12-1-2010

An Approach to Mitigating Excess Medical Waste

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An Approach to Mitigating Excess Medical Waste

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Senior Honors Thesis

University of South Florida

December, 1st 2010

Submitted to the Honor’s College

in partial fulfillment of the requirements for the degree of

Bachelor of Science

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Preface

By: Ryan Kania

He was an old man living in a house made of sticks with dirt floors and no running water. His health was essential to his livelihood, and he was losing it. I pitied him at first sight, but when asked about what he wanted, he said, “I do not want anything.” As I stood there in disbelief at this man’s response, my naiveté became increasingly obvious. He was content living with such modest means and that instilled in me a deeper appreciation for his culture. I became curious about how to contribute to his community’s development.

On the last day of my Guatemalan volunteer trip in fall 2008, shock overwhelmed me as I watched a man’s life end while his family paced back and forth near me. The physicians, having exhausted their alternatives, were unable to treat the gunshot wound to his chest because they lacked medical supplies. The pain endured by the victim and his family haunted me, and the intellectual issues of global health inequities motivated me. Upon returning to school and conducting research, I learned that poor health leads to lower educational attainment, lower labor productivity, slower economic growth, and less investment in human capital.

I educated myself about the surplus of medical supplies in the US and in response, created Advocates for World Health (AWH) with some of my own scholarship money. AWH’s mission to provide a framework for college students to bridge the health care chasm between the developing world and the developed began with recruiting intelligent students across fields such as medical research, anthropology, and economics. As a result of their innovative perspectives and my thesis research, a new and dynamic supply chain targeting the prevailing surplus was generated for AWH’s business model.
On my second trip to Guatemala, I interviewed an executive of Aprofam, Guatemala’s largest not for profit network of hospitals. When asked about foreign aid attempts, he affirmed, “Yes, yes I know about them...” He told me that local residents were also discouraged by previous aid workers that pursued unintentionally harmful ideas on how to improve Guatemalan conditions. I immediately thought about my experience with the man who wanted nothing and both insights culminated in establishing AWH’s culturally relativistic approach emphasizing community research.

Through a local hospital, AWH mediated its first shipment of medical supplies to Guatemala in the fall of 2009. In January of 2010, AWH sent its largest shipment to Haiti in collaboration with the American Red Cross. With almost two years of growth and five volunteer trips to develop international relationships, AWH has spread to four office locations with over twenty people working as full time volunteer staff, partnered with organizations such as Aprofam and American Red Cross, and most importantly, created change in the access and quality of health care in Guatemala and Haiti.

I’ve learned a lot from my international experiences. I understand the effects that global health inequities can have and, through community research, the importance of eliminating them. The man who wanted nothing has come to be an integral part of AWH’s vision as a representation of relating to other cultures and social business opportunities in industrializing nations. Through AWH, I plan to leverage my knowledge in public health and economics to positively change lives around the world. Looking forward I recognize an obligation, albeit a passion, to lead in the struggle against global health inequities.
Abstract

We present a literature-based review on global health disparities and a health economics perspective on utilizing low cost interventions to improve these disparities. We then introduce the need for a non-for-profit organization that specializes in excess medical waste as a low cost intervention to empower targeted communities and improve global health disparities while decreasing the burden of medical waste. Medical waste is defined and a literature-based review is presented on the current body of knowledge concerning medical waste such as how much exists and why it exists. We then present a research study survey that will be executed to characterize excess medical waste in Hillsborough County.

I. Emerging Global Issues

I.A. Current State of Global Health Disparities

Global health is a comprehensive field of study taking into account all nations’ health perspectives. The field focuses on achieving both “good” as in quality and “fair” as in an equitable distribution of health care access for all people (Deaton, 2004). Currently there are health disparities between developing countries and developed. (Global Markets Institute, 2008) Developing countries primarily have lower health care access (Marmot, 2006).

Developing countries, due to their lower quality healthcare access, have populations that are more vulnerable to an array of diseases that plague economic progress. The overwhelming economic costs
associated with these diseases are detrimental to the peoples' income, productivity, and psychological well-being (The Commission on Macroeconomics and Health, 2001). For example, the total cost dedicated to treating and preventing malaria in sub-Saharan Africa in 1999 was approximately 5.8% of their GDP. The total cost dedicated to HIV/AIDS was 11.7% of GDP. (WHO 2001) As poor healthcare access leads to poor economic outcomes and poor economic outcomes lead to poor health, global health disparities are perpetuated.

We can also demonstrate this type of disparity through a public health analysis. Cross comparisons of quantitative factors such as life expectancy and mortality rates are commonly used among public health experts. Life expectancies can range anywhere from 32.5 (males and females) years in Swaziland to 82 years in Japan - and the gap is growing. (WHO, 2001).

Health disparities are inherent in countries, too. An example of an intra-country disparity can be seen in the quality of healthcare access received by different groups of people in a population. In developing countries, private health care maintains higher quality and accountability compared to public health care. However, private health care is only financially feasible for the upper class. As a result, the majority of people in low-income countries can be forced to walk miles to wait days for public health care. While we understand that inequalities exist inside of countries, we place an emphasis on rectifying discrepancies between countries (Deaton, 2007).

I.B. What is Medical Waste? A Novel Classification System
Medical Waste can be found in healthcare provider facilities, original equipment manufacturer facilities, incineration plants, and landfill buries.

In the following discussion, we define a nomenclature system where ‘total medical waste’ produced is the sum of what is ‘regulated medical waste’ and ‘excess medical supply.’

Total Medical Waste (TMW) = Regulated Medical Waste (RMW) + Excess Medical Waste (EMW).

‘Medical waste’, classically defined by the Medical Waste Tracking Act of 1988, is “any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining to thereto or in the production or test of biological.” For example, blood-soaked bandages, culture dishes, discarded surgical gloves, used needles, and removed body organs. Similarly, the EPA defines medical waste as “waste capable of producing an infectious disease”. ‘Medical waste’ storage and disposal is highly regulated on many federal, state, and county levels, as it poses infectious risk. What is classically defined as ‘medical waste’ we define as ‘regulated medical waste’ (RMW.)

