DISEASE DIVAS: FINAL PROPOSAL

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I. How Might We

Problem

How might we improve established data collection methods in West Africa by working with rural communities to balance cultural practices with innovative technologies in order to amplify the public health response to infectious disease?

a. Who: Rural communities in West Africa and other developing regions are lacking in healthcare infrastructure.
b. What: Poor data collection in rural regions leads to an inadequate allocation of resources during infectious disease outbreaks. Lack of a personal approach to rural communities makes collecting data difficult and ignorance regarding cultural practices prevents NGOs from accurately representing a region.
c. When: The spread of disease is an ongoing problem and is currently seen with the Ebola virus outbreak in West Africa. Disease outbreaks are occurring all over the world. NGOs focus more on immediate crisis relief rather than long term solutions, so ideas such as a centralized database tend to get pushed to the side.
d. Where: The Ebola outbreak is mostly affecting West Africa, but disease outbreaks can be found in many developing areas around the world. Data collection methods tend to be lacking in most developing regions around the world due to problems such as illiteracy and cultural barriers.
e. Why: Disease outbreaks are a time sensitive issue. By improving data collection methods, NGOs would be more prepared to respond to disease outbreaks and could allocate resources in a more effective way. This would ultimately reduce the spread of the disease and allow communities to better prepare themselves for disease outbreaks.

Significance

The 2014 Ebola virus disease (EVD) outbreak in West Africa has brought major public health concerns to the public's attention. One of the most significant flaws in health infrastructure is inaccurate and inefficient health information systems and databases. Health information communication between local communities and national/international health organizations is fragmented. On a local level, normalcies such as illiteracy and technological impediments restrict the ability to acquire health statistics. This problem is widespread across developing nations, but the Disease Divas

explored instances in Sierra Leone, Liberia, and Guinea the most extensively. Improving data collection procedures in developing countries will enable a more effective public health response during periods of crisis, which benefits infected and at-risk citizens of West African nations. Also, acquiring accurate health statistics encourages appropriate resource allocation so valuable assets such as medication, food, and healthcare professionals are not squandered.

Previously, there had been minimal motivation to develop a comprehensive data collection system that spans all areas of health information, most likely due to the fact that creating a centralized data collection would be a time-consuming process that would take the focus of NGOs away from providing immediate health care resources. However, significant "increases in the resources for health," and development of "performance-based resource allocation,"[1] has resulted in a "recent upsurge in demand for health information."[2] During infectious disease response, resources must be distributed swiftly and appropriately in order to maximize the effects of the public health response, a process that can only be enhanced by a better health information system. Improving data collection methods is important for several different tiers in a country's health care infrastructure. The government utilizes collected health data to ascertain the degree to which health care can be improved. Hospitals require accurate data collection to maintain internal procedures (such as employee schedules) and to analyze relevant "population profiles and risk factors in decision-making regarding allocation of resources."[1] However, the lack of a strong regulatory framework prevents information collected at the local level to be transmitted to the planning authorities.

The Disease Divas hope to provide a West African community with a reliable and simple procedure for data collection with minimal costs to society. By working around established cultural practices, a balance between community values and innovative technologies can be achieved so accurate health data can be swiftly transmitted to relevant parties. According to the World Health Organization, improving data communication between communities and national organizations can assist in the detection and control of chronic and crisis health problems, inspire improvements in quality of services, provide motivation for implementation of effective health policies, and mobilize new resources. [1] However, the development of new data collection methods will cost money and resources especially when training health workers collecting field data, providing incentives for locals to give data, and making questionnaires and surveys more accessible. Also, the lack of internet access in rural communities greatly inhibits the ability to store and send data.

