and resources was focused only towards salmon.[19] Furthermore, tropical waters host a variety of different pathogens, which make vaccinations in different countries more difficult.[19]

## Alternative Approaches: Preventative and Therapeutic Solutions

Prevention of disease by creating farms that are hygienic, clean and not overcrowded is the first step towards halting the spread of infectious diseases among fish. Many other tactics can be used as well to help decrease the risk and spread of diseases in aquaculture. Vaccines are one such measure that is a very useful tool for combating diseases. Although not "impenetrable shields," mass vaccination against diseases such as furunculosis and vibriosis are effective and can decrease mortality substantially.[8] Vaccines are currently used in the U.S. and the E.U., but are not common in Asian nations (with the exception of Japan) although aquaculture is heavy in that region of the world.[19] The majority of fish farms are small and do not have much technical support, so farmers use antibiotics instead of preventive measures since antibiotics are widely available.[19] In addition, lack of resources to understand fish diseases as well as the economic investment and commercialization to produce vaccines are barriers to the development and use of vaccines.[19] Vaccinations can be administered orally, injected, or given through immersion (fish are sprayed or dipped in concentrated vaccine solutions).[8,22] The method used depends on a variety of factors such as stress of the fish, dosage and how long the vaccine will last.[8,22] Injections are typically the better form of administration. However, they are often more expensive, there is a greater chance of adhesions to the fish and considerable time is required to inject each fish.[8,22] Oral forms are easier to administer and do not cause the fish stress.[22] Vaccines are an excellent preventative measure since they do not leave residues on the fish tissues or in the environment and they provide long lasting protection.[19]

Probiotics are another tool that has proven to be of great aid. Probiotics are "mono- or mixed cultures of live microbes that when applied to animal or human, generate a beneficial effect on health of the host."[23] They help combat pathogenic microbes by obstructing the pathogen's cellular functions and outcompeting it for nutrients and space, therefore supporting healthy digestion and contributing to effective disease prevention.[23]

Even with excellent conditions, diseases are inevitable and techniques to control diseases while limiting the use of antibiotics are essential for controlling bacterial infections and promoting sustainable fish farms.[20] The use of bacteriophages is a promising alternative approach to combating disease in aquaculture facilities and can hopefully be implemented in the near future. Bacteriophages are viruses that kill only specific strains of bacteria, as opposed to antibiotics that are broad-spectrum and kill off beneficial bacteria as well.[20] Phage usage is advantageous since it directly targets the problem causing pathogen.[20] Phage can be applied to a variety of organisms at any point in their development, from larvae to mature stages, and can be administered through various means. Moreover, it can most likely be used in open systems such as open water salmon aquaculture farms.[20] However, a disadvantage to using phages compared to broad spectrum antibiotics is that the phages are strain-specific, so a fish farmer cannot just quickly administer the phages without testing to see which bacteria is causing harm, like one could do with antibiotics.[20] This loss of time could be detrimental to the health of the fishes. Also, there are also concerns that the phages may transfer virulence factors, turning non-pathogenic bacteria pathogenic; therefore, testing is necessary prior to implementation.[20,24] Nevertheless, bacteriophages can be one of many alternative tools to antibiotics for creating healthier farms for both fish and people.

## Future Priorities, Recommendations, and Research

Antibiotic resistant bacteria are not confined within national borders and therefore the issue regarding antibiotic resistance, antibiotic residuals found on human food and antibiotic persistence in the environment is a global problem that can only be combated through inter-

national effort. The WHO, FAO and OIE are three such global organizations that are current key players in assessing and combating human health threats from antibiotic usage. Based on the available scientific evidence examined in the earlier portion of this paper, it is clear that action must be taken in order to address this dire issue. Creating policy is not enough to combat all the problems associated with aquaculture. Enforcement, education of small-scale farmers, investments into vaccines and world trade agreements are but a few broad topics that must be addressed.

Focus should be directed towards nations such as China and Chile, where regulations and enforcement regarding antibiotic usage in aquaculture is poor.[5] Although, as examined earlier, Norway has been shown to be a successful model in pioneering for sustainable and healthy aquaculture practices, it is not practical to assume that other countries will be able to replicate Norway's practices. For instance, Thailand is very different from Norway: it is a lower-income country and farms different species of fish. The dissimilar chemical and physical environment between countries makes it hard to propose standard international regulations.[11] However, policy makers and governmental agencies can look at what successful countries have done and then apply within reason the same practice. Specific policy proposals are beyond the scope of this review and therefore only points of interest and general recommendations will be explored. Key issues (not in any particular order) to be addressed are the following:

**1. Research.** The most up-to-date research must be conducted regarding aquaculture practices. A review made available of antibacterials used at international, national and local levels would help scientists create targeted and specific studies to further research in this field and screen for residues and resistance factors.[5,14] A short term goal could be having international agencies and the industries come together to create a comprehensive inventory of all materials like antibiotics, metals and other chemicals used in aquaculture at all levels and make the list available for viewing.[5,14] This list would be vital since record-keeping of the amount and kinds of antibiotics used in aquaculture are not mandatory in many countries.[20] Creating a surveillance program is the first step towards gathering all information together so that longer-term and more important sustainable goals can be achieved. In Australia, for example, there are no registered antibiotics, although there is much speculation, stories and evidence that antibiotics are in fact being used.[4] In addition, surveillance of bacterial resistance is crucial to ensuring that levels of residues on fish remain at safe levels.[3]

**2. Vaccines.** In Norway, the government heavily supported research for vaccines in order to decrease the need for antibiotics.[18] Research needs to be conducted on the epidemiology and etiology of fish diseases endemic to Asian-Pacific countries so vaccines can be developed for the variety of fish species farmed in these countries.[19] In fact, 11 out of the 15 top aquaculture-producing countries are in Asia, which accounts for 94% of global production.[5] China is the top producing country and accounts for 71% of global production.[19] Research on vaccines in the Asian-Pacific region is vital and partnerships between the private sector, governments and universities will need to play a role in making this happen.[19]

**3. Hygiene and Sanitary Measures.** In order to prevent the need for antibiotics, a focus on improving conditions on the fish farms to avoid preventable disease epidemics among fish populations is necessary. Pens should be kept clean and overcrowding should be eliminated or at the very least minimized. Infected fish should be isolated immediately and zoning controls should be instituted.

**4. Enforced Ban on Certain Antibiotics.** An international agreement must be created that restricts prophylactic antibiotic use, use of antibiotics that are used in human medicine (i.e. quinoles) and use of antibiotics that have been shown to be harmful to humans (i.e. nitrofurans and chloramphenicol).[5] Restricting these antibiotics will help combat the three major problems with antibiotic usage: resistance, residues found on seafood products and accumulation in the marine environment.

## CONCLUSION

These broad policy aims attempt to form a platform towards addressing issues in aquaculture, and are a bold stepping stone towards a global solution in respect to sustainable aquaculture practices. These points aim to change aquaculture practices abroad and aim to protect the environment, human health and most importantly prevent the spread of antibiotic resistance worldwide.

## CONCLUDING REMARKS

Through actual practice, it has been demonstrated that aquaculture with limited use of antibiotics is possible logistically and finically through dealing with both local and global approaches.[7] The list of future recommendations aims at addressing this issue. The scientific evidence speaks for itself and now it is the job of regulatory agencies, governments and citizens to combat the excess and overuse of antibiotics in the aquaculture industry. Human health and aquaculture practices are closely intertwined, and by improving aquaculture practices, the health of the public can be improved as well.

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# The Rise, Critique and Persistence of the DALY in Global Health

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**A barrage of criticism from global health scholars in disciplines ranging from economics to anthropology immediately followed the introduction of the disability-adjusted life year, or DALY, in 1994. Despite demonstrated flaws in its justification and design, the DALY is still in wide use in the field of global health, promoted by scholars as well as by major publications like *The Lancet* and by funding agencies like the Gates Foundation. Two case studies first pointed out flaws in the mid-1990s that are still being overlooked in current research projects. The DALY has persisted while the power structure of global health has changed from the political to the economic and biomedical, and power (and money) have become concentrated in the hands of a few individuals. This change in regime is the reason that the DALY has persisted despite its flaws, but it also has positive implications for the future. Because of the extreme concentration of power in global health today, it would not be impossible to uproot the DALY, even though it is so widely used. If research dollars were devoted to the development of a better metric, only a handful of leaders would need to be convinced of its value in order for it to take over. The elimination of the DALY and development of a replacement is therefore not only necessary, as has been pointed out for almost twenty years, but also feasible, due to more recent changes in the political structure of global health. A new, two-part metric is proposed that would address the most common critiques of the DALY while still providing numerical guidance for health policy decision-making.**

## INTRODUCTION

### What is the DALY?

The disability-adjusted life year, or DALY, is a metric designed to quantitatively measure the impact of various diseases and conditions on the productivity and well-being of people through a combination of mortality and morbidity estimates. As a numerical value that can be compared across nations, its use has become widespread in policymaking, academia and nonprofit work. Although the DALY has continually grown in popularity, it has also been contested since its inception, notably in Sudhir Anand and Kara Hanson's 1997 paper, and by anthropologists such as Vincanne Adams.[1] Even leaders from "hard" sciences, such as Director of the National Institutes of Health (NIH) Francis Collins, have called DALYs and similar metrics like the quality-adjusted life year "only partially successful in providing the kind of information that policy-makers need," and urged the NIH to fund the "development and application of more rigorous models."[2] The DALY has been evaluated by members of various disciplines since the mid-1990s, and this paper will outline their arguments and provide examples of how the drawbacks of DALYs can at times impede the goals of global health. Despite its failings, the DALY is still widely used by researchers, and the following analysis will attempt to illuminate how the current power structure in global health is preventing viable alternatives from being developed.