‘Excess medical waste’, on the other hand, is not considered to pose infectious risk and thus is neither regulated nor previously defined. It includes any equipment that is outdated, no longer used, broken or expired and that does not pose infectious risk. Neither does it pose pathological, open sharps, or heavy metal risk. Materials become EMW because of breaking, expiration, over ordering, re-modeling, inventory mismanagement, among other reasons.
Once materials are considered ‘Regulated Medical Waste’ they can be:

<table>
<thead>
<tr>
<th>Stagnant</th>
<th>Terminated</th>
<th>Reinstated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Buried</td>
<td>2. Re-processed</td>
</tr>
<tr>
<td></td>
<td>3. Broken-down and Recycled</td>
<td></td>
</tr>
</tbody>
</table>

Once materials are considered ‘Excess Medical Waste’ they can be:

<table>
<thead>
<tr>
<th>Stagnant</th>
<th>Terminated</th>
<th>Reinstated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stored</td>
<td>1. Incinerated</td>
<td>1. Used</td>
</tr>
<tr>
<td></td>
<td>2. Buried</td>
<td>2. Re-Used</td>
</tr>
<tr>
<td></td>
<td>3. Broken-down and Recycled</td>
<td>3. Fixed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Re-processed</td>
</tr>
</tbody>
</table>

A point of interest is the process of reinstating medical waste. EMW or RMW are waste up until the point that they are reinstated, when they again become medical supply and are no longer considered waste. This reinstated medical supply no longer contributes to medical waste burden and can be utilized by health care facilities.

The current state of literature, research, government regulation, and reporting measures on ‘total medical waste’ and its composition and entities refer solely to the term ‘medical waste’ that stems from the classical definition set forth by the MWTA and the EPA. Thus, estimates and understandings of what
we differentiate as total medical waste, regulated medical waste, and excess medical supply have been ambiguous and unclear.

The current scientific misclassification is skewing the societal constructs and approaches to medical waste. Some studies talk about medical waste and specifically define it alluding to RMW while some just refer to medical waste while no studies emphasize excess medical waste. We propose that the scientific, regulatory, and political entities that drive the working knowledge of medical waste adapt and differentiate between the terms ‘total medical waste’, ‘regulated medical waste’, and ‘excess medical waste.’ If and when reporting measures adopt this nomenclature system, the intricacies and true burden of medical waste will become clearer.

I.C. Emerging Issues with Medical Waste

A 2007 New York Times article opened by saying, “The health care industry has a garbage problem.”

The health care industry produces billions of pounds of regulated medical waste each year that is often buried and incinerated. This estimated medical waste does not even include excess medical waste (Chen, 2010).

An environmental health and public health concern of medical waste is increasing landfill and incineration usage (AFSCME, 1986). Medical supplies are being composed of an increasing percentage of plastics (Thornton et al., 1996). When these supplies become waste and get burned, air pollutants such as hydrochloric acid, dioxin, furan, lead, cadmium, and mercury are emitted (Hagenmaier et al., 2010). The emission of toxins is especially the case for incinerated plastics (Phillips, 2004). Thus, an
increasing amount of medical waste, and the fact that an increasing proportion of this waste is composed of plastics, is taking a toll on the environment (Held, 1998).

A case study in Ohio found that 73,000 tons of MW is generated each year, 150,000 children live within two miles of a medical waste incinerator, 26 permit holding medical waste incinerators are present, and four hospitals are-licensed to burn waste on-site (Sustainable Cleveland Partnership, 2007).

II. A Solution to Global Health and Medical Waste Conditions

II.A. Applying a Health Economics Approach

It has been suggested that industrialized countries collaborate with low and middle-income countries to invest in health to increase global economic development. The following correlations and causal factors have been established (Deaton, 2002):

1. Countries with lower infant mortality rates experienced higher economic growth
2. Improved health resulted in higher per capita income
3. Countries with a longer life expectancy invested more in education and had higher savings rates

Increased investments in health translates to hundreds of billions of dollars each year of increased income in the low income countries. This prevents some 8 million deaths annually from infectious diseases that plague developing nations. Better health outcomes of a population lead to improved investments in education and higher savings rates (Enis and Kari, 2000).
It has been established that there are global health and economic disparities, and that they collectively perpetuate into greater inequalities over time. Better health leads to an improved economic climate, which partially mitigates cross-country gaps between rich and poor populations (Lawson and Gilman, 2009).

It is important to create effective methods for improving healthcare and in turn, the economic welfare of a nation. In 2000, the World Bank interviewed about 60,000 people across 47 countries on what poverty relief meant to them. The most common answers were opportunity, empowerment, and security. Interestingly, when people have autonomy to lead their own lives, economic well being follows.

To uplift these ideals, non-for profit organizations have especially been at the forefront of positive change over the last two decades. U.S. non-for profit organizations’ financial assistance towards international developments has gone up from US$2.5 billion in 1990 to over US$13 billion in 2005. Just four agencies—the World Bank, the Bill and Melinda Gates Foundation, the U.S. government, and the Global Fund to Fight AIDS, Tuberculosis and Malaria—accounted for about one-third of global health financing (Sachs, 2001).

Among the most popular interventions were simple, low cost technologies that empowered the targeted communities. An example of a low cost intervention is providing medical supplies to an international health care provider; the very basis of AWH’s business model. Looking into the future, we expect this increased involvement of non-for profit organizations to continue as societies integrate and technology changes at an unprecedented rate (Prahalad, 2002).
Cost benefit analyses show definitive results when focused on low cost interventions such as vaccinations and over short periods of time. Results become more ambiguous when dealing with education, and other broader ideals. However, it is imperative to invest in broader ideals such as education to supplement a foundation of low-cost intervention programs to develop truly sustainable disparity-reducing efforts.

II.B. Advocates for World Health - A Non-for Profit Business Solution

What economic welfare is and how to actively improve the “welfare” of a nation are questions that drive societal concerns and humanitarianism. Generally speaking, welfare is the level of prosperity and quality of living standards in an economy.

There are many ways to improve the welfare of a nation. Issues related to the U.S. healthcare industry predicate a growing opportunity in capitalizing on medical waste by matching domestic surplus and supply with foreign need and demand. By increasing a foreign country’s health care access to resources, health and economic welfare are directly improved.

Joseph Romm, an American author and physicist, states, "Waste is not an inevitable result of production, but rather a measure of its inefficiency." Capitalizing on inefficiencies of United States production systems, there is an opportunity for mitigating and utilizing medical waste as resource that can be re-invested into developing communities.