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[1] http://www.who.int/healthmetrics/documents/hmnissue_nationalsubnationalhealthinfosystems.pdf?ua=1
[2] http://www.oecd.org/site/worldforum06/38934748.ppt

Stakeholders

Several parties have a vested interest in promoting the improvement of data collection strategies. With more accurate data, national governments and policymakers can appropriately allocate resources such as food and medical equipment to areas in need.[3] Local community leaders can benefit from improved data collection by using the information to determine local risks to the health and well-being of the area. For example, if a leader notices a significant increase in deaths associated with dysentery, then he can advise his constituents to avoid tainted water sources. The creation of data records can link past and present health care data and better prepare these communities for the appearances of illnesses in the future[4]. Non-Governmental Organizations can use databases to determine the most effective locations to establish healthcare centers, where to send volunteers, and where to target relief efforts. Internet providers could benefit from improving data collection technologies since several areas in Africa still require access to high-speed broadband.[5] Perhaps NGOs and internet providers could would together to ensure stable and long-lasting internet connection to developing areas.

Context and Existing Solutions

Initial research of the problem space led us to investigate discrepancies between Ebola statistics of the national Ministries of Health in affected countries and the World Health Organization. We were shocked at the notable differences between the data reported by each organization. In the chart below, notice the discrepancies between the Ministry of Health reports and the World Health Organization reports for Ebola cases through the month of October 2014.
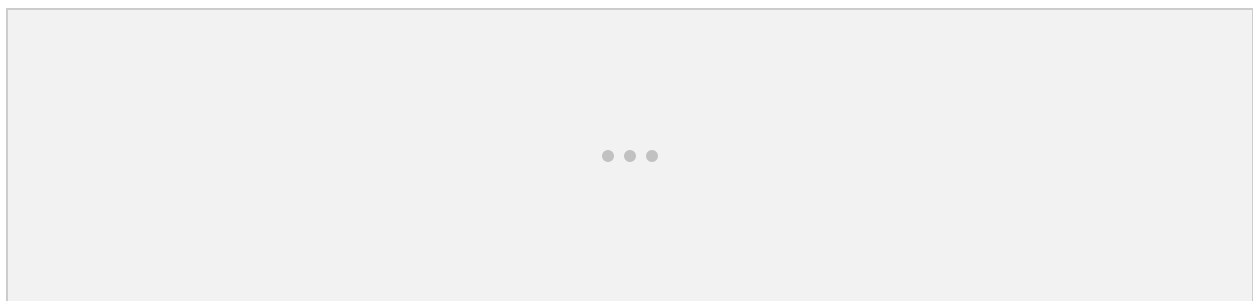

Figure 1: Sierra Leone Statistics Collected by the Ministry of Health and the World Health Organization[6]

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[3] http://www.who.int/healthmetrics/documents/hmnissue_nationalsubnationalhealthinfosystems.pdf?ua=1
[4] http://www.phinnetwork.org/portals/0/improving_data_quality.pdf
[5] http://www.un.org/africarenewal/magazine/april-2014/internet-access-no-longer-luxury
[6] http://health.gov.sl/?page_id=576

In several cases, regional Ebola infection/death data were not even represented in the daily report. In the chart below, Ebola case data in Liberia for the month of October, 2014. Notice the consistent discrepancies between the Ministry of Health's reports and the World Health Organization's reports. The large black box represents data that was unavailable for those dates.
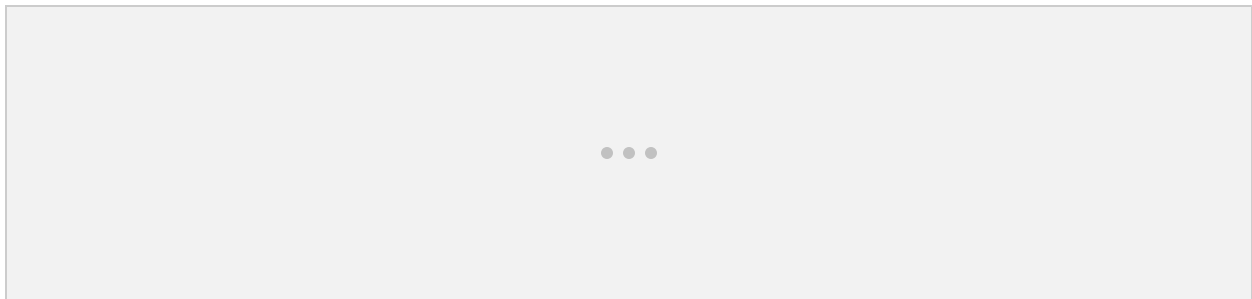