Christopher Murray publicly introduced the DALY in 1994, in an article published by the World Health Organization (WHO) entitled "Quantifying the burden of disease: the technical basis for disability-adjusted life years."[3] In the paper, he explained his justifications for creating the DALY and described the technical details of the metric. His goal was to open the "black box" of policymakers' values in public health by attaching numerical values to various health conditions and disabilities in order to create a metric that would combine both mortality and morbidity into a single value.[3] This "black box" referred to the "wide variation in the implied value of saving a life" evident in different pieces of public safety legislation.[3] The DALY addressed this variation by creating a standard way of calculating the value of peoples' lives and, therefore, the amount of money that should be spent to help them.

Calculating DALYs involves several steps. First, potential years of healthy life lost are calculated using one of several life-expectancy measures, and, in the case of "non-fatal health outcomes," are then multiplied by a "disability weight." These weights are values between zero and one, with zero representing full health and one representing death, determined by "an independent group of experts."[3] The years of life are also adjusted by the presumed differential societal value of individuals at different ages, with the negative impact of a death peaking around age 12 and reaching negligible impact at age 100 (Figure 1).[3] Therefore, individual deaths contribute some number of DALYs that varies depending on age and disability status. In practice, this means that the deaths of individuals who are old, sick or disabled contribute less to the estimated burden of disease. Many researchers have taken this unequal valuing of life to be an ethical problem that could someday manifest itself as a practical one, as will be discussed below. Apart from these ethical issues, many scholars see problems with the actual statistical uses of the DALY metric, as documented below.

### What should DALYs measure?

Jeffery Hammer, an economist, argues that the goal that DALYs help to achieve is not the right one for policymakers to be pursuing. For Hammer, a debate about the specifics of the DALY is less fundamental than the debate about which economic model should be used for building health systems. The three main categories of goals for health systems, he writes, are "improving aggregate health status," "improving equity and reducing poverty" and "improving individual welfare."[4] Of the three goals that Hammer describes, he emphasizes that DALYs or cost-effectiveness analysis can only reasonably address the goal of improving aggregate health status. When people argue against the use of the DALY, he says, they are really disputing that specific economic model, not the calculation itself. "Discussions of means are often confused by what are really disagreements about ends," he writes.[4]

Hammer also questions the means by which policymakers attempt to address the goal of improving aggregate health status, which they support by using the DALY. Improving aggregate health involves "allocating limited resources to the provision of treatments for those diseases which have the highest health impact per dollar spent."[4] But

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Figure 1: Curve showing age-weighting by gender in DALY calculations[3]


if the state or other funding agencies are entering the business of providing health care, Hammer says, they should be focusing on "projects which yield the greatest improvement in the measure of health status chosen relative to what would happen if the Ministry did not do them" (author's emphasis).[4] That is, the government could provide a service that would yield a benefit, but if the service would have otherwise been provided by the private sector, then not all of the benefit could be attributed to the government's action. Therefore, it is not always best to devote the most resources to the health problem that yields the most DALYs. To Hammer, DALYs "make no sense" because they are implemented according to an economic model that ignores the way the world works in practice.[5] He sees this lack of awareness as an ethical problem because the uninformed decisions it leads to can potentially affect millions, if not billions, of people.

Michael Reich, another economist, sees as the main flaw of the DALY its goal of being a "double metric," meaning it seeks to increase efficiency as well as equity.[6] Reich disapproves of the DALY's use as a means to achieve two of Hammer's three goals (improving aggregate health status and improving equity), rather than only the one that Hammer argues that it is appropriate for (improving health status). The problem is that these two goals are not always aligned; Reich criticizes the 1993 World Development Report (WDR), for which the DALY was designed, for not specifying what to do "when cost-effectiveness and equity are in conflict."[6] Reich also sees ethical issues embedded in the use of the DALY, yet in the end, he does not fully reject it, because it "stands head and shoulders above all others [metrics used in the WDR]."[6] He believes that combinatory measures of health are helpful and necessary, and that the problems with the DALY are less severe than problems with other proposed metrics. Reich might explain the continued use of the DALY in terms of convenience; it was invented for the World Health Organization, made readily available, and nothing better has emerged since.

## Arguments against the DALY

Anand and Hanson, two economists who wrote an early, strongly-stated critique of Murray's work, frame the problem in a way similar to Reich's paper. Their primary critique of the DALY is that it attempts both to measure the global burden of disease and to guide the allocation of resources.1 In their paper, they explain how Murray failed to meet either of these goals individually and therefore why the DALY as a whole does not work.

First, according to Anand and Hanson, the DALY failed to provide a measure for resource allocation because it did not account for differentials in resource availability. This idea parallels Hammer's critique that governments ignore the contributions of the private sector (or lack thereof) when determining their own impact on health. Murray justifies his weighting technique with the example that "the premature death of a 40-year-old woman should contribute equally to estimates of the global burden of disease irrespective of whether she lives in the slums of Bogota or a wealthy suburb of Boston."[3] But Becker and her colleagues challenge readers to wonder "whether these two deaths are really alike," since the individuals have different resources available and might be fulfilling different roles in their communities and families.[7] Anand and Hanson also argue that since DALYs are based on baseline measurements from wealthy countries, the differential found between these populations and those of developing countries measures the "burden of disease and underdevelopment, and not that of disease alone" (authors' emphasis).[1] Both on an individual and a national scale, the DALY fails to account for differences in resources.

The DALY also fails at its other goal: that of measurement of disease burden, for both statistical and ethical reasons. In their arguments against the technical details of the DALY, Anand and Hanson were among the many who found fault with the fact that the weighting system was established by a "group of independent experts," stating that there was no way to assess "the statistical or scientific basis for selecting the weights and, thus…their validity."[1] Murray set out to eliminate the "black box" of policy decision-making by standardizing it. However, he chose to standardize the DALY by relegating the task of weighting to an unnamed group of "experts" and failed to account for the problem he had originally pointed out.

Disabled activists make a philosophical argument that their lives should be valued equally to those of people with no disabilities.

Because the DALY is a statistical measure, technical arguments against it are important, but what people have written about the ethical problems is also compelling. Anand and Hanson argue philosophically against the very idea of devaluing lives, pointing out that "by definition, DALYs are a 'bad' which should be minimized," even though "more of a 'life-year (even 'adjusted') should be a 'good', which should be maximized and not minimized."[1] Discounting life in general is problematic, but especially so for people with life-long disabilities; disabled activists make a philosophical argument that their lives should be valued equally to those of people with no disabilities (see, for example, the work of Dr. Adrienne Asch). The World Health Organization was criticized for seemingly devaluing the lives of disabled people, and the WHO responded to this criticism by making the language explaining devaluation in the new version of its protocol even more explicit.[8] Becker et al. ask whether the stigma of disability should be factored into the DALY algorithm in order to address this problem.[7] However, devaluing the life of someone with a congenital disability is itself a form of discrimination. Factoring stigma into the algorithm would result in the devaluation of the lives of those with disabilities even further, as well as validating the stigma against them. Especially with congenital disabilities, which are usually not curable, decision-making based on cost-effectiveness analysis would result in widespread defunding of health services for this population. Arnesen and Nord proposed that this problem is due to the "functional capacity," or economic value, of humans being confused with the actual value of their lives.[8] In order for a metric to accomplish what the DALY attempts, it is necessary to combine all these factors. Measuring the burden of disease and resource allocation together requires conflating economics with

health, and therefore even a better-calculated metric would still face the ethical conundrum of putting a price on life.

Reidpath et al. similarly critiqued the ethical implications of the disability weights in the DALY, but they were especially critical of the way later iterations of the DALY, designed to address these issues, failed to make the measure more equitable. Major critics in the 1990s objected to the original DALY's emphasis on the ability to perform activities associated with "normal" human life, and ignored "the social, cultural or environmental context of the condition."[9] In response, Murray and his team asked judges of disability weights to consider the "average handicap" associated with the social situation of people with certain disabilities, including stigma and other cultural factors. But Reidpath and his colleagues argued that, because of regional differences, this "average" handicap is just as useless as not taking culture into account at all. The authors found it inappropriate that, for example, the "same disability weight would be used in the calculation of the DALYs associated with epilepsy in Bogota, Beijing, New York and Newcastle."[9] The authors insisted, however, that even with regional differences taken into account, the measure still would not be equitable, returning to the argument about differential resources in disease treatment that Anand and Hanson referred to as the "burden of underdevelopment."[9]

## CASE STUDIES

A wide array of convincing economic and ethical arguments against the DALY were deployed well before the year 2000. One might expect, given this history, that the DALY would have been abandoned, either along with all other summary metrics or in favor of a less problematic one. Yet in June 2013, *The Lancet*, one of the world's leading medical journals, published a special issue devoted to the topic of health metrics entitled "Global Health Metrics & Evaluation: Data, Debates, Directions."[10] Out of the first twenty conference abstracts presented, five of them used DALYs, and most of the others measured variables that the DALY could not be applied to, such as malarial parasite density, which they did not relate to the burden of disease.[10] Case studies, presented below, show that researchers such as those published in *The Lancet* often fail to take into account critiques of the metric upon which they chose to base their policy recommendations.

> The most fundamental issue with the DALY, namely that it tries both to measure the burden of disease and to direct funding, could be addressed by introducing not one, but two new metrics; one for burden, and one for need.