Health care facilities generate in excess of two million tons, or four billion pounds, of general waste annually. Approximately 85% of this general waste is noninfectious excess medical waste, with a large
portion being generated in the operating room (Rutala, 1983). There is opportunity to find alternatives for excess medical waste rather than be stored or end up at an incineration plant or a waste burial like regulated medical supply most often does. Excess medical waste should more often be reinstated for use, re-use, reprocess, and/or broken down and recycled with proper appropriation. There is immense opportunity for utilizing excess medical waste because it does not involve infectious risk (Bisson, 1993).

Increasing reinstatement of EMS by providing healthcare facilities in developing countries with a low cost intervention for medical supplies can work to improve global health disparities while decreasing burden of total medical waste.

III. Characterizing the Excess Medical Waste Market

III.A. How much medical waste is there and why?

In the following discussion, we discuss the current estimated burden of RMW in the United States. The literature refers to this RMW solely as medical waste, utilizing the classical MWTA/EPA definition of medical waste. As such, keep in mind that while we are referring to RMW, we use the term ‘medical waste’ for synchronicity with current literature.

The amount of medical waste from hospitals accounts for nearly 1% of all waste generated in the U.S. and that proportion is still increasing (McVeigh, 1993). No single organization comprehensively monitors the amount of RMS in the United States and current data is underestimated. A study in the
1900’s estimated that medical waste amounts to two million tons a year and that 20-30% of a hospital’s waste comes from the operation room (EPA, 1998).

United States hospitals combined produce an average 5,900 pounds of waste per day (EPA, 2010). More recent estimates place the number at 6,600 pounds of waste per day or 2.4 million tons per year (Cox, 1988).

The amount of medical waste from hospitals accounts for nearly 1% of all waste generated in the U.S. and is still increasing. Estimates are based off of number of hospital beds, occupancy rate, and estimates of per bed/ per day generation rate.

\[ \text{RMW} = \# \text{Hospital Beds} \times \text{Occupancy Rate} \times \text{Per Bed/Per Day Generation Rate} \]

Because estimates are based off of hospitals and other healthcare facilities contribute to medical waste as well, TMW contribution by the healthcare industry is under estimated. There are no current estimates of per/bed per day generation of EMW.

III.B. Why is the amount of RMW increasing?

First, the number of hospitals, and thus the number of hospital beds, is increasing (Fast Facts on US Hospitals, 2009).
Second, the estimated hospital per bed/per day generation is increasing. The estimated per bed/per day generation rate in 1987 was 13 pounds. More recent independent estimates of hospital waste generation range between 16 to 23 pounds per bed per day and is still increasing.

A possible contribution to the increasing estimates of per bed/ per day generation is that in the shift towards more disposable products, more plastic medical products are being produced. About twenty percent of hospital unused medical supply is estimated to be plastics or three times the proportion of plastics in the general waste stream.

Third, much of the literature speaks to the fact that healthcare workers are reporting an increased amount of disposable items use in the medical setting, but no data is available. However, the progressive increases in total U.S. hospital per bed per day waste may be correlated to this shift in disposable items. A shift towards the use of disposables makes it simpler for a facility practice safe infection prevention measures.

IV. Factors Surrounding Medical Waste

IV.A. Policy Relating to Medical Waste

Regulated medical waste is highly regulated because it presents infectious risks. Excess medical supply has little regulatory oversight in tracking, storage, and appropriation as opposed to regulated medical waste.
RMW is highly regulated from labeling to storage to disposal. This high regulation is resultant of concern over its infectious nature. Excess medical equipment, on the other hand, is not regulated, as it is not of infectious concern. However, EMW sits in storage and is disposed of as well, often times ending up in landfills or being incinerated and contributing to TMW burden.

The Federal Environmental Protection Agency (EPA) enacted the Medical Waste Tracking Act (MWTA) in 1989. This act pertained solely to RMW. The MWTA was a two-year program implemented in four states and Puerto Rico. Information was collected and research performed on RMW and various treatments to reduce the disease causing potential of RMW (EPA MWTA, 2010). The resulting publications set guideline models for state programs to regulate RMW. In addition, the EPA concluded that, “the disease-causing potential of medical waste is greatest at the point of generation and naturally tapers off after that point”. “Thus, risk to the general public of disease caused by exposure to medical waste is likely to be much lower than risk for the occupationally exposed individual.”

Generally, the federal government develops regulations for hazardous wastes while the state develops regulations for office waste and municipal waste. Concerning TMW, the federal government has set forth general guidelines and regulations, primarily through the EPA, MWTA, and Center for Disease Control (CDC, 2010.)

In addition to the federal government regulations, states develop individual regulations for RMW while enforcing the federal guidelines. Each state then oversees the generation, transport, storage, treatment, incineration, and final disposal of RMW. Using Florida as a case study, the Florida the state authority sees that the EPA's regulations are being followed. The Florida Department of Health (DOH) oversees
RMW generation, transport, storage, and treatment while the Florida Department of Environmental Protection (DEP) oversees RMW incineration and final disposal (Florida Department of Health, 2010).

**IV.B. Social Constructs of Medical Waste**

There are social misunderstandings about the usefulness of reinstated medical supplies that derive from social stigma as well as strict federal regulations. However, the federal regulations apply only to RMS waste, which poses infectious risk.

The term waste implies that excess medical waste is synonymous to trash. It is trash in that the healthcare facility or OEM facility no longer uses it. Yet, it does not pose infectious or hazardous risk. With the proper management and allocation, excess medical waste can be reinstated through a number of processes and be converted to usable medical supply.

TMW consists of what we distinctively classify as RMW and EMW. Unfortunately, scientific and regulatory communities most often refer only to 'medical waste', creating a lack of segregated consideration towards RMW and TMW. These social misunderstandings may impede the utility of EMW by profit seeking reinstating companies, non-for profit reinstating companies, and hospitals looking to donate supplies for tax incentives.
Even in considering the reinstatement of RMW, the U.S. Government Accountability Office released a comprehensive report on reprocessed single-use devices (SUD) and found no indication of elevated health risk (US GAO, 2000). The FDA reported 434 adverse events involving SUDs, that only 65 of the cases actually involved the device, and that the adverse events reported were similar to those reported for new medical supply devices (US GAO, 2008).