Figure 2: Ebola Statistics Collected by the Liberian Ministry of Health and the World Health Organization[78]

The most disturbing aspect of this inconsistent data is that the World Health Organization claims that it acquires health information from national Ministries of Health. If this is truly the case, then the numbers should match up. Since the data does not align, then a breakdown in communication must exist between Ministries of Health and the World Health Organization. This realization inspired the Disease Divas to further explore the chain of communication between local communities and world health organizations during periods of public health crisis.

After interviewing several experts on public health infrastructure and response in West Africa, such as Dr. Michael Best and Margarita Gonzalez, and studying previous emergency health response strategies in West Africa, such as the HIV/AIDS response, the Disease Divas gained valuable insight into ongoing attempts to solving this problem. During the HIV/AIDS outbreak, public health response was best implemented when utilizing a bottom-up strategy with disease prevention and protection began at the local level[9] [10] [11]. Additionally, the individual personality and culture of each community must be respected in order to ensure long-term local participation in established health

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[7] http://apps.who.int/ebola/en/current-situation/ebola-situation-report
[8] http://www.mohsw.gov.lr/content_display.php?press_id=248&sub=press_release
[9] *Letting Them Die: Why HIV/AIDS Prevention Programmes Fail* by Catherine Campbell
[10] *Global health: U.S. Agency for International Development fights AIDS in Africa, but better data needed to measure impact: report to the Chairman, Subcommittee on African Affairs, Committee on Foreign Relations, U.S. Senate / United States General Accounting Office.*
[11] *Trends and Patterns of HIV/AIDS Infection in Selected Developing Countries. U.S. Bureau of the Census. (n.d.).*

response procedures. In regards to current health information collection and storage strategies, technologies such as Integrated Disease Surveillance and Response[12], or IDSR, and Magpi[13] have been implemented but underutilized. These technologies have proven to be valuable in increasing data collection quality, but their effects could be amplified by making them more accessible to rural areas.

Magpi is a company that has developed a mobile data collection app to create an online reservoir of field data. The company was created by Joel Selanikio, a doctor previously working in the field who wanted to improve the methods of data collection. This app allows "users to create mass SMS or voice messaging campaigns in any language from an easy-to-use web interface, without having to work through local carriers[14]." From a recent Ted Talk, Selanikio mentioned that instead paper copies passed through three-four people before reaching local center, the Magpi software serves as a centralized location for data that is accurate and time-sensitive[15].This app has reached much success, as many NGOs are now using it as part of data collection in the fields.

The Disease Divas hope to balance cultural practices with innovative technologies to encourage the integration of rural communities with established data collection systems. By connecting rural areas directly to national healthcare databases, the discrepancies between statistics recorded at the local level and statistics processed at the national level will be minimized. Implementing technologies, such as a smart pen that transmits written information directly to a database, eliminates intermediate steps in the communication chain and limits the opportunities for data to become misconstrued or falsified. Improving data collection methods would allow NGOs and governments to find more accurate trends among data and to better allocate resources during disease outbreaks.