### Case Study 1: *The Lancet* and Disease Burden in Kenya

Anand and Hanson pointed out the problematic nature of having an unspecified group of "experts" decide on disease weights. The following example provides more specificity, but brings up even more questions about the decision-making process. One of the abstracts in *The Lancet*'s special issue on metrics summarized a presentation about the authors' attempt to establish disability weights (DWs) for pediatric congenital anomalies by surveying health professionals in Canada and Kenya.[11] Out of 15 "health states" measured, two were significantly different between the two countries with a p-value below 0.0001. For one of them, cleft lip and palate, Canadians ranked the disability at 0.25, about the same as inflammatory heart disease or a pelvic fracture, while Kenyans ranked it as important as a lower arm fracture or malaria.[11,12] Despite this, the authors declared in their conclusion that they were successfully able to establish new disability weights because "DWs do not appear to differ significantly across cultural contexts."[11] Faced with such a large, statistically significant disparity for two of the syndromes, the authors simply averaged the Canadian and Kenyan values for their final report, not being able to come up with any better method.[11] This is problematic and its risks can be demonstrated anecdotally in the case of Dr. Poenaru, where upon moving to Kenya to practice surgery, "cleft lip and palate repair—a plastic surgeon's domain—has become his bread and butter."[13] The fact that he considers the burden of cleft palate greater than his patients do could cause him to perform more surgeries than they think are necessary, thereby directing limited resources towards that problem and subjecting patients to the unavoidable risks of surgery for reasons that they might not consider adequate. The "black box" of decision-making that Murray complained about is certainly opened by the DALY, but the "value choices" he talks about are ensconced by the introduction of his metric.[3]

### Case Study 2: Disease Spending in Tanzania

Becker et al. provide an analytical critique of the DALY, as described above, but they also cite a study of health spending in Tanzania as an example of effective use of DALYs to align health care spending with needs. Before the study, the share of expenditures on each of various programs was either above or below the share of DALYs it was calculated to contribute, and afterwards, the levels were almost perfectly aligned. The budget for two areas (the Expanded Program on Immunization and TB DOTS, or short-course directly-observed tuberculosis treatment) fell significantly.[7] The reason that these programs were calculated to comprise such a small proportion of the burden of disease illustrates another key flaw in the DALY; it discounts future lives at a 3% rate per year compared to current lives.1 Anand and Hanson extrapolate this discount rate to its absurd conclusion, namely that there is "a 50% chance that the world will end in 23.4 years," which is when future lives are discounted all the way to zero.[1] So the "success" of this program, therefore, was mostly predicated on the fact that it severely discounted the lives of future generations, and the funding changes it guided make future patients more likely to face both re-emergent infectious diseases that had previously been controlled by immunizations, as well as multidrug-resistant tuberculosis. Even critical scholars in global health can sometimes overlook problems related to the metrics they use. Becker et al. list Anand and Hanson's paper as a "suggested reading," but fail to account for one of its most convincing arguments in their analysis.[7] Admittedly, the authors do lament the "anemic response to multidrug-resistant tuberculosis," but they attribute it to the problems with using cost-effectiveness analysis in general, rather than seeing it as an easily avoidable pitfall associated specifically with the DALY.[7]

### DALYs and Lack of Data

Even if one assumes that the DALY, having now been in use for two decades, is a permanent fixture in the study of global health, various people have proposed ways of improving it. Jeff Hammer's main critique of the DALY does not focus on its embedded value judgments, but in the lack of data behind its general use.[14] Becker and colleagues describe the extrapolation used in the World Development Report as requiring a "leap of faith."[7] Cooper et al. pointed out that the reported numbers for most of the 48 countries in sub-Saharan Africa were based on records from South Africa alone, which account for only 1% of the sub-Saharan population.[15] This extrapolation is simply based on GDP, and is unbelievably common; Hammer pointed out that each actual observation in the Global Burden of Disease report was

used in models to create 1,500 additional entries.[14] Those who work on estimating disease burden should prioritize the collection (rather than extrapolation) of "vital statistics": records of birth, death, and changes in marital status, usually reported by country. However, both the collection and the coding of cause-of-death are often questionable. Arthur Kleinman, a psychiatrist and medical anthropologist, states this very strongly: "mortality rates are social fabrications that are based upon often seriously inadequate sets of data of questionable accuracy."[16] Jeff Hammer cited a study by Veena Das in which she found that death by "broken heart," interpreted as cardiovascular disease, was actually a death attributed to grief over the loss of a spouse.[14]

Areas of neglect in global health can be explained by lack of funding. The fact that better data are not being collected suggests that big donors are not interested in measuring health, but this is actually not the case. International funding organizations like WHO and AusAID are spending money to develop sophisticated toolkits to use to monitor country-wide collection of vital statistics; that is, to monitor the actual collection of data.[17] The Gates Foundation is also a major funder of work in metrics as they strive to meet Bill Gates's Grand Challenge #13: Develop Technologies that Permit Quantitative Assessment of Population Health Status.[18] One of the recipients of this funding is the Institute for Health Metrics and Evaluation (IHME).

### Explaining the Persistence of the DALY

Since the IHME is currently directed by Christopher Murray, the developer of the DALY, the institute likely holds a preference for studying combinatory metrics rather than actual morbidity and mortality rates. The organization, according to his Director's Statement, has contributed to global health by inventing new tools for identifying causes of death, documenting global health expenditures, and "creating new ways of measuring health challenges," including combinatory metrics like the DALY.[19] The IHME's website fails to reference performing any data collection. The organization's principles state that they aim to base "measurements on…available data and objectively portray the uncertainty in measurements" and to "consult with the global health community" even though "consultation does not necessarily lead to consensus."[19] In essence, this means that the availability of data is more important than either its completeness or its importance to the actual communities being studied. The actual practice of the IHME could be different, but its rhetoric privileges mathematical calculations over human needs.

The persistence of the DALY comes from the way in which Murray, in his career, has navigated the change in power structure in the world of global health. He created the DALY for the World Health Organization, but he moved on in 2003 and in 2007 became the director of the IHME, which is located in Seattle, Washington.[19] Jeff Hammer described the way the center of power of global health has moved from Washington, D.C. to Seattle. The U.S. government, as the most powerful voting member of the World Health Organization, used to be the ruling power, but the Gates Foundation has since eclipsed it.[16] It is not surprising that Gates, with his background in business, finds numerical computational models of disease appealing, and in fact the Gates Foundation underwrote many of the papers in *The Lancet* special issue on metrics.[10] The DALY, then, has survived partly because it has received the stamp of approval of a few powerful actors.

Vincanne Adams, an anthropologist, discusses the role of metrics in the new political regimes of global health. Metrics, she says, can be seen as a good thing, since in a way they counteract political power, which is Murray's original justification for the DALY.[20] However, she points to two problems: one, of finding a metric that can serve as a universal standard, and two, of the new kinds of sovereignty that new metrics will make possible.[20] The DALY clearly failed at serving as an appropriate universal standard, but it persisted because of the new, economically justified biomedical sovereignty that it helped to usher in, as the major source of power changed from politics to economics.

## CONCLUSION

### An Alternative to the DALY?

Francis Collins, who, like Gates, is in charge of one of the world's most important funding sources of health research, is critical of the DALY. Although Collins speaks out against current metrics, he still encourages the use of summary statistics in general. Anthropologists may always critique efforts to summarize the human experience using numbers, but there will, for the foreseeable future, always be people in power in the field of global health who will want summary statistics of the burden of disease. Nonetheless, there are certainly criticisms of the manner in which the DALY does its job that are convincing even to people who find numbers more compelling stories, and which could be solved by introducing a new metric for disease calculation.

The most fundamental issue with the DALY, namely that it tries both to measure the burden of disease and to direct funding, could be addressed by introducing not one, but two new metrics; one for burden, and one for need. Reidpath et al. called for a "measure that included context," which would "more closely reflect the realities of the burden of disease."[9] This metric for burden could be based, not on extrapolations from GDP, but on real measurements of morbidity and mortality, and the disability weights would be region—or country—specific, to ensure that the "burden" measured describes the actual suffering of the people as well as possible. The metric for funding, on the other hand, should be based on economic measures such as GDP, as well as other measures of the resources available in the health system of a country. This two-part system would appease both social scientists and quantitative researchers, and could lead to more equitable spending on global health that would also be more consistent with the needs of present and future populations.

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# Access to Safe Anesthesia: A Global Perspective

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**Basic surgery and safe anesthesia are essential health services, but their importance has been consistently undervalued in global health efforts. One third of the world population does not have access to essential surgery and even more are subjected to unsafe anesthesia. At the same time, the global burden of injuries and other non-communicable diseases requiring surgery and anesthesia is rapidly increasing. Despite tremendous global disparities in access to safe anesthesia, governments and major donors have been reluctant to prioritize the issue because of myths about burden of disease and the cost-effectiveness of surgical services. This article summarizes the most up-to-date literature on anesthetic capacity in low- and middle-income countries, discusses the compelling reasons why safe anesthesia is a vital part of health system planning and provides future strategies to improve global disparities in access to care.**

## INTRODUCTION

The World Health Organization (WHO) and World Bank expect that by 2026, the burden of diseases requiring surgery and anesthesia will eclipse that of HIV, tuberculosis and malaria (measured in disability adjusted life-years).[1] However surgery and anesthetic care has long been "the neglected stepchild of global health".[2] There is no global funding organization for improving these services as there is for HIV or vaccine preventable diseases.[3,4] In general, major donors have been unwilling to acknowledge and support the provision of safe surgery and anesthesia as part of improving global health. This has been because of misconceptions about both the burden of disease requiring surgery and anesthesia and the cost-effectiveness of anesthetic care, in addition to a lack of a coordinated and sustainable strategy for providing services in many low resource settings.[5] This commentary describes the global inequities in access to safe anesthesia, discusses the compelling reasons why it should be prioritized in global health efforts and provides possible strategies to improve access to quality anesthetic care.

## GLOBAL CAPACITY OF ESSENTIAL SURGERY AND ANESTHESIA

The global volume of major surgery in 2004 was between 187 and 281 million cases; meaning approximately one in every 25 people underwent an operation requiring anesthesia.[6] But recent estimates point to a much larger and unmet need for operative management along with significant global inequities in access to care. It is estimated that two billion people worldwide—or 30% of the world's population—do not have access to surgery, let alone safe anesthesia.[7] 75% of major operations were performed in the wealthiest third of the world's countries, while the poorest third of the world's population underwent only 3.5% of operations.[6] This reflects a profound disparity in access to essential surgery and safe anesthesia and a large, untreated global burden of disease.