Safety concerns of reinstating RMS include the risk of infectious disease while safety concerns of reinstating both RMS and EMS include malfunction and patient consent to use the reinstated supply. Politicians and interest groups have actively lobbied for legislation that requires signed patient consent for treatment with reinstated supply, documentation of all reinstated supply used, increased surveillance of reinstated supply efficacy and failure, and/or increased medical waste reinstatement company liability (US Congress, 1990). No research is available on the safety of reinstating expired EMW, although it is commonly known that medical supply companies somewhat arbitrarily apply expiration dates to supplies and that the supplies are still sterile after that date.

IV.C. Impressions

This study brings attention to the fact that excess medical supply is an underrepresented yet highly relevant domain in how we construct our knowledge, regulations, and practices concerning total medical waste burden of the healthcare industry.

Studies have made estimates to the amount of RMS, albeit they report acknowledgement of considerable underestimation. There are currently no comprehensive estimates or reporting efforts for
EMW. Therefore, neither is there for TMS. The total burden of the healthcare industry on medical waste is not fully understood.

There has not been a concerted effort to study, characterize, identify, regulate, organize, track, store, utilize and appropriate EMW. There have been no reports identifying excess medical waste as a defined entity contributing to TMW, no estimations on how much TMW consists of EMW, and no estimations on how much EMW exists as stagnant.

**IV.D. Recommendations**

Increase attention to EMW to understand dimensions that drive it such as how much exists, where much of it exists, and what barriers there are to accessing and utilizing it.

Adapt to and differentiate between the terms ‘total medical waste’, ‘regulated medical waste’, and ‘excess medical waste.’

EMS includes materials that have been expired but never used or contaminated. Continued research should be done on the safety of expired medical equipment and the possibilities and process of re-instating them. Also important is the social constructs and perceptions of the cleanliness of medical waste and its reinstatement.

**V. Survey Characterizing the Excess Medical Waste Market in Hillsborough County**

**V.A. Purpose:**
A better understanding of excess medical waste can immensely help reduce the burden of total medical waste because it is not true waste in the sense of the word. Excess medical waste can be used, reused, or even recycled rather than end up in landfills or incinerators.

Excess medical waste in Hillsborough County is identified and characterized through analysis of healthcare facilities, the main producers of excess medical waste. A novel survey tool to estimate quantity of and characterize factors relating to excess medical waste is introduced. Excess medical waste is examined through a multi-dimensional construction of how much, why, and how medical waste exists.

V.B. Research Objectives:

The primary objectives of this study are:

- To elucidate the primary factors contributing to excess medical waste and how much medical waste exists
- To introduce a novel survey tool for characterizing the nature of excess medical waste of healthcare facilities.
- To implement the survey to characterize excess medical waste of healthcare providers in Hillsborough County.

V.C. Research Methods:

IRB approval will obtained from the University of South Florida Internal Review Board.
This study will be conducted in three phases, a pilot study, a semi-structured pilot study, and a subsequent full study. The pilot study will involve unstructured (Bernard 2006) or open-ended interviews (Schensul, et al. 1999) with three healthcare facility administrators practicing in Hillsborough County who work directly with excess medical waste. The purpose of these conversations is to develop a baseline understanding of the factors that could influence excess medical waste. Responses to these initial interviews will help to guide subsequent, more structured deliveries of the survey and, ultimately, the optimization of the survey (Weller and Romney 1988).

Using data gathered in the first phase, more formal semi-structured (Bernard 2006) interviews will be executed with three healthcare facility administrators practicing in Hillsborough County who work directly with excess medical waste. Questions relating to the social constructs of excess medical waste will be designed based on guidelines provided by Schensul et al. (1999:154-55) and will elicit more detailed information about perceptions and driving factors related to excess medical waste. This will help ensure the methodology, survey distribution, and survey designs are optimized.

At that point, phase three can begin, which involves the delivery of the survey. Based on interview data gathered from the previous phases, the survey will consist of questions relating to perceptions and determinants of excess medical waste across several categories. The survey addresses domains of excess medical waste practices such as how much waste exists, waste management practices, social constructs of the waste, and alternatives to dumping/incinerating. The survey will also address categories of organization measures such as healthcare facility type, size, and economic measures. The hypotheses generating nature of the quasi-experimental structure of the survey study will present correlations between excess medical waste practices and organizational measures, thus providing insight for future studies.
Each category will contain several questions, which will facilitate validation of responses from each participant across a given category. The final survey will have around 60 questions. Many questions will be a 5-point Likert-scale, ranging from ‘Completely Disagree’ to ‘Completely Agree’. The purpose of these categories, and of the use of Likert-scale questions, is to facilitate the creation of quantitative indices related to each category, which then can be analyzed statistically.

The total sample size for the final quantitative analyses ideally will be around 150 participants, with a goal to have between 40 and 75 respondents in any given subgroup (e.g., males/females, younger adults/middle aged/older adults, etc.). Including 75 people in each comparison group will provide enough statistical power at $\alpha = 0.05$ and $1-\beta = 0.80$ to detect less than a .75 difference in standard deviation for bivariate comparisons such as a $t$-test or Mann-Whitney U test (Hays 1963:330), a correlation between two variables, such as Pearson’s $r$, at less than $r = 0.30$, and cultural consensus where degree of agreement can be assessed at $r < 0.16$ and with a validity of greater than 0.95 (Weller and Romney 1988:73-77), all tests that will be used in this project. These numbers reflect the quantitative strength of this project given such a sample size, and indeed good statistical power is retained when sample sizes drop to as low as 40 respondents (Weller 1993).

V.D. Evaluation Plan

All quantitative data analysis will take place within SPSS or R, both of which are commonly used software packages for statistical analyses. Anthropac or SPSS will be used to analyze consensus data, depending on the type of consensus analysis required.
In order to test the hypotheses, indices will be created for each respondent, for each major category listed above, by summing their responses to each question related to that category. As such, scores for each index will range from \((n \times 1)\) to \((n \times 5)\), where \(n\) is the number of questions in a given category. For instance, if each category had 5 questions, the index range would be 5-25. This index can be used in a variety of ways, including as the dependent variable in regression equations or in comparison with other variables when testing for correlation.

The analytical methods selected will be used to shed light on our research objectives, rather than structured to test specific hypotheses. Beyond this, given that the survey questions and specific categories are only going to be known following the interviews, it is unknown precisely what will be tested. However, what follows are some likely analysis scenarios based on relevant literature and experience in past studies.