Why is it still a problem?
Although data collection inefficiencies have always been a flawed aspect of public health infrastructure in West Africa, the problem has been brought to public attention because of the most recent EVD outbreak. During periods of chronic health conditions, concerns regarding data collection strategies are not considered a top priority. However, during times of crisis health response, governments are focused on

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[12] http://www.cdc.gov/globalhealth/healthprotection/ghsb/idsr/what/default.html
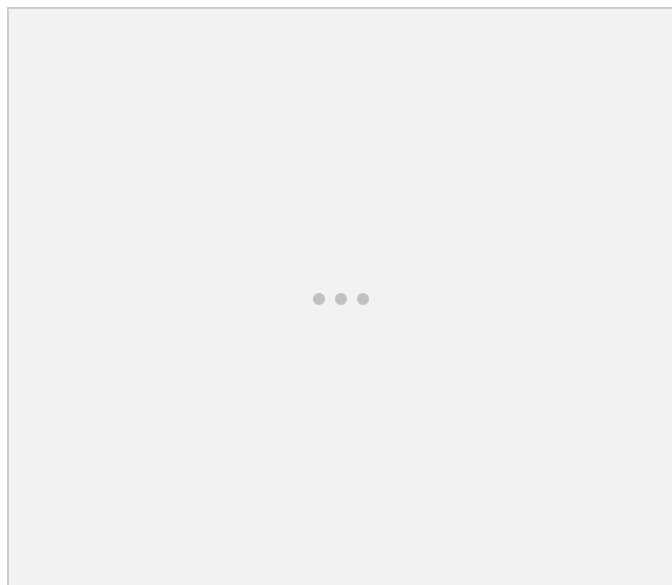[13] http://www.forbes.com/sites/benkepes/2014/08/25/magpi-helps-collect-ngo-data-one-part-of-helping-deal-with-the-ebola-crisis/
[14] http://www.forbes.com/sites/benkepes/2014/08/25/magpi-helps-collect-ngo-data-one-part-of-helping-deal-with-the-ebola-crisis/
[15] http://www.ted.com/talks/joel_selanikio_the_surprising_seeds_of_a_big_data_revolution_in_healthcare?language=en#t-5001

addressing the treatment of infectious disease rather than working to improve databasing infrastructure. Since the Disease Divas are not involved in the medical aspect of crisis health response, they are willing to commit themselves to improving data collection strategies during periods of chronic or crisis health conditions. Also, the need for comprehensive databasing is a recent demand due to the large influx in resources (food, healthcare supplies, etc.) to West Africa.[16]

The rich diversity of West African communities makes creating a "one-size-fits-all" device impossible to achieve. Implementing a particular data collection procedure that satisfies the cultural practices of each individual community can be costly and inefficient to the government and large Non-Governmental Organizations (NGOs). Because the Disease Divas are a small team, they are willing to focus on a single community as a "case study," find a solution that works for the particular community, then utilize NGOs to expand the breadth of our solution to more than a single community. Through this system, the Disease Divas can successfully marry local cultural practices with innovative technologies to improve data collection strategies.

Another obstacle that has hindered the development of efficient data collection is the lack of internet access in rural communities. Fortunately, high speed broadband is becoming more available as technology and accessibility improve.[17] Internet access allows information to be sent directly to hospitals and health ministries. A network of sixteen undersea internet cables already exists in Africa (See Figure 3), but connecting rural communities with the established infrastructure can be timely and costly.

Figure 3: Diagram of undersea internet cables in Africa[18]

However, there is benefit in improving data collection methods in communities without internet access. Data can be used so the community itself can identify local health concerns and act without the assistance of the government.

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[16]http://www.who.int/healthmetrics/documents/hmnissue_nationalsubnationalhealthinfosystems.pdf?ua=1
[17] http://www.oafrica.com/data/
[18] https://thenextweb.com/files/2011/04/west-africa-cable-systems.jpg

II. Proposed Work

Goal

The Disease Divas are looking to partner with an NGO and use one rural community in West Africa as a case study to explore current data collection methods and to research a way to balance cultural practices within the community with new technology that will improve data collection and allow for the improved allocation of resources in rural communities. We are hoping to create a device that will make it easier for rural communities to collect healthcare data and manage their own healthcare infrastructure. Success will be reached when technology is successfully implemented and used in a rural community. Another measure of success would be the amount of time it takes for healthcare data to be recorded and sent to a centralized, national database. It is our goal to reduce this time and make healthcare data more centralized and accurate. These markers of success encompass how often healthcare workers are using the technology and how well rural communities are able to respond to public health issues using the recorded data.