Part of the problem is that basic facility infrastructure is vastly inadequate in many low and middle-income countries (LMICs). Despite WHO's expectations that surgical and anesthetic care be available at district hospital level, operating theatres remain a scarce resource.[8] In a study of 78 district hospitals in seven LMICs, there was less than one operating theatre per 100,000 people in five of the countries.[8] Aside from inadequate physical infrastructure, the other key factors limiting anesthetic capacity and access to services are shortages and misdistribution in the anesthetic workforce and shortages in anesthetic equipment and medications. These will be discussed.

## ANESTHETIC CARE: WHY IS IT IMPORTANT?

Anesthetic-related mortality is closely connected to the level of development in countries and the number of anestheticphysicians.[9] A recent systematic review and meta-analysis by Bainbridge et al. found that anesthetic-related mortality was three times higher in developing compared to developed countries.[9] Furthermore, this is likely to be an underestimate, because the review excluded many countries with a gross domestic product per capita lower than any of the included countries.[10] In reality, anesthetic mortality is probably much higher, especially in sub-Saharan Africa—reportedly as high as one in every 150 cases.[10]

Aside from the problem of inadequate physical resources, there are significant gaps in the global anesthetic workforce. The shortage of trained anesthetic physicians and nurses has been, until recently, poorly documented. In a study of 12 LMICs, 11 countries had less than one anesthetist or non-physician anesthetic provider per 100,000 population.[1] The worst shortage documented in the study was in the Democratic Republic of Congo, which had one anesthetist for every five million people.[1] In another study of 22 countries, irrespective of the size of hospitals or complexity of cases, nurses or clinical assistants were the main providers of anesthetic care, often without supervision or adequate training.[11] This has been recognized as the rule rather than the exception in most LMICs.[11]

Recruitment and retention of anesthetic physicians also remains a significant challenge. Training opportunities for anesthetists are mostly limited by the costs and availability of anesthetic equipment and medications, particularly general anesthesia. In Uganda, training positions remain unfilled, because potential trainees are unable to afford the costs of specialist anesthetic training.[1] The yearly study cost for anesthetist trainees is US$1750, which is almost ten times the average annual household income.[1] Similar workforce problems exist in other sub-Saharan African countries. In Kenya, only 13 of the country's 120 anesthetists work in public hospitals.[7] In many LMICs, both public and private sectors implement 'user fees'; most patients are unable to afford government-subsidized healthcare in public hospitals, let alone private healthcare. This workforce misdistribution between public and private sectors (even within cities) is another barrier to adequate surgical and anesthetic care.

Many countries have attempted to alleviate workforce problems by training anesthetic officers or nurse anesthetists that can perform basic peri-operative management, a relationship analogous to physicians assistants and doctors in the United States.[12,13] Despite some successes, workforce expansion is limited by a shortage of anesthetic physicians to provide adequate training and supervision.[1] These anesthetic officers and nurses may be able to provide basic peri-operative care, but they are unable to

provide the expertise required in more complex surgery—for example, surgeries to combat solid organ malignancies and ischemic heart disease. Furthermore, the number of these basic anesthetic providers still does not meet workforce requirements in many settings.[1]

Table 1. Comparison between surgical/anesthetic diseases and neglected tropical diseases

| | Global burden of disease (%) | Disability-adjusted life years in Africa | MDG recognition |
|---|---|---|---|
| Surgical/anesthetic diseases | 11 | 25 million | None |
| Neglected tropical diseases | 1.3 | 20 million | Goal 8 (as part of 'other diseases') |

## DEBUNKING MYTHS AND RECOGNIZING ITS IMPORTANCE

There has been a pervasive perception in global health discourse that essential surgery and safe anesthesia poses only a limited global burden of disease and therefore should not be prioritized. This misconception dates back to the Millennium Development Goals (MDGs), a set of eight overarching targets established by the United Nations, that have driven global development efforts since 2000. Health was a key priority in the MDGs and was represented in three of the eight goals (reducing child mortality, improving maternal health and combating HIV/AIDS, malaria, tuberculosis and other diseases). Despite a burden of disease greater than the "other diseases" (infectious tropical diseases such as dengue fever, lymphatic filariasis and schistosomiasis), essential surgery and anesthesia were never directly addressed in the MDGs. Even by the most conservative estimates, conditions that require surgery and anesthesia account for 11% of the global burden of disease.[14] On the other hand, infectious tropical diseases, accounting for 1.3% of the global burden of disease, were directly addressed as "other diseases" in MDG Six (Table 1.).[14, 15] This lack of prioritization has carried over into the new Post-2015 Development Agenda, which will succeed the MDGs.[16]

The misconception that surgery and anesthesia are not cost-effective public health interventions has continually hampered efforts to galvanize global health action. This assumption is not supported by recent studies. For example, the cost-effectiveness of basic surgical and anesthetic care—US$11 per each of 33 disability-adjusted life years (DALY) averted—is comparable to other public health interventions such as vitamin A supplementation (US$9/DALY averted) and detection and home treatment of acute respiratory tract infections (US$20/DALY averted).[17,18] Basic surgery is more cost-effective than anti-retroviral therapy (US$300-500/DALY averted), even assuming high compliance and low-cost production.[14] Emergency obstetric care, of which anesthesia is an essential component, provides one of the best returns on expenditure (US$10.93/DALY averted).[18]

The prioritization of infectious diseases over non-communicable and surgical diseases has meant that improvements in local surgical and anesthetic capacity in many LMICs have been generally short-term and related to medical missions.[5] While significant progress has been achieved in other development indicators, the absence of long-term, sustained funding has meant that anesthetic equipment and infrastructure is critically undersupplied.[1]

One example of essential anesthetic equipment is the relatively simple pulse oximeter, which is used to monitor patients' oxygenation status and to detect any sign of deterioration during operations. Because of their usefulness, pulse oximeters have been included as essential components of the WHO's Guidelines for Safe Surgery and are often used as a proxy measurement for anesthetic capacity. However, in one large study of 590 healthcare facilities in 22 LMICs, approximately half of all facilities studied did not have reliable and continuous access to functioning pulse oximetry.[11] Anesthetic machines, or basic airways management such as adult endotracheal tubes and laryngoscopes, are also scarce in most low and middle income countries.[11] This peri-operative equipment is essential for the provision of general anesthesia. The type of anesthesia available was also variable. Regional and spinal anesthesia was available in 56% and 65.5% of facilities respectively, while general inhaled anesthesia was available in 58.5% of facilities.[11]

While equipment and infrastructure is lacking, epidemiological shifts are increasing the strain on existing surgical and anesthetic resources. Non-communicable diseases have already surpassed infectious diseases and become the leading cause of death and disability worldwide.[19] The burden of these diseases is disproportionately carried by the worlds poorest; 80% of deaths from NCDs occur in LMICs. Conditions such as cancer and injuries will therefore comprise an increasing global burden of disease and disproportionately affect LMICs, which have little or no anesthetic capacity. Poor access to essential surgery and safe anesthesia contributes to an enormous disparity in global deaths from injuries; 90% of deaths from injuries occur in LMICs.[5] The Global Burden of Disease Study estimates that by 2030, injuries will be the fifth leading cause of death in developing countries, ahead of HIV, tuberculosis and malaria.[20] The situation is most urgent in sub-Saharan Africa, which has the smallest proportion of motor vehicles globally but highest proportion of road accidents.[20] 85% of children in the region will require surgical and anesthetic care by the age of 15, yet access to these services remains among the worst in the world.[21] Strategies to address the increasing burden of injuries in Africa must prioritize access to surgery and anesthesia.

## ADVOCACY AND FUTURE DIRECTION

Improved advocacy for access to essential surgery and anesthesia will require more systematic research into workforce, equipment and infrastructure deficiencies. Developed in 2007, the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care is an evidence-based tool designed to provide a "snapshot" of surgical and anesthetic resources.[11] Partnerships between researchers, non-government organizations and health ministries can help facilitate the collection of this data. Nevertheless, accurately measuring access to safe anesthesia remains challenging, because there is no single indicator that describes access and quality of anesthetic services, unlike access to essential medicines where registry-level data are available. Establishing a reliable epidemiological evidence base for anesthetic capacity is much more difficult than for single diseases, where population studies using a single disease marker (e.g., glycosylated hemoglobin levels in diabetes mellitus) can estimate prevalence rates. Several surrogate markers of anesthetic and surgical capacity, for example, perioperative mortality rate, caesarean delivery rate per live births and availability of pulse oximetry, have been proposed and tested.[7,11] Future studies should incorporate these as part of anesthetic capacity assessments. Utilizing new technology, for example, WHO Service Availability Mapping, offers a low-cost and fast way to monitor health service capacity.[22] Ongoing efforts to implement these tools to compare information between and within LMICs will lead to better quality data and strengthen advocacy efforts.

Proponents of safe surgery and anesthesia must discard the idea that anesthesia is a cost-ineffective luxury. Advocates for infectious disease programs cite a basic human right to health. The global surgical and anesthesia communities must appropriate this argument and highlight the poverty-lifting potential of improving access to operative management.[23] Emphasizing disparities in access to care and exposing myths about the cost-effectiveness of basic services will also be important. Framing the situation as a human rights issue will also help galvanize support from donors and policy makers.