For example, consensus analysis can reveal degrees of concord or discord within groups on a given subject, and can also help to confirm that patterns in responses appear consistent. For instance, it will be possible to say whether or not perceptions related to footwear choice are truly shared throughout the community, or within various subsets (e.g., men, women, physicians, administration, etc.). The steps for collecting and analyzing consensus data are described in detail by Weller (2007), but the data can come from the same quantitative survey without modification. Analysis involves measuring the amount of concord on a given question or theme, which is determined by measuring correlation (e.g., with Pearson’s r) between or among groups (such as males vs. females) or by measuring the variance among the entire sample (e.g., with measures of standard deviation). Thus, the amount of agreement or disagreement regarding specific questions or themes can be measured.
Logistic regression is another approach that will work well with these data. If the dependent variable is set to, for example, whether or not the participant agrees with wearing open-toed shoes in medical facilities, survey indices and pertinent demographic data can be used as independents to determine the relative weight of each dimension to that belief.

Beyond these approaches, other methods offer promise as well. Discriminant function analysis can help to determine which combination of variables accounts for the majority of differentiation between two or more groups (e.g., men/women, physicians/nurses/administration, etc.). This can be useful when trying to account for differences in perspectives among groups. Principle components analysis is another excellent tool for uncovering relationships that may have otherwise remained obscured, and can reveal dimensions of grouping that are less intuitive but yet crucially important. And finally, within a single group, measures of correlation such as Pearson’s r or Spearman’s r can show the extent to which two individual questions – or even two entire categorical indices – are related.

V.E. Detailed Budget with Budget Justification

$5.00 dollar gift cards * 150 participants = $750.00
Travel expenses for intra Hillsborough County pilot study = $200.00
Skype calls @ $0.01/minute = $100.00
Total: $1050.00
Section 1:

What type of organization are you (as defined by AHCA list provided)?
___________________________________________________________________________________________________

Are you?

- [ ] Public
- [ ] Private
- [ ] Not-for-profit

Section 2:

How many square feet is your facility?
___________________________________________________________________________________________________

How many employees do you have?
If applicable, how many hospital beds do you have?

If applicable, what is your average daily percent occupancy?

What is your average number of patients treated per month?

Section 3:

Do you have employees responsible for the purchase and allocation of medical supplies?

Yes  No

If yes, how many do you employ?

How often do you purchase medical supplies?
Section 4:

Do you purchase re-processed single use medical equipment?

- [ ] Yes
- [ ] No

Do you have in-house medical device re-processing?

- [ ] Yes
- [ ] No

Do you sell medical supplies to a medical device re-processing company?

- [ ] Yes
- [ ] No

Do you contract reprocessing of your medical devices to a private company?

- [ ] Yes
- [ ] No

Section 5:

Do you have excess medical waste?

- [ ] Yes
- [ ] No
If yes, why? Check all applicable.

- [ ] Expired
- [ ] Upgraded
- [ ] Ordered
- [ ] Anticipated a too many
- [ ] Anticipated a greater need
- [ ] Other

Explanation if needed:

___________________________________________________________________________________________________

___________________________________________________________________________________________________

___________________________________________________________________________________________________

How much excess medical waste do you have?

___________________________________________________________________________________________________

In how many different storage locations is the excess medical waste stored?

___________________________________________________________________________________________________

Do you have employees responsible for allocating excess medical waste? If yes, how many do you employ?

___________________________________________________________________________________________________

How many of these are the same as those responsible for the allocation of general medical supplies?

___________________________________________________________________________________________________

Do you utilize professional consulting for excess medical waste?

- [ ] Yes
- [ ] No
Section 6:

How do you keep track of your general medical supply inventory?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Do Not  Online  Handwritten  Spreadsheet  Database  Other:
          Form          Form

How do you keep track of expiration of medical supplies?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Do Not  Online  Handwritten  Spreadsheet  Database  Other:
          Form          Form

How do you keep track of upgrades to medical supplies?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Do Not  Online  Handwritten  Spreadsheet  Database  Other:
          Form          Form

How do you keep track of excess medical equipment?

☐ ☐ ☐ ☐ ☐ ☐ ☐
Do Not  Online  Handwritten  Spreadsheet  Database  Other:
          Form          Form

Section 7

Do you currently incinerate excess medical waste? If yes, how often? How much?

___________________________________________________________________________________________________
___________________________________________________________________________________________________
___________________________________________________________________________________________________
Do you currently sell excess medical waste? If yes, how often?

___________________________________________________________________________________________________
___________________________________________________________________________________________________
___________________________________________________________________________________________________

Do you currently donate excess medical waste? If yes, how often?

___________________________________________________________________________________________________
___________________________________________________________________________________________________
___________________________________________________________________________________________________
___________________________________________________________________________________________________

If yes to the previous question, do you process excess medical waste and send it directly to healthcare providers, through external intermediary organizations, or through an in-house organization?

___________________________________________________________________________________________________
___________________________________________________________________________________________________
___________________________________________________________________________________________________
___________________________________________________________________________________________________
Section 8

How willing are you to donate excess medical waste directly to healthcare providers that will use them?

___________________________________________________________________________________________________
___________________________________________________________________________________________________
___________________________________________________________________________________________________

How willing are you to sell excess medical waste for profit?

___________________________________________________________________________________________________
___________________________________________________________________________________________________
___________________________________________________________________________________________________

How willing are you to donate excess medical waste to a non-profit organization willing to receive donated medical supplies and appropriate them to healthcare providers that will use them?

___________________________________________________________________________________________________
___________________________________________________________________________________________________
___________________________________________________________________________________________________

How willing are you to hire professional consulting in the appropriation of excess medical waste?
Part VI. Business Plan – Facilitating the Excess Medical Waste Market

VI.A. Mission & Vision

Advocates for World Health is a framework for young professionals to achieve both personal and professional growth in conducting health care business. AWH takes advantage of excess medical supply to provide foreign health care providers with the means to improve health outcomes in their nations.

When researching the variety of approaches employed to increase profitability while improving international communities’ living conditions, the concept of social business, developed by Nobel Peace Prize winner Muhamma Yunus, shaped AWH’s vision. The concept of social business basically states that while individual incomes may be low in developing countries, the aggregate buying power of poor communities is quite large and they pay higher prices than upper classes. This creates an opportunity for helping people while making profits for corporations with economies of scale and efficient supply chains. (HBS) It is a two-way relationship between corporation and developing community, one in which both parties can benefit. Advocates for World Health (AWH) will apply this concept to the healthcare industry (Finch, 2006).