Objectives

OBJECTIVE ONE: Establish a partner organization.

Our first objective is to discover a willing and engaging partner organization that is connected in rural West Africa. This is an extremely critical aspect of our project because our solution is based on community feedback and healthcare workers on the ground in West Africa. Without their input, we will not be able to get a true sense of the parameters and limitations of our technology. Additionally, if our system is not user friendly, it will never be successfully implemented. A partner organization has been emphasized from day one as a necessity for all successful teams, and we feel that this is our main priority for the rest of the semester[19].

The first task is to compile a comprehensive list of all of our contacts we've made over the past few months and follow up with individuals who have not gotten back to us, or those with whom we need to move forward in our professional relationship. We will reach out to these contacts to determine if they have any connections with NGOs working in West Africa. Additionally, we will reach out to our contacts at the CDC such as Dr. David Guthrie to determine if it would be possible to work with any scientists and get their feedback. We feel that it would be much easier to start partnering with an organization which has mutual ties, versus sending a formal email. As we reach out to our contacts, we will simultaneously research what NGOs are

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[19] Dr. Rob Butera: "If you do not have a willing partner, you will fail."

currently working in the public health sector in West Africa. In our research, we will be focusing specifically on how these NGOs collect data, what communities they work with, and what value they place on building personal relationships with rural communities and leaders. From this research, we will narrow down the organizations which hold promise. Once we have compiled all NGOs we are interested in possibly partnering with, we will begin to utilize all contacts or start contacting them and gauge each organization's interest. If there is a positive response, we will request a meeting where we can sit down face to face and talk about what we are passionate about, where our skills lie, and how we may be able to make an impact in the organization's cause. From these meetings, we will discuss as a team which organization we feel is the best partner for our project.

Determining success will be as simple as having a written partnership agreement with our designated partner NGO by the beginning of Summer 2015. This agreement will outline our commitment to develop a technological solution, as well confirm our partner's willingness to work alongside us.

One of our biggest potential problems is our quickly approaching deadline. Our relationship with our partner should be organic and filled with mutual respect. It may be difficult to establish a strong relationship with a partner in such a short time frame. Additionally, it may be difficult to convey our "expertise" and earn the respect of NGOs based on our status as undergraduate freshmen. We'll have to do more work in order to appear professional and knowledgeable of our problem space. In order to earn the respect of potential partners, we will be reaching out to organizations as we complete objective two so that our research outcomes give substance to our claims and show what we have to offer.

OBJECTIVE TWO: Explore current data collection technologies to determine bottlenecks within these systems.

Our team hopes to develop a technology-based solution that will be used by healthcare workers in these communities and can easily be integrated into existing data collection practices. We are focusing on bridging the gap of transcription of medical records from paper to computer, a key break in the communication chain. The current system provides numerous opportunities for transcription errors: Ebola patients' medical information is initially recorded with pen and paper, but since these objects become contaminated with Ebola virus in the process, they cannot be transferred between treatment centers. When patients are moved, the information must be repeated orally to another healthcare worker, who writes the information down on another form. This process may be repeated several times, and only later is the information entered into a computer, and then often into an Excel spreadsheet that is emailed up the communication chain.

To combat inaccuracy and discrepancies, we are interested in pursuing smartpen and smart paper technology, for example Evernote or the Livescribe Pen, which records and stores a user's handwriting. Such technology would eliminate the middle steps of re-writing medical records by sending the information directly to a computer. In addition, the data would then be immediately entered into the system and would become available over the computer network to organizations and hospitals reporting statistics.