Despite the bleak picture, surgical diseases are starting to be recognized by the global health community. The implicit inclusion of injuries in Goal 4 of the Post-2015 Development Agenda (through recognition of non-communicable diseases) is an important step.[16] Proponents of surgery and anesthesia should point out that these services improve public health and strengthen health systems.[8] There are numerous opportunities to integrate surgery and anesthesia into maternal, child health and non-communicable disease programs.[14] Operative resources are essential for improving maternal health (Goal 5 of the MDGs) by providing services for dilation and curettage, placental extractions and caesarean sections. The early detection and treatment of cancer, prioritized in the Post-2015 Development Goals, must link primary and surgical care.[14] Even tropical infectious diseases, such as lymphatic filariasis and schistosomiasis, can often require surgical interventions. These examples illustrate the important role that good operative resources, which include anesthesia, can play in improving health systems in LMICs.

How can basic anesthetic supplies and workforce issues be improved? Improving the skills of existing health professionals and expanding training programs for non-physician anesthetic providers will help to fill workforce gaps; however, there must be close collaboration between physicians, universities and health ministries to ensure quality training and supervi-

sion.[8] Advances in anesthetic equipment and technology have been preferentially developed for high-resource settings due to financial incentives.[14] The same problem has occurred in the pharmaceutical industry, where diseases that are more prevalent in high-income countries are prioritized for drug development. Public-private partnerships and the establishment of not-for-profit anesthetic supply companies may help to solve this problem.[24] Currently in many LMICs, essential surgical and anesthetic supplies are imported.[14] Reducing the cost of equipment and medications could be achieved by encouraging locally- and mass-produced generic anesthetic toolkits.[25]

## CONCLUSION

The global burden of disease is shifting, and the increasing incidence of surgical diseases will disproportionately affect developing countries with poor access to anesthesia. The global health community must recognize the importance of essential surgery and safe anesthesia and prioritize it as part of an integrated effort to improve health systems. Improving access to safe anesthetic care will require systematic research into resource gaps in local settings, sustained advocacy, multi-sector collaboration, political prioritization and innovative funding solutions to improve anesthetic workforce, equipment and infrastructure.

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# Maasai Culture and its Effect on Sexual Health: A Field Study on the Disparities of Knowledge within the Community

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**Kenya has been greatly impacted by sexually transmitted infections, particularly HIV/AIDS. Although numerous HIV/AIDS prevention programs exist in Kenya, the prevalence of the disease remains fairly high at a rate of 6.2%. Narok County is a region in southern Kenya in which 99% of the population is Maasai.[1] Although the Maasai make up such a large proportion of this region, very few studies on HIV/AIDS have been conducted on this specific population. As cultural sensitivity is crucial in implementing preventative measures, the purpose of this field study was to assess the societal norms and behaviors that contribute to the high transmission rates within the Maasai community of the South Narok district and to gather information on gender- and age-related attitudes regarding the topic. We believe that investigation into cultural barriers and current attitudes and opinions of different age groups and professionals will contribute to the implementation of a sexual health education program that effectively reduces the prevalence of sexually transmitted infections within this community based on its specific needs. To this end, we investigated several cultural, socioeconomic and logistical factors that influence sexual health decisions amongst the Maasai.**

## GOALS OF OUR RESEARCH

HIV is a virus that destroys its hosts' immune systems and significantly reduces quality of life, making AIDS—the resultant condition—responsible for 58.8 million disability-adjusted life years (DALYs) worldwide.[2] In Sub–Saharan Africa, an estimated 22.1 million people currently live with HIV/AIDS, a number that is nearly 150% higher than that of any other region worldwide. Specifically in Kenya, 1.5 million people are infected with HIV/AIDS.[3] Women of 20–25 years of age comprise the demographic group with the highest rates of HIV infection (13%), while the highest rates for men are in the group aged 40 or older (13%).[4] As this part of the world has the greatest number of people living with HIV/AIDS, action in this region must be prioritized in order to understand the cause of the problem and find solutions.

The most prominent indigenous tribe of southern Kenya is the Maasai, a pastoral tribe that resides in the most rural region of the country. This Christian tribe, whose primary language is Maa, comprises 99% of Narok County, a district located near the Tanzanian border of Kenya. The goal of this field study was to assess the cultural needs, sexual health and education of the Maasai population of the Loita Hills (a province of Narok County) to be able to address the issue of HIV/AIDS in a culturally–sensitive manner.

By conducting interviews with local students, tribal leaders, health professionals and school employees, we hoped to evaluate the efficiency of the current healthcare infrastructure of this area. Although knowledge of the existence of HIV and other sexually transmitted infections (STIs) exists within the Maasai community, the usage of condoms is reported at a meager rate of 15%.[5] In the Maasai culture, semen has traditionally been viewed as beneficial to female health, though this view is gradually disappearing.[5] In regards to pregnancy, a family is viewed to be more financially and socially well–off with a greater number of children.[5] Since the usage of contraception lowers the chances of pregnancy, condom use is subsequently reduced. The benefits of condom usage are also not widely recognized because knowledge of STIs is minimal within this community and sex education is not openly provided for younger children. Thus, well–implemented sex education programs could play a significant role in reducing STI transmission rates among the Maasai by increasing condom use and encouraging other preventative measures.

There are several HIV/AIDS prevention programs currently active in Kenya, ranging from those of non-governmental organizations (NGOs) to government efforts, and including the USAIDs, International Medical Corps and Avert Kenya. But even though such programs exist, rural villages do not benefit from them as much as major cities due to unequal funding, lack of resources and underdeveloped infrastructure.[3,6,7] By acquiring a deeper understanding of the underlying causes of sexually transmitted infections within this population, it may be possible to formulate and implement a culturally sensitive means of reducing STI prevalence.

## METHODS

This interview-based study was conducted in the South Narok District of Kenya where large populations of Maasai reside. Locations that were assessed include the villages of Ilkerin and Entesekera as well as the city of Narok, as they are the most populous areas of the district. To evaluate the relationship dynamics and sexual practices of the Maasai youth, 80 primary school students at Ilkerin-Loita Boarding Primary School and 80 secondary school students from Loita High School were interviewed. This participant demographic was specifically selected because school-aged non-students were not available to participate due to familial obligations. In an attempt to reduce bias, an even number of males and females were selected as well as an equal number of students from each age group.

160 students (80 male and 80 female) were selected at random based on their ages, and each was asked about his or her class level, the age at which he or she became sexually active and his or her number of previous sexual partners. Additionally, the students were asked about their knowledge of sexually transmitted infections, including specific STIs such as HIV/AIDS, gonorrhea, chlamydia, syphilis and herpes simplex virus as well as the modes of transmission, symptoms of and protective measures that can be taken against each of these diseases. They were also asked to provide examples of the information they had received regarding sexual health from their schools' science courses and health clubs (Table 1). This was done to assess the efficacy of the current sexual health courses that are available to the students. The questionnaire administered to the students is shown in Table 1.

Science teachers of Ilkerin-Loita Boarding Primary School and Loita School District board officials were also interviewed to determine what measures are taken in the classroom to ensure the sexual safety of primary and secondary school students. They were asked about the school's health curriculum as well as their opinions on the root of the STI problem and the roles they play when they are suspicious of a student's STI status. The pastor of Ilkerin-Loita Boarding Primary School, who also functions as the students' counselor, was interviewed to assess his relationship with the students and their level of comfort in discussing personal topics with him, including relationships and sexuality. He was also asked to explain what measures he takes when students seek advice from him on such matters (Table 2).

As the Ilkerin Loita Community Dispensary is the only dispensary—public clinic—within the Loita Hills region, the clinician and community healthcare worker of the clinic were interviewed to determine the number of STI cases they encounter annually, the most common STIs they face and the demographics of those who are diagnosed with these diseases. Moreover, they were asked about their level of medical training and the clinical resources at their disposal (Table 3).

Nurses at the Entesekera Health Center were interviewed to evaluate their level of training, the prevalence of sexually transmitted infections in the area and the measures taken by the hospital to lower the rates of STI transmission (Table 3). These questions were asked to determine the skill level of the community healthcare workers and nurses as well as the resources that are available to visiting patients.

Within the Loita Hills region is a non-profit organization called Enteshota Loita Community Based Organization (ELCBO) that is dedicated to educating local citizens about STIs and protective measures. Individuals who work for this organization were also interviewed to examine their efforts in educating and empowering citizens—women and youths in particular—with regards to sexual health. They were asked about the steps they take to ensure that they reach a significant proportion of the population as well as what resources they provide to those in need of sexual health advice. They also provided information on the demographics of those who take the initiative to approach them and the primary reasons why individuals seek help from ELCBO (Table 4).

Moreover, a convenience sample of 100 locals was selected while conducting field research. Individuals were asked about their personal and home lives, marriage and children as well as certain cultural practices that they personally engage in (Table 5). This was done to gain a better understanding of the current cultural practices of the Maasai in order to formulate culturally-sensitive measures that can be implemented in the future.

Finally, in addition to locals, Maasai community leaders were questioned to assess how Maasai cultural practices potentially influence the spread of sexually transmitted infections among the people. Furthermore, they were asked about their knowledge of STIs, the history of the problem in the community and what role they have specifically played in lowering transmission rates (Table 6).

## RESULTS

In the Maasai community, the average age at which children begin engaging in sexual activity is ten. At the primary school, with class levels from 1-8, there were a total of 810 students (502 males and 308 females). At the secondary school, with class levels 9-12, there were a total of 407 students (250 males and 157 females). Of the students surveyed from both schools (n=160), 78% stated that 4-10 female students in the upper grades (classes 6-12) drop out per academic year due to pregnancy, while the remaining 22% believed this number to be much higher, at an estimated 4-10 pregnancies per academic term (three months). Although these statistics apply to the 260 females in the upper class levels, various students stated that occasionally, their lower-class level peers become pregnant as well. There was a consensus in the idea that pregnancy rates are higher in female students who do not live on-campus, as it is uncommon for sexual activity to take place on school grounds. However, pregnancies do occur when students return home for the holidays after each term. Many women do not have permanent partners and are exposed to multiple partners throughout their youth. Furthermore, as polygamy is a Maasai cultural normality, it is difficult to openly discourage. However, with education, it is possible to adopt safer sexual practices within these relationships among future generations.