AWH’s vision is to bridge the gap in global health inequalities between developing countries and developed. The vision centers around the Lakota Sioux prayer Mitakuye Oyasin which preaches that everything is connected. It is much like the Ubuntu concept developed by Desmond Tutu, “I am what I
AWH believes in a globally synchronized economy, one that is unified and accounts for all people (McKeever, 2008).

AWH’s philosophy is: “As the Cherokee saying goes Ho! Mitakuye Oyasin, “We are all related.” Each one of us are brothers and sisters who share the same common heritage—humanity. Just as you would care for your loved ones if they were ill, injured or impoverished, we strive through medical and ethical practices to deliver the same to all people. Whoever, wherever, whenever, we will be there to offer aid. Let there be a variety in people.”

VI.B. Executive Summary

In line with its vision, Advocates for World Health will capitalize on inefficiencies in the United States' health care sector. Every year hospitals, clinics, and other health care facilities in the US generate billions of pounds of medical waste. AWH defines total medical waste as the sum of regulated medical waste (RMW) and excess medical waste (EMW). What is classically defined as ‘medical waste’, AWH defines as ‘regulated medical waste’ (RMW). ‘Excess medical waste’, on the other hand, is not considered to pose infectious risk and thus is not regulated. It includes any equipment that is outdated, no longer used, broken or expired and that does not pose infectious risk. Neither does it pose pathological, open sharps, or heavy metal risk. Materials become EMW because of breaking, expiration, over ordering, remodeling, inventory mismanagement, among other reasons. There are economic inefficiencies in inventory control, adaptation to technological change, and et cetera, in the health care industry, which lead to medical supplies in EMW that can still be used, but are instead thrown away.
AWH acquires these goods in the United States and negotiates a selling price with international health care providers. AWH generates profits to reinvest in the community while the buyer is able to purchase the supplies at a low price. Although other non- and for- profit organizations have attempted to implement solutions that capitalize on the waste, there is still an abundance of medical supplies lingering in an extensive network of health care providers throughout the United States. As of 2010, there were 5,815 US registered hospitals, 5,010 US community hospitals, and 2,923 not for profit community hospitals, all potentially creating surplus in the US (American Hospital Association).

To address this issue and differentiate itself, AWH’s action plan for the next five years is to:

1. Provide the needed medical supplies
2. Provide an educational program that teaches the proper use of the supplies
3. Monitor the use of the supplies over the duration of their life

Sending medical equipment and supplies abroad is an effective, low cost intervention and it is easy to quantify the costs and benefits in receiving communities. The ability to focus on an intervention capable of having a large impact on health care allows AWH to further specialize and differentiate itself.

To acquire more medical supplies, AWH is currently employing a growth strategy by expanding its human capital in Gainesville and Tampa, Florida. The primary means is through recruiting college students to emulate the prototype business model; a networking machine connecting local health care providers to AWH. Each division is equipped with a compliance partner that ensures the donated supplies have been used properly.
AWH believes that by ensuring a seamless transfer and utilization of supplies from US' donors to international donees, it is improving the health care access and outcomes of a given nation. In turn, this improves the country's welfare and eventually contributes to bridging a gap in global healthcare inequalities.

**VI.C. Corporate Structure & Management**

![Diagram of corporate structure and management](image)

**VI.D. Informational Resources**

Each of AWH's departments can subsist independently, but through group synergy the following departments more effectively function as a single unit working towards a common goal. There are a few reporting systems that serve as an important backbone for communication. They include: legal, reporting, and research. Under the legal resources, AWH has a volunteer employment agreement and confidentiality agreement to ensure a high level of activity and conceal differentiation strategies. Secondly, there are documents for reporting which include the executives' monthly report and information packet. The purpose of these documents is to inform partners and keep executives in close proximity with workers. Thirdly, there are research documents that can be prepared by AWH's R&D
department or third party sources. Either way, they are mandated for reading to ensure that volunteers reach a minimum level of knowledge and competency before they begin representing AWH through their works (Fritz, 1996).

VI.E. Networking

The networking department is primarily responsible for marketing AWH’s business model and carrying out survey research as a means for establishing relationships with health care providers. The department is lead by the Lead Surveyor and Networking Officer. The Lead Surveyor is a liaison between R&D and Networking to manage the evaluation of medical surplus in a given region. The Networking Officer specializes in the management of both partners and potential donors. Once a donation has been identified through networking, the process is pushed on to the production department.

VI.F. Production

The production department is the primary activator of the supply chain. It serves as a drastic cost cutting measure by replacing assets with information through the utilization of inventory lists. The production team is responsible for coordinating the donation all the way from identifying a user for the supplies, to transporting the medical supplies to AWH’s warehouse for compliance, to the final steps of ensuring that a donation has been sent and is being monitored properly.
VI.G. Fundraising

The fundraising department is responsible for bringing in monetary donations through increasing awareness via hosting community events, designing website advertising schemes and et cetera. Bringing in monetary donations is incredibly important, but AWH also realizes that by only focusing efforts on raising funds, no supplies are actually sent aboard. However, without sufficient funds, AWH is incapable of funding things such as salaries, promotional materials, research components, and other technology-related products.

VI.H. Human Relations

HR is primarily concerned with streamlining recruiting. Through establishing partnerships, creating mass emails and advertisements, and speaking to the media, HR positions AWH so that it receives a large and diversified pool of applicants. AWH is highly selective in hiring new partners.

VI.I. Research & Development (R&D)

R&D conducts research for evaluation of medical surplus and develops proposals for hospital administration teams. The R&D department is at the forefront of establishing competitive advantage through innovation. Improving implementation and efficiency of current undertakings is AWH’s primary means for competing. In addition, the R&D department creates an opportunity for fundraising through grants. For example, there are a limited number of organizations that currently track how much
medical waste the United States produces in a year. AWH has made this, along with similar topics, a priority in its research. Evaluation of medical surplus is critical for AWH’s short and long term success. It is an approach that has been lightly touched yet highly lucrative in information and contribution to the mitigation of US medical supplies.