Figure 4. Livescribe Pen and Paper System[20]

Before we begin developing hardware, we need to complete extensive market research on different technologies which could be modified to thrive in rural developing areas in West Africa. Some of these smartpen and paper systems are beginning to be implemented in the US, and we need to determine if and how they can be modified for use in West Africa. For instance, such technology must be able to withstand dusty conditions and be able to be easily sanitized. In addition, this technology must be able to work within the capabilities of existing infrastructure in West Africa: we must consider battery life, WiFi or Bluetooth connectivity, and method of charging. When we have a comprehensive list of potential technologies and the merits, qualifications, and requirements of each, we will be able to make an informed decision about the technology we wish to develop. We plan to complete the bulk of our market research by the end of Summer 2015.

Once we've decided on a technology, we will move forward into our development phase, in which we will begin testing devices and prototyping our hardware solutions. We plan to conduct experiments on our prototypes to gain a better understanding of the limitations of the technology. Throughout the process, we will consult with hardware development experts on campus and seek their feedback regarding our technology. We have already begun to reach out to potential advisors and hope to find an advisor during Spring or Summer 2015.

After we create our first few prototypes, we would love to get feedback from communities in the field on what aspects could be improved or what ideas could be

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[20] http://boingboing.net/2009/12/10/livescribe-pulse-sma.html

implemented. We will continue this cycle of prototyping and getting feedback until we are satisfied with our final technology.

We hope to develop data collection software to accompany the hardware as well as revolutionize public health responses in rural West Africa. This software will have two main aspects: an interface and support for the hardware itself, and a pattern recognition component that can automatically detect trends.

The hardware support software will depend on the technology we decide to create. For example, a smartpen system would require handwriting recognition support, wireless transfer, and electronic form field recognition. The software interface must be easily understood by the users and therefore should transcend language barriers as much as possible.

The data analysis component is designed to act as an automatic public health system which will detect patterns in symptoms and diagnoses and prompt community leaders to respond to the issues at hand. At the heart of our project, we want to empower communities to respond to their own public health crises rather than depend solely on government or foreign aid. If local communities were able to detect Ebola Virus Disease in its early stages, it would have been much easier to control the outbreak, rather than spend time convincing communities that the threat was real and implementing government-created interventions that didn't work effectively.

As the hardware team researches different technologies, software team members will research different public health and data collection softwares already in place to determine their successes and failures. By understanding the limitations of softwares currently in existence, we will be able to create a software system that will be much more marketable to different agencies and communities. We must emphasize that while we are creating a software to accompany our hardware, we are not looking to create a data collection system to replace the plethora of systems floating around West Africa already. Rather, we hope to create a system that will directly benefit communities at the local level, not just help route information to centralized platforms at the national level. After researching the features and limitations of current data collection systems, we will meet with programming and system experts on campus to determine the best strategies for developing our software. Once we have an idea of what our system will look like, we will begin to actually code it. Along the way, we will seek input from public health officials at the CDC in order to learn what data, information, and features they would like to see in a data collection software package.

Measures of success for the hardware include if and how well the technology works. We will have to determine if the functions the technology is supposed to have are available and if they perform as they should. In addition, user-friendliness will be a critical measure of success. How intuitive is the technology? Is it something the community will want to utilize? Do healthcare workers in the community understand

how this technology works? Is the technology easy and safe to reuse? These are the kinds of questions we will have to be intentional about asking ourselves as we develop our hardware.

The success of our software will be measured by several factors. The complexity of our software will gauge our success; a more complex and holistic system will demonstrate a greater skillset, yet the interface should still be simple and easy to understand. Again, user-friendliness is critical, especially taking into account language barriers between trainers, staff, and community members. Our software should be less than or equal to the difficulty level of editing an Excel spreadsheet. Otherwise, it is unlikely to be adopted in West African data collection practices. A final metric will be to determine how accurately and precisely our software detects emerging infectious diseases, and what benefits arise as a result of the early warning.

One daunting problem is the issue of identifying technologies that currently do not have anything to do with public health for use and re-imagining them for applications in the healthcare setting. We will have to be creative about ways to use different technologies and how those technologies can be modified to thrive in rural West Africa. Another issue to tackle is developing a highly sophisticated technology with minimal engineering experience or skills. Luckily, our team has a drive to learn and discover, which will be of great use as we begin developing our own hardware and software.