> Although more individuals are seeking such help from hospitals and local dispensaries, there are still some who believe that they can treat their HIV/AIDS by using herbal remedies at home.

Individuals are often reluctant to seek help regarding their sexual health because of the stigma associated with sexuality. To their benefit, the younger Maasai generation is receiving more exposure to such topics through the Internet and social networking. However, there is still a large majority unaware of sexual education resources. We recommend that in order to better educate the locals, community NGOs and healthcare clinics should place informational posters and pamphlets in their facilities that are easily accessible to the community. These sources could provide information on the importance of condom use and testing as well as images of the clinical manifestations of various STIs. By better recognizing the symptoms of various STIs and being aware of prevention methods, disease rates can be significantly reduced within the community.

### Cultural Barriers

The homes of the Maasai are circular structures called "manyattas," which are anywhere from six feet to ten feet in diameter and consist of two beds: one for the parents, and one for the children to share. As one of the science teachers at the primary school explained, "Children grow up witnessing their parents engaging in sexual intercourse and learn the act from a young age. When the family has guests, the children are expected to stay at a neighboring manyatta to make room for the visitors. No separation exists between the female and male children there, and this provides them with the opportunity to experiment sexually." Creating separate bedrooms or even separate manyattas for the children would greatly reduce their exposure to sexual activities and may delay their experimentation. In the possibility that providing the chil-

dren with their own space may actually further encourage them to experiment, we hope that by educating the community, parental involvement can help promote safe behaviors.

The Maasai's pastoral lifestyle also contributes to their polygamous behavior. As the Maasai men must travel long distances to graze their cattle, they frequently seek sexual satisfaction from females along the way, contributing to the high rates of extramarital affairs. In the Maasai culture, men in the same age group are initiated as warriors, or "morans," together. Those who become morans discontinue their education to take on their new role within the community. Traditionally, wife sharing was admissible for morans in the same age group. Though this is becoming less acceptable now, it is still practiced in secret.

Of the 100 locals who were interviewed, 64 were female and 36 were male. Of the females, 11 were aged ten and under, 15 were between ages 11 and 25, 30 were between ages 26 and 45 and the remaining eight were aged 46 or above. 50 of these 64 females were married, and 92% of these marriages had been arranged. In the Maasai community, parentally arranged marriages are common practice because the dowry offered by the groom's family in exchange for the bride contributes a substantial amount of property to the bride's family. Of the 50 married women, 31 were married to a man who had at least one other wife. These women described their relationship with the other wife (or wives) as amicable and found it beneficial to have additional help in the home. Of the 36 men who were interviewed, 28 were above age ten, and 20 of these were married. Of the 70 total individuals who were married, 71% believed that extramarital affairs are still occurring within their community, but only 12 people attributed this to the fact that marriages are arranged. It should be noted however that according to many women, an increasing number of women are now refusing to marry the man chosen by their parents thanks to the female-empowerment movement that is taking place throughout the region. Women are beginning to realize that they have a choice in such matters and are taking a more proactive approach in their relationships.

The Maasai often have many children to help care for the family animals. Because public schools are scarce and funding a child's private education is expensive, families can only afford to send a small number of their children to school. Most frequently, the daughters are those who do not receive the opportunity to continue their education because they are married around age 12. Early marriages are incentivized by dowries, offerings of large numbers of cattle, goats and sheep to the bride's parents. According to one of the CBO workers, "Although mothers wish for their daughters to progress, it is often the father who discourages their education and promotes early marriage." Moreover, when an unmarried girl becomes pregnant, she is often forced to abandon her schooling and marry any man who accepts her and her unborn child.

There is still a significant social stigma associated with STIs within the community. For instance, when people within the community think they may have contracted a sexually transmitted infection—specifically HIV/AIDS as they perceive this to be the most detrimental—they secretly seek help from a healthcare professional and hide their diagnosis from the community to avoid public shaming. However, a large number of the Maasai villagers still use alternative- or self-medication. Although more individuals are seeking help from hospitals and local dispensaries, there are still some who believe that they can treat their HIV/AIDS by using herbal remedies at home. For bacterial infections such as gonorrhea and syphilis, homemade herbal remedies are more commonly used. Many of the locals who were interviewed stated that visiting an herbalist or 'witch doctor' is a better option than seeing any other health professional, as the herbalists are readily available. Additionally, Kenyan law requires that professional health centers inform an individual's spouse of his or her STI status, further deterring individuals from seeking out professional help and contributing to the spread of disease.

## Logistical and Geographical Barriers

Though many of the schools in the Loita Hills area are boarding schools, dormitory fees are considered to be very expensive, costing families 4400KES (50.6USD). This forces a majority of students to commute from home for 640KES (7.28USD), which is much more affordable. As villages are dispersed throughout the region, students of all ages must walk an average of eight kilometers back and forth from school, which can make children walking home alone targets of crime, assault and rape. However, as it is culturally customary for women to be submissive, rapes are not viewed with the same level of seriousness as they are elsewhere and frequently go un-reported. The underreporting of rape may encourage the perpetuation of such incidences and thus further the spread of STIs, as proper protective measures are not taken during nonconsensual sexual activity.

## Efforts of the Community Based Organizations (CBO)

Enteshota Loita Community Based Organization (ELCBO) is an NGO that has three locations and four sub-locations within the Loita Hills region, funded by the National AIDS Control Council (NACC).[7] It educates locals on sexual health while also advocating against female genital mutilation, which is still practiced illegally among the Maasai. Each month, ELCBO hosts a three-day seminar at one of its locations to educate locals by showing videos, provide condoms from the Ministry of Health through the World Health Organization (WHO), test for STIs and provide counseling. Individuals are encouraged to interact and share their ideas regarding sexuality, after which they might feel more empowered to spread their new knowledge throughout their communities. Those who test positive for an STI are referred to the health center, where they can receive medication provided by the government. Although contraception is not commonly accepted in the Maasai culture, the community has reported an increase in condom use over the past five years, mainly due to the educational efforts of groups such as the ELCBO. Representatives of this organization also visit local schools twice a week to educate students on sexual health. Since most students do not receive any information on sexual health from their families, they rely on these organizations and school health classes to gain such knowledge.

> By revamping the sexual health curriculum to better emphasize the seriousness of STIs, children would possibly be more inclined to take protective measures.

Individuals who visit the ELCBO office are typically students ranging from the ages of 12-17, but even those as old as 40 years of age contact the organization for condoms. One of the community workers stated, "Young girls often seek help from the center when they are being forced into marriage by their parents against their will. In such cases, we visit the family along with an educated female as a role model, to advocate for them to continue attending school as opposed to getting married." More men visit than women because they are generally more open about their sexuality, especially to the male workers at the office. It is noted that the females who do visit, however, are not ashamed to talk to the male workers about their issues.

According to the community workers, birth control pills were introduced into the community five years ago and have helped to decrease the rates of teen pregnancy. However, girls aged 13 and older still do become pregnant quite frequently due to lack of knowledge, as it is uncommon for uneducated parents to discuss

sexuality with their children. Additionally, the fathers who typically attend these seminars are the ones who also send their daughters to school, indicating that there is a correlation between an appreciation for education and openness to understanding sexual health.

## School Environment

In Loita, sexual health education is incorporated into health classes, science classes and social science classes. As reported by the science teachers, sexual health education is taught at the primary school level, beginning in class two (ages seven to eight) at a much more basic level than in the upper level classes. This is necessary as the younger students often engage in sexual activity without being aware of the consequences of their actions. Therefore, it is not uncommon for them to become pregnant without understanding the physiological rationale behind it. Science teachers are thus now advocating for a renewed curriculum that teaches younger students about their bodily functions and the changes that occur during puberty so that they can make appropriate decisions regarding such matters.

Primary school students in the upper classes as well as secondary students are taught the very basics about various sexually transmitted diseases such as HIV/AIDS, gonorrhea, chlamydia and syphilis in their science curricula. Although an attempt is made to educate the children about the signs and symptoms of these diseases as well as the protective measures one must take in order to avoid infection, the material that is used is often outdated, lacks visual aids and has unrelated statistics, leading to a very low impact rate. Furthermore, most of the STI prevention efforts were more religion-based, as opposed to providing students with the biological facts necessary for making logical, relevant decisions. For instance, the health books used by students had pictures of churches, schools and hospitals as opposed to anatomical photos or pictures of various STI symptoms and presentations. Age-appropriate visual aids, statistics and geography-specific tools should be utilized in order to ensure that sexual health courses are comprehensive and effective.

It would also be beneficial to provide students with information on local disease rates in addition to a list of local dispensaries and clinics that offer testing and treatment. Furthermore, it is important that students are tested on the material in an academic setting after initial exposure to ensure that they are actually retaining the information. As each age group beginning from primary, secondary and postsecondary schools has a different most common STI, it is important to approach these student groups accordingly. A systematic curriculum that includes visual aids and photographs of the common symptoms of STIs would teach students to be more aware of the signs of such diseases, should they be present on their own bodies. By being familiar the presentation of common STIs, students would potentially be able to diagnose their diseases earlier on and prevent them from spreading.

Despite their existing knowledge of STIs, the younger students do not take the initiative to be tested until teachers notice the signs and suspect that the children might be infected. The schools provide sexual health education, but do not encourage condom distribution to students to discourage sexual activity. Most schools also promote abstinence due to religious affiliation. However, the science teachers often take it upon themselves to educate students on the proper use of contraceptives. Some even provide their students with condoms. Due to the shame and discomfort associated with seeking out help, students admit that they still fail to use protection despite knowing that they should. As the health clinics surrounding the school offer testing free of charge, it is the responsibility of the students to seek appropriate help, as their parents are often uneducated and cannot adequately advise the children. By revamping the sexual health curriculum to better emphasize the seriousness of STIs, children would possibly be more inclined to take protective measures.