VI.J. SWOT Analysis

VI.J.i. Strengths

In the waste industry, AWH has considerable advantages over for profit organizations in acquiring medical supplies. Exemption from federal income tax enhances AWH’s ability to accumulate income and the ability to offer tax advantages for charitable contributions are among the primary drivers for its operations.

AWH has advantages over previously mentioned not for profits, too. AWH is singularly concerned with matching surplus medical supplies with the demand of international health care providers. Utilizing a highly leveraged supply chain that revolves around inventory lists coupled with drastic cost cutting measures establishing a sustainable advantage, AWH enables itself to take its focus off of fundraising and increase efforts on networking with potential donors.

Disruptive Technology:

Disruptive technology is innovation that disrupts markets through methods not anticipated by firms in the market. It’s usually accomplished through undercutting prices or targeting a different set of
consumers. Part of the point in studying these markets and writing this thesis is to identify a disruptive
technology that will enable AWH to surpass its competitors.

AWH believes it can accomplish this through increased efforts in networking and marketing as well as
innovation in its supply chain. The strategies work hand in hand via leveraging one another. By
effectively marketing the innovative concept behind the supply chain, AWH is able to encourage a more
comprehensive and user friendly business model. By utilizing the innovative supply chain concept,
AWH’s human capital is able to focus on more important issues such as meeting new health care
providers rather than handling logistics.

Human Capital & Operational Structure:

Uprooting AWH’s operating efforts to gather more supplies, increase awareness, and encourage
participation in its online service is AWH’s student organizations. To the likes of Partners-in-Health and
the American Red Cross, AWH invests in the youth to spread operations throughout the US. However,
none of AWH’s competitors currently place emphasis on networking as much as possible. AWH believes
in its high energy college activists as long term investments in connecting with as many hospitals,
clinics, not for profit organizations, medical associations, and original equipment manufacturers. Young
partners generate enthusiasm and help to create a positive image in the community as they develop
relationships with donors. Additionally, they gain experience in a health care business which benefits
their future career prospects. By partnering with universities, AWH encourages funding from
universities, increased philanthropy from the community, and considerable leverage in research efforts
which serve as cost cutting measures.
As part of an ongoing relationship with a university's computer science department, AWH has partnered with a team of computer programmers to create a web interface that will serve as a comprehensive database of excess medical supplies in the US. Having the web interface act as an autonomic and efficient facilitator between two parties for medical supplies, AWH can further leverage itself in its supply chain logistics and operations. By establishing this database, AWH can create a paper trail that details exactly what is available in what amount and et cetera. Additionally, it allows for further streamlining of the supply chain so partners can focus their efforts on networking and marketing rather than filing out paperwork. Both donors and donees would acquire materials faster and incur lower transaction costs through AWH's ability to automatically administer matching between those in supply and those in demand.

Remedy, the original creator of the website interface concept named Med-Eq, started in the early 1990s and asserted that they did not intend to reinvent the wheel, so they turned to a huge network of existent non-profit medical charities to emphasize collaboration (REMEDY, 2010). Albeit their original idea was fascinating and perhaps brilliant, it did not consider all of the necessary support functions that surround such a venture. In their case, marketing was a focal point which never became one their priorities. Through researching room for improvement of the concept, AWH has made networking and marketing a priority in implementing this concept.

VI.J.ii. Weaknesses
Networking and marketing, some of the most important areas that AWH should be concerned with developing, has not compared to some of its distant competitors such as Greenpeace, InterVol, and MedShare. AWH has not developed in its communities like the former organizations have. This lack of exposure has affected the volume of medical supply and monetary donations as well as its reputation in the community as a responsible and trustworthy organization.

VI.J.iii. Opportunities

The medical surplus industry contains many small, spread out not for profit organizations that do not collaborate regularly. There are a number of companies that consult, manage, sell products for, and reprocess EMW. Remedy is similar to AWH in that it has been active in collecting and distributing EMW since 1997.

Remedy is a cost-effective means for donations by employing medical students to get involved in international health and environmental issues. At Yale and the University of California – San Francisco medical school, some of the students monitor the operating rooms as a primary source for medical supply donations (Spry et al., 1991). Despite focusing on streamlining the process, it is largely an automated approach with a few hospitals. Material to be donated is inventoried and stored for donation, and defective material is discarded.

Organizations like Remedy compete for the same medical supplies through contacting individual hospitals, clinics, original equipment manufacturers, and medical associations. However, these efforts are too spread out and disconnected from each other which creates a serious problem in properly
documenting the donations, monitoring the proper use of the donations, and it creates unnecessary search and exchange costs in the aggregate economy.

AWH seeks to build a business model in which AWH is at the forefront of coordinating these organizations’ efforts in mitigating the issue with excess medical supplies.

VI.J.iv. Threats

AWH faces threats primarily from other not for profit organizations. For example, MedShare, an organization founded in 1998, is dedicated to improving healthcare and environmental cleanliness through the efficient recovery and redistribution of surplus medical supplies from US health care providers. Last year, MedShare’s supply and recovery operations saved 534,730 pounds of CO2 and 1.8 million kWh of energy, equal to 150 households’ annual electricity use (MedShare 2010). MedShare also has an online database displaying all medical supplies in their inventory which is somewhat similar to AWH’s web interface, but there are still some distinct differences. Another competitor, REMEDY, is a group of health care professionals promoting the nationwide practice of recovery of exposed-but-unused surgical supplies. Its mission is to provide international medical relief while reducing medical waste from US hospitals. Their unique approach embodies a web based interface that connects donors with charities. (Med-Eq) Both MedShare and Remedy are much larger organizations than AWH and have further developed their business models. However, this also puts AWH in the position of researching their weaknesses and capitalizing on them.

VI.K. Alternative Strategies
The medical surplus industry is currently shifting towards a new paradigm: recycling and re-sterilizing medical supplies. Taking excess used/unused instruments and sanitizing them so that they can be sold at 40-60% of the original price is what highly lucrative companies like SterilMed are pursuing. Although this could be a long term opportunity for AWH, it could also an immediate threat. As more of these recycling companies prop up, there are less medical supplies for AWH to send abroad.

A vertical integration strategy for AWH would be to create its own recycling arm that would compete in the evolving industry. Collecting, recycling, distributing and monitoring would all be accomplished through the new arm and supply chain. Depending on its success, AWH could make more profits to reinvest in itself and in turn, the communities it serves. However, AWH does face some barriers to entry such as economies of scale (other companies have lower average costs). Under the current state, preexisting profit making institutions could outcompete AWH through their stronger brand name and lower cost structure unless AWH were to differentiate itself.