The challenges we anticipate in developing hardware are related to the compatibility of our device with local infrastructure, especially possible unavailability of electricity or WiFi. Language barriers are another potential challenge in terms of training local staff to use our device. Field testing of our device prototypes will be especially useful in eliminating this issue.

The main problem we will encounter with the software will be creating a system that is similar to the numerous public health systems already in place, yet different enough to not have significant overlap by providing unique features. We want our software to serve as a bridge between communities and organizations rather than add another system. Again, we lack the programming expertise at the moment to develop this kind of software system. By utilizing campus resources and seeking knowledge, we believe we will be able to program and develop some kind of software solution. Additional challenges we will face while developing software include language barriers and local technological impediments.

OBJECTIVE THREE: Interview Atlanta hospitals and clinics to determine effective data collection strategies in U.S.

Our third and final objective is to reach out to hospitals and clinics in the Atlanta area, such as Grady Hospital and Northside Hospital at Sandy Springs, in order to

engage in a discussion with medical personnel about the current shift from paper to electronic documents in the United States. Though our project focuses on data collection in the developing world, the transition from paper to electronic medical records is a relevant trend affecting even the most modern healthcare facilities. We want to discover what challenges hospitals are currently facing as they make this technological leap, as well as what successful deployment strategies have been used to make it a smooth transition. We want to hear multiple perspectives, including emergency triage workers, nurses, doctors, and hospital administrators. We also want to survey what technologies are currently being used in different departments; for instance, certain emergency rooms have begun to use technology similar to the NextGen NextPen. By understanding the most effective data collection systems in U.S. hospitals, we will be able to modify that system for West African communities.

To begin, we will utilize our network of medical connections to begin finding contacts at local hospitals and clinics. Once we've established these contacts, we will begin interviewing employees, shadowing in different areas, and trying to identify the bottlenecks and weaknesses of the current systems. We will observe a variety of perspectives, from individual patient to overall hospital administrator, in order to gain a comprehensive understanding of the paper to electronic transition in the U.S. Once we've completed our study of local hospitals and clinics, we will analyze our findings to detect trends and identify strengths and weaknesses of the systems. We will then work to apply our new insight to the scope of West African rural communities.

Our goals are to observe three hospitals, and to hear from at least three different perspectives at each location. The quality of our research and results will determine how successful this objective is in terms of guiding the development of our data collection technology.

One of the largest obstacles with this objective is the security and confidentiality of the data we are interested in. It may be difficult, or even impossible, for us to see any patient records or to watch the information transfer between paper and electronic sources. Additionally, there are several restrictions to shadow at hospitals, and overriding these restrictions will depend on our contacts at the individual locations. Further, hospital employees may not have time to answer our questions or walk us through their experiences with evolving data collection technology.

Research Team
Our team currently will have seven members and at least one advisor. Each team member will have one of the following positions:

- Hardware Development Chair: This team member would spearhead the design of the hardware aspect of our solution. They would be responsible for design plans and the creation of a prototype.
- Hardware Development Team Member: As an assistant to the Hardware Development Chair, this team member would help research possible hardware designs and gather the necessary materials needed for this part of the solution. This team member would also be in charge of making sure the hardware is user friendly.
- Software Development Chair: This member would be responsible for the software aspect of our solution. They would be responsible for coding the software system.
- Software Development Team Member: As an assistant to the Software Development Chair, this team member would be responsible for the software's design and making sure that the software is user friendly.
- Cultural Chair: In order to make sure our solution balances technology with current cultural practices, we will need a team member to research the cultural aspects of a community. It is their responsibility to make sure our solution respects the culture of the community we are working in.
- NGO Contact: This member would be responsible for maintaining contact with the NGO we have partnered with and would complete tasks such as sending emails, scheduling meetings, and preparing presentations to give to the NGO. This job is vital for maintaining strong ties with the NGO we are working with.
- Budget and Materials Chair: This team member will be responsible for keeping up with all financial records of the group and for requesting the necessary materials for our project. They will act as the liaison between our group and Grand Challenges when our group needs financial support, such as funding for travel or other services. This job is important to make sure our group has the resources to make progress.