At religious schools, the school pastor acts as a confidant

Table 1: Survey on students' knowledge of common STIs and STI resources

| |
|---|
| 1. State your gender. |
| 2. What class level are you in? |
| 3. Are you sexually active? If so please state the age you became active. |
| 4. How many sexual partners have you had? (NA if not sexually active) |
| 5. Have you received exposure to sexual health courses over the course of your education? |
| 6. Are their specific organizations/clubs on campus that give more information on safe sex practices? |
| 7. Roughly how many of your classmates become pregnant each year? (as far as you know) |
| 8. What are the top 3 STIs you believe you are most at risk for in your age group? |
| 9. Please elaborate on your top 3 STI knowledge (i.e. prevention, protection, symptoms, treatment) |
| 10. Are you aware of your community and school resources? If so what are they? |
| 11. Do you believe that STI cases have gone down in your community based on personal discussion with your peers? |
| 12. Do you believe students are likely to stay in monogamous relationships? |
| 13. How far is your home from this school? |
| 14. What form of transportation do you use to get to/from school? (Disregard if you board) |
| 15. What do you think can be done to increase awareness and lower prevalence rates of STIs? |

Table 2: Survey for the school faculty and pastor on STI curriculum/counseling

| |
|---|
| 1. Do you teach the sexual health courses in your science classes? |
| 2. What tools/materials are used? |
| 3. Please share your current sexual health curriculum |
| 4. What do you believe is placing students at risk for STIs? |
| 5. How are students approached if suspected to have a STI? |
| 6. Who do students confide in for sexual health questions and concerns? |
| 7. Are there gender specific teachers made available for students? |
| 8. Where do you believe sexual activity is taking place? |
| 9. Do you believe students stay in monogamous relationships? |

Table 3: Survey for the nurses and healthcare workers

| |
|---|
| 1. What is your level of medical education and training? |
| 2. How many STIs do you encounter yearly? |
| 3. What are the most common STIs? |
| 4. What age group is most prevalent for the top 3 STIs presented at the clinic/hospital? |
| 5. How are STIs generally diagnosed? |
| 6. How are STIs treated? |
| 7. Who provides funding for medications? |
| 8. How often are supplies replenished? |
| 9. What current measures are in place to lower transmission rates? |
| 10. Are patients more open with gender specific practitioners? |
| 11. What medication is generally prescribed? How much does medication cost? Who provides the clinics with necessary medications? |
| 12. Do patients always use the medications given to them? Are their alternative medicinal preferences? |
| 13. How does the center contribute to lowering STI rates? |

Table 4: Survey for the NGO community workers

| |
|---|
| 1. How many people come to information sessions held by this NGO? |
| 2. What efforts are in place to generate more interest in safe sexual health practices? |
| 3. What is the average age of participants? |
| 4. What are the primary reasons that individuals come into the centers? |
| 5. What resources are provided on hand for individuals who come in seeking private counseling? |
| 6. Are gender specific counselors available? |
| 7. Please comment on what you believe is the modernization of your culture in regards to relationships and safe sexual practices. |
| 8. How are community members who reside far from the center impacted? |

Table 5: Interview questions answered by the sample of locals

| |
|---|
| 1. Please state your gender and age. |
| 2. Please describe your daily activities. |
| 3. Would you consider your community to be pastoral? |
| 4. Are you married? (If yes answer question #5) |
| 5. Was your marriage arranged? |
| 6. Does your culture permit polygamous marriages? |
| 7. Is it the male or the female who has more than one spouse? |
| 8. If your husband has more than one wife, do you establish a relationship with her? Males, if you have multiple wives, please describe the relationship they have with one another. |
| 9. At what age were you married? |
| 10. How many children do you have? |
| 11. How many of your children go to school? |
| 12. If you have children who do not go to school, what do they do? |
| 13. Are all of your children from the same partner? |
| 14. On average how many children do most families have? |
| 15. Are you aware of STIs? Please explain. |
| 16. What would you do if you contracted an STI? |
| 17. Is infidelity an issue within your pastoral community? If so, is it socially acceptable? |
| 18. Please describe what wife sharing means in your community. |
| 19. Is wife sharing still a common practice? |
| 20. Please describe your family's living situation. |
| 21. Do you engage in sexual activity in the presence of your children? Children, have you witnessed your parents engaging in sexual activity? |
| 22. Please describe the spatial dimensions of your manyatta (home). |

Table 6: Survey for the Maasai community leaders

| |
|---|
| 1. What cultural practices do you believe lead to increased transmission rates? |
| 2. What community resources are being used to help lower transmission rates? |
| 3. If so, do you believe STI rates have been lowered or increased? |
| 4. What do you believe is the root of the transmission? |
| 5. What role do you specifically have in helping your community become more aware of safe sexual practices? |

Table 7: Average onset of sexual activity

| Gender (n=160) | Average onset age of sexual activity |
|---|---|
| Male | 10 years old |
| Female | 10 years old |

Table 8: Females in relationships in Secondary School

| Number of relationships secondary school | n=40 |
|---|---|
| Female in one relationship | 28/40 70% |
| Female in more than one relationship | 14/40 35% |

Table 9: July 2009- Aug 2012 Medical Records

| Sexually Transmitted Infections Reported | Percentage who acquired |
|---|---|
| Gonorrhea | 2.16% |
| Syphilis | .047% |
| Herpes Simplex Virus | .047% |
| Other STI's (not otherwise specified) | 1.49% |

and provides students with appropriate counseling after he is informed of their STI status, either by the students or by other school officials. According to the pastor, boarding students as well as commuters aged 14 and older feel comfortable enough to seek advice regarding their sexual health. However, the male students are more likely to do so than the female students. The pastors typically provide advice from a biblical point of view and preach abstinence, which may be impractical as children who wish to engage in sexual activities tend do so regardless of religious teachings. The female students are placed at an additional disadvantage because of the lack of female advisors. Therefore, in the schools, hiring a female counselor or empowering female teachers would be beneficial to the female students who do not feel comfortable confiding in an older male teacher or headmaster about their sexuality. It would also be advantageous to transition from a system that preaches abstinence to one that advocates safe sex practices, although this would be a significant cultural leap. Furthermore, the implementation of a peer education program would be beneficial, as students are more inclined to learn from their age-mates when it comes to sexual health.

Throughout secondary school, a male student will have an average of five partners and typically get tested for STIs once a year with the encouragement of the school health club, which meets once a week during the academic year. Students claimed that although they were aware of the prevalent STIs and recognize the signs of infection for diseases such as gonorrhea, syphilis and herpes simplex virus, the cultural stigma associated with STIs makes it difficult for them to seek aid and information from various sources. Furthermore, 136 of the 180 students that were interviewed felt they would be ashamed to be caught inquiring about STI testing and contraceptives at the local clinic and would rather ignore any signs and symptoms, should they occur.

At the secondary school level, 28 of 40 female students stated that they had been in a romantic relationship before, and of those 28, 14 had been in more than one (Table 8). Teen pregnancy becomes more common at the secondary level, as approximately two girls become pregnant during each term at Loita High School. Though most girls who become pregnant are forced to drop out of school to care for their child, there are some who have the support of their families to continue their education while the family assists in taking care of the child. However, these girls are often shamed by their classmates, forcing them to switch schools. Although the faculty does its best to foster a respectful environment within the school, that task becomes challenging due to the extremely unbalanced student-to-teacher ratio.

## Healthcare Professionals/Clinics/Hospitals

In Loita Hills, locals can receive medical help at two medical centers. The Ilkerin Loita Community Dispensary is the local health clinic located near the primary school and operated by a clinician and a community health care worker. Kenyan clinicians receive three years of medical education (whereas doctors must complete five years as well as an internship), and the health care workers complete only their education through secondary school followed by a 6-week certification program. The Ministry of Health as well as USAID provides medication, condoms and Rapid HIV Test kits to the dispensary on a quarterly basis.[7] However, if they run out of supplies, they must wait until these organizations return to assess their needs at a later time. Though the dispensary provides condoms, the healthcare workers noted that a large majority of individuals who would actually go to retrieve them were younger generation males. However, since patients are usually uncomfortable directly asking healthcare workers for condoms, workers place them outside the clinic for patients to take.

At the Ilkerin Loita Dispensary, medical records were available beginning in 2009, and according to these records, the STI rates from July 2009 to August 2012 were as follows: 2.16% gonorrhea, .047% syphilis, .047% herpes simplex virus and 1.49% "other STIs" (Table 9).

However, it should be noted that the diagnoses may not be entirely accurate, as most diagnoses were made merely based on visual symptoms by a young healthcare worker with very minimal training in medicine. Patients who seek treatment for sexually transmitted infection at the dispensary are typically between 15 and 45 years old. A visit to the dispensary costs 50KES (.60USD), a fee that is frequently waived when patients are incapable of paying. In addition to treating patients for the symptoms they present with, the dispensary attempts to take preventative measures by displaying visual aids on the life cycle of Malaria, Typhus and HIV/AIDS. However, none were displayed for other STIs such as gonorrhea, syphilis and herpes simplex virus.

For more severe health issues, individuals are referred to the Entesekera Health Center, the main hospital of Loita Hills, lo-

cated 27 kilometers away from the primary school. Patients are often sent here from the dispensary if more resources are needed for treatment, but the distance remains a huge barrier as walking is the only means of transportation for most locals. The health center is equipped with an ambulance for distant patients at their expense and the Ministry of Health also provides them with medication and test kits. The health center also purchases its own supplies if needed. An outpatient visit to the Health Center costs 300KES (3.80USD), with an additional 250KES (2.99USD) for testing.