A second alternative would be to take a more active environmental stance. Under current operations, US medical waste may be reduced and sent abroad, but improper disposal is still possible in the receiving nation. This type of disposal allows for the pollution of land, water, air, and other natural resources, which leads to an ambiguous cost-benefit analysis for donees. Being that AWH will conduct their business primarily in developing countries that may or may not have landfills, it is vital that AWH focus their attention on the development of a waste management program. By distributing excess medical supplies from the United States to developing countries, AWH is temporarily delaying the disposal of medical supplies. However, the supplies must be disposed of eventually. With the development of a waste management program, AWH will ensure that both hazardous and
nonhazardous supplies are being disposed of properly. By aiding the developing countries in the sorting and disposal process, AWH can ensure that the supplies are not being dumped in rivers or exposed to the public.

Within the United States, there may be supplies that need to be disposed of immediately after use. For those circumstances, AWH will focus their program on educating local suppliers on the proper ways to dispose of supplies. In doing so, AWH will provide their suppliers with posters and different garbage labels to help with the sorting process.

One of AWH’s main advantages is that it is run by college students working for a cause; however, this can also be one of their disadvantages. By allowing college students to actively manage, AWH has to overcome preconceived notions about its credibility. One way companies like 1-800-Got-Junk have overcome this is by creating a unique and uniform system to differentiate themselves from others. AWH competes with only a couple other nonprofit organizations and of those companies, none have a uniform system for the collection and distribution of medical supplies. Therefore, by creating such a system, AWH can increase their brand recognition and establish an association between their services and their uniform. As a result of implementing this suggestion, potential suppliers would see that AWH are professionals and capable of handling the task.

Another suggestion involves the implementation of distributing instructional videos. Being that AWH transports excess medical supplies from the United States to developing countries, AWH needs to ensure the supplies are being used properly. One way of doing this is by teaming up with local universities and medical schools to create instructional videos on how to use the supplies. For example,
if AWH were to send a batch of scalpels, AWH would also send a video along with the supplies that was conducted by a medical school student or doctor on the proper usage techniques and procedures.

To correspond with the previous suggestion on the development of a waste management program, the video would also include a demonstration on how to properly dispose of the supplies. As a result of the instructional videos, AWH can ensure that the best practices are known and being practiced.

**VI.J. Business Metrics**

AWH was founded in fall of 2008 and has performed on par, or slightly below, some of its major competitors. Since 2008, AWH has sent 5 donations totaling roughly 9,000lbs, or the equivalent of filling a 35 ft semi-truck. Where AWH is lacking is in raising funds. To this day, AWH has accepted approximately $7,500. Part of this lack in raising funds is attributed to AWH’s restructuring period that consumed approximately 1 year. However, AWH has addressed this issue by establishing an entire department dedicated to bringing in a sustainable flow of funds in the near future.

A comparison with AWH’s most similar competitor's beginning is appropriate. MedShare was founded in 1998 and processed it's first 40 ft semi truck donation in 1999. A year later, MedShare received what they call their “seal of approval” which was a $250,000 donation from the Robert W. Woodruff Foundation. In 2009, MedShare celebrated its 500th 40ft semi truck donation and also received millions of dollars in donations during the same year.

Looking to the future, AWH uses MedShare as a benchmark for its performance. AWH has optimally positioned itself for the next two years to receive as many medical supplies donations as possible while
trusting that funding will follow productivity. In the next year (2011), AWH aims to facilitate over 20,000lbs of supplies and in the following year (2012), over 35,000lbs.

VII. Conclusion

Unused medical supplies, which are still useful to other health care providers, are a problem that needs to be mitigated for environmental and humanitarian purposes. Through speaking with executives in the US health care industry, AWH has learned that this surplus results from failed health care ventures and mismanaged inventory systems. As a result of mismanagement, some materials have a terrible effect on the environment by contaminating land, air, and water resources. The variety of waste includes infectious, pathological, and/or hazardous waste, heavy metals, pressurized containers, and sharps. Furthermore, these supplies could be put to better use elsewhere as in a clinic or in a hospital in the developing world.

Knowing this, it is not difficult to imagine that there is a slowly diminishing, albeit existent misunderstanding about the usefulness of unused medical supplies surplus due to social stigma and strict health care regulations. In many cases, profitable solutions such as reselling to re-sterilization companies are forgone. And in other cases, hospitals and clinics want to donate surplus for tax incentives, but it is costly for them.

As such an unused medical supplies market cannot exist in part due to costs associated with the lack of information available. Potential users of these materials are unaware of a supply location thus making the value of these materials decrease as they approach expiration. As a result, profits are short lived due to search, storage and transportation costs.
AWH is in the beginning stages of launching a web interface to serve as part of a larger scale facilitator between two parties for medical equipment and supplies. The interface designed would create a market for these materials by mitigating the issue of information asymmetries. Likewise, both parties matched would acquire materials faster and incur lower transaction costs because AWH will administer matching between those in supply and those in demand. A selective membership program would have to be established to regulate supply/demand conditions.

However, there are a few challenges that AWH must encounter in its operations with its medical supplies first. Identifying the supplies and marketing the incentives would be crucial for participation rates among US health care providers. AWH due to the complexity of the supply chain flow of these materials would require skilled personnel to oversee and collect data on each listing to ensure usability and legality. The capability to process the supplies down the rest of the value chain would be rudimentary.

By supplying health institutions in the developing world with needed medical supplies and equipment, AWH will substantially reduce the cost of receiving health care in the communities it serves. Usually lack of supplies is the determining factor in receiving care. In addition, the quality of the health care provided is primarily susceptible with the amount of available resources that are at the disposal of health institutions and clinicians alike.

Through establishing divisions spanning from Tampa to Washington, AWH hopes to prove itself to potential donors as a movement that can have a large impact on improving health care access in developing nations. By improving a nation’s healthcare, one can improve its welfare. Eventually, the gap in healthcare inequalities, and in turn poverty, slowly bridges into a better lifestyle for all people.
References:

2. American Federation of State, County and Municipal Employees (1986). Background to a Petition to OSHA to Develop an Emergency Temporary Standard for Prevention of Transmission of Bloodborne Infection in the Workplace, Washington, DC.