We have not picked an advisor for our project, but the following individuals would be excellent potential advisors:

1) Seymour Goodman - Professor Goodman teaches in both the College of Computing as well as the Sam Nunn School of International Affairs. His work is related to international developments in information technologies and the public policy issues surrounding this field. As someone who has studied computing in over 100 countries and on all seven continents, he would be able to advise our team in creating a solution for developing regions.
2) Dr. Adam Weiss - Dr. Weiss has been a strong force in the eradication of Guinea worm and has a great deal of experience with data collection in developing

countries. As a contact from the Carter Center who has worked on the ground in Africa and has found solutions for communities, Dr. Weiss would be an excellent resource and advisor for our team.

3) Ayanna Howard - As a professor in the School of Electrical and Computer Engineering, Dr. Howard's research is centered around the idea of humanized intelligence, or embedding human cognitive capability into the control path of autonomous systems. Dr. Howard's robotics expertise could help our team find a data collection system for illiterate regions in developing countries.

Timeline

By the end of the Spring 2015 semester, we hope to have created a partnership with an NGO who will connect us to a community in West Africa that will act as a case study for our group. With the help of the NGO, we will learn more about the cultural practices of a community and the problems with their current health care data collection methods. Using this information, we will be better prepared to work towards a solution.

Over the summer of 2015, we hope to begin working towards a solution based on the information we have gathered from the community we are exploring. With the resources and guidance of our NGO partner, we will look into software and hardware options that will improve methods of data collection while working with current cultural practices.

In the fall of 2015, we will finish up a prototype of our solution and begin to implement the solution within the community we have used as a case study. Ideally, our team will travel to West Africa at some point during our project to see our work in action, but the reason we are partnering with an NGO is so we have a contact on the ground in West Africa. Once the solution has been implemented in the community, we will access its strengths and weaknesses to determine what needs to be improved. Spring 2016 will be focused around improving our prototype and discovering ways to apply our solution to more communities.

Budget
- Materials and Supplies
  - Materials for hardware aspect of solution
    - Since we will be testing the effectiveness of different paper-to-digital technologies, we will need to the funding to purchase 2-3 different smart pens
      - Livescribe ~$150
      - Equil Smartpen 2 ~$170
      - Sky Wifi Smartpen ~$200

- Services
  - Software Developer
    - Hiring someone to code the software aspect of our project would allow our team to progress at a faster rate, especially because we do not have much coding experience.

III. Expected Outcomes & Future Directions

This project will result in the creation of a new technology that will make data collection easier and more feasible in rural communities within developing countries. Most rural regions in developing countries do not have strong data collection methods or proper ways to store data in a centralized database due to illiteracy or cultural practices. An improved system of collecting and storing data would make it easier for communities to see the spread of a disease and to determine where healthcare resources are needed. After 2 years, our team hopes to be able to travel to West Africa to see our technology in place within a community. By creating a solution and teaching civilians how to use our technology, we want to put data collection in the control of a community so that they are more aware of disease outbreak situations within their own community and can be better prepared. We are currently looking into small, grassroots NGOs and start-ups as a partner for funding and resources, but other large organizations such as The Carter Center and the CDC could also provide a vast amount of aid. By keeping collaborative relationships with contacts such as Adam Weiss and Margarita Gonzalez, we will receive construct feedback along the way from experts who have worked in the field and understand our problem space.

By improving data collection methods, NGOs and governments will have more accurate data and better models of the spread of a disease, which will allow them to better allocate resources to those in need and to provide more aid to rural communities. The Disease Divas plan to start in one community to implement technology and create a solution that strikes a balance with cultural practices in the region, but ultimately our team hopes to create a solution that will apply to many different populations in areas all over the world to reduce the spread of infectious diseases.

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