The Entesekera Health Center also has an education center that holds monthly seminars in order to educate locals on modes of transmission, means of protection and signs and symptoms of various sexually transmitted infections, although no measures have been taken to assess the effectiveness of these programs. Nurses also meet with tribal chiefs and prominent figures to discuss the prevalence of HIV in hopes of gaining their support in reducing transmission. It was noted that no pamphlets or other educational tools were made available to inform patients about STIs other than HIV/AIDS.

On the other hand, the major district hospitals have a much more advanced record keeping system. Although they have recently adopted an online record-keeping database for patients that are categorized by reason for visit, the actual prevalence of specific cases cannot be calculated due to the lack of an accurate population count per specific region. Ultimately, it is imperative that the rural village clinics adopt an organized and thorough record-keeping system. Further, by providing the current healthcare workers with more intensive training by educated professionals in more urban hospitals the rates of misdiagnosis of STIs could be substantially reduced. As correct diagnoses are made, the data that is provided to the government will subsequently become more accurate and up-to-date. In Kenya, if an individual tests positive for any sexually transmitted infection at a health center, the center is required by law to inform the individual's spouse so that he or she may receive appropriate testing and treatment as well. This deters individuals from seeking help at such clinics and encourages them to treat themselves, contributing to the high rates of STIs.

## CONCLUSION

In the past ten years since HIV/AIDS information was first disseminated to the South Narok District of Loita Hills, the number of STI cases has decreased significantly. However, the STI rates are still high relative to those of other developing countries. The primary reason for the high prevalence of sexually transmitted infections within the Maasai community is lack of awareness, primarily due to gender inequity and educational disparities. Though the government, local health clinics and NGOs provide resources such as condoms and STI testing, the reception of such programs is tepid. The lack of motivation within the Maasai community may stem from the upbringing and cultural practices that children are taught from a young age. As the Maasai community relies heavily on cattle herding for financial income, a majority of families do not prioritize traditional education and instead wish for their children to learn proper agricultural techniques. This heavily influences the barrier to sexual health education among the Maasai youth.

Although sexual health education is provided to students in the school setting, funding a child's education is quite difficult for a majority of parents. Despite the fact that the Kenyan government passed the Basic Education Bill in 2012, requiring every child to receive an education, this law is not strictly enforced in remote villages.[8] Thus, basic schooling still remains a luxury that is available only to a small number of children. Additionally, after a thorough evaluation of the health curriculum of the Loita District, it is apparent that a large majority of schools preach abstinence and do not acknowledge the fact that the use of preventative measures such as condom use need to be taught to the student body.

At the Ilkerin Loita Community Dispensary, proper record keeping was not enforced. The visits of numerous patients often go unrecorded, and as under-qualified healthcare workers are continuously assigned to new locations, handwritten notes by each individual become easily misinterpreted over time. Thus, it may be possible that a number of STI cases have gone unreported or have been misdiagnosed. Also, as many STIs have similar clinical presentations or periods of latency, it is difficult to accurately diagnose a patient without proper medical training and the availability of adequate laboratory equipment, a difficulty that would also contribute to misleading data. Even if patients are accurately diagnosed, they may not always be compliant with treatment measures and would prefer relying on herbal remedies from a local "witch doctor" instead.

Although the Ministry of Health periodically provides health clinics with supplies, additional medicine and testing kits can be supplied to high-volume clinics. Because supplies are provided based on need, it is crucial that village dispensaries keep accurate records in order to replenish these materials as necessary. Furthermore, the sex of the healthcare worker affects whether or not patients seek assistance in regard to their sexuality. As young adult males are more likely to obtain condoms from health clinics, they shy away when the healthcare worker is female. In such cases, it would be beneficial for clinics to make condoms available outside, giving individuals the chance to obtain protection without having to feel ashamed in the presence of another person. Moreover, it is necessary for more information to be presented to individuals seeking contraception on the implications of STIs as well as the biological specifics of certain diseases, as merely distributing condoms does not adequately teach individuals about their health.

We recognize that our student sample size was fairly small. However, as this study was conducted during the summer, a majority of the students had gone home for the holiday. Another weakness of our study lies in the fact that we utilized a convenience sample when interviewing the locals. This was due to the logistics, as collections of manyattas were located within a one-mile radius and researchers conducted the field study on foot.

Future studies can be conducted on a greater scale to incorporate the opinions of a larger population of Maasai. For instance, the North Narok District and other counties where Maasai reside can be included. Moreover, separate studies on the specific barriers to health promotion and disease prevention should be conducted. Evaluating school health curriculums, community efforts, NGOs and community health centers on an individual basis could provide more detailed information regarding the improvements that can be made in each of these areas. With collaborative efforts between these sectors, the Maasai community can be targeted from several angles and a significant change can be made in their overall sexual health. Ultimately, STI rates and sexual health practices in Sub-Saharan African tribes is an understudied field and as the tribes have such differing practices, it is difficult to generalize prevention programs and directly compare successes and failures. Thus, more data is necessary before parallels can be made between tribes.

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# SPRING 2014 LINEUP

## Episode 31: Complexity, Change, and Hope: The Fight Against Childhood Cancer in the US and Abroad

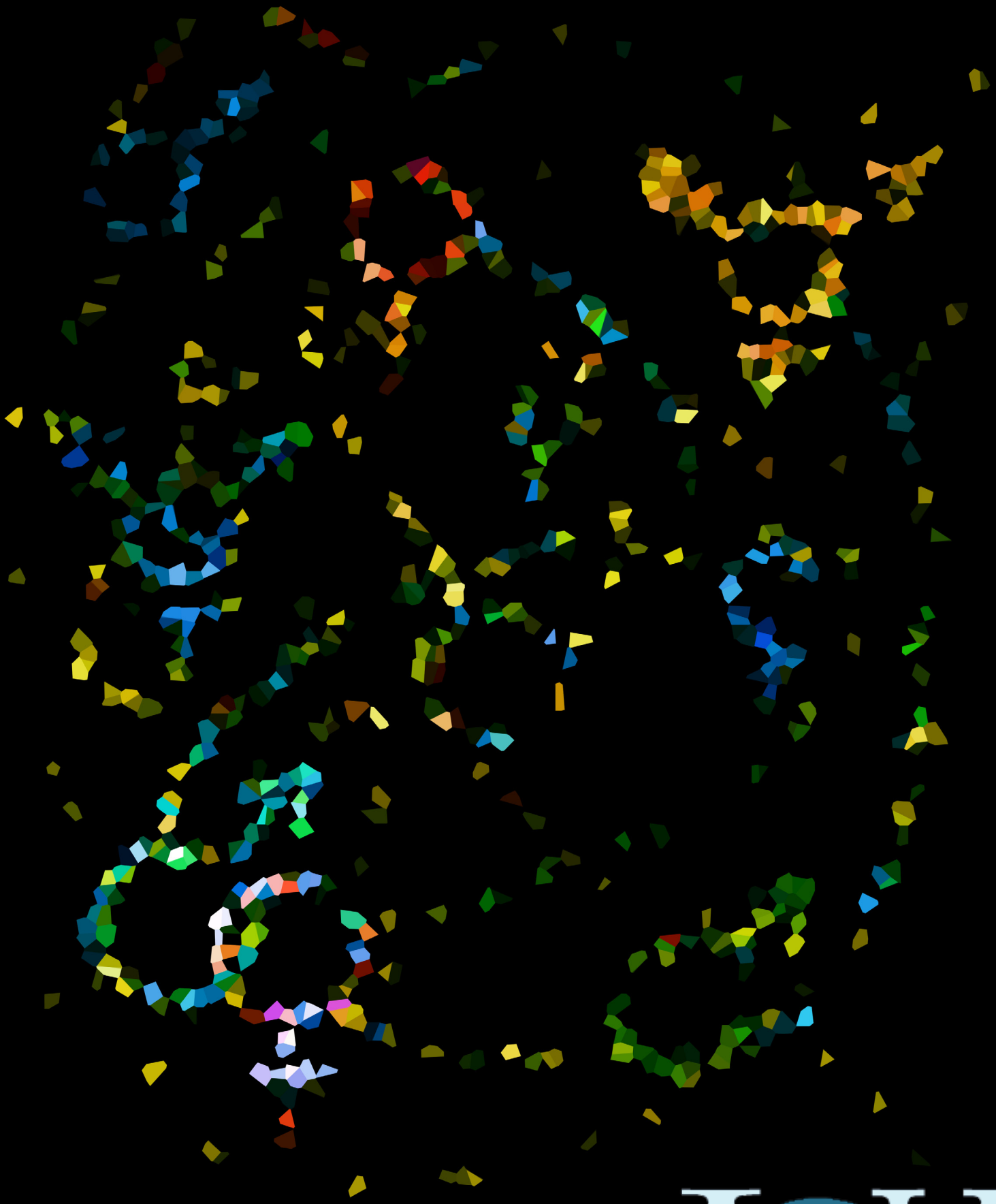
***Dr. Daniel Bowers***, pediatric oncologist at Children's Medical Center of Dallas, discusses the rapidly changing field of pediatric oncology and the impact the future could have on childhood cancer survival rates in the developing world

## Episode 30: Disaster Medicine and Relief: Moving Forward from Tohoku

***Dr. Shunichi Homma***, Associate Chief of Cardiology at Columbia University and president of JAMS-NET (Japanese Medical Support Network), and ***Kenny Nakazawa,*** a 2013 Nishimiya Fellow and student at Columbia University discuss lessons learnt from Japan's March 11, 2011 eathquake and tsunami and how to approach future disasters.

## Episode 29: Why We Should Care

***Dr. Mary Ann LoFrumento***, a founding member of Hands up for Haiti, describes approaches to improving and raising awareness of sustainable global health care.



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