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Interactive Data Visualization to Improve Accessibility of Information for the Armenian EyeCare Project

An Interactive Qualifying Project Report Submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science in cooperation with the Armenian EyeCare Project

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Abstract

Our goal was to produce an interactive data visualization for the Armenian EyeCare Project (AECP) in an interactive data visualization. We created this visualization to help the sponsor effectively show its successes in a way that could be understood by three main target audiences: donors, volunteers, and patients. We also created a user manual to ensure that the AECP would be able to continue updating the visualizations with new data on their projects.

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All edits were accomplished by team members with equal contribution. We divided the sections each time we reviewed the paper so that everyone changed parts in each section and the paper was a cumulative representation of each of our edits.

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Executive Summary

Our sponsors from the Armenian EyeCare Project (AECP) expressed to our team that they felt as though the successes they have had with their various works were not easily accessible or well-known to the public. They have stated that they feel as though these accomplishments should be easily understood by a general audience, but believe that many do not have a good understanding of what the AECP does and has accomplished. In their approach to dealing with ocular health in Armenia, the AECP takes a five-point approach:

- Patient Care
- Medical Education and Training
- Public Education
- Research
- Capacity Building

The success of these five points heavily depends on the AECP's ability to share information regarding their projects. Not only did a lack of information available affect how the AECP reaches the general public, but also potential donors and volunteers. The AECP is reliant on benefactors and volunteers in order to run their program, and if they are not effectively communicating their current accomplishments, then someone considering donating or volunteering may fail to see the benefit their contribution could have.

Raw data can be difficult to understand for a person who is not an expert on the subject, and there are many studies that show humans tend to prefer visual representations of data to raw numbers (Franconeri). Therefore, the AECP wished to improve the methods by which they communicated their accomplishments to the public by utilizing visualizations of their data, specifically organizing it by geographic location into an interactive visual.

We aimed to create an appealing presentation of data that was informative to multiple specific target audiences. The medium we chose to pursue was interactive data visualization, which would be the format for our first deliverables. For the AECP, there are three main target audiences for the interactive visual to inform and attract: donors, volunteers, and those who wish to learn more about programs available. Our visuals needed to be useful to each of these groups, so we sought to determine the best way to organize and present the data we were given by the AECP. The visuals needed to be organized, easy to navigate, and effective in communicating the data itself in a way that would be appealing to the AECP's target audiences. Additionally, the visual had to be able to be kept up-to-date with the latest data that has been collected, meaning the AECP would have to make edits to the visualizations going forward. This led us to create a user manual, not only so that the AECP can keep the visuals up to date, but so that they could improve upon them or create others, as they collect more data over time.

In creating the interactive visualizations, we isolated a few main goals to focus on. First, we noted that the visualizations should have user-friendly programming, both so that we could create a product that is easy to navigate and so that it could be easily updated by the AECP. We also wanted these visualizations to simplify large amounts of data into an organized format so that users could gain a great deal of information in a concise format. Finally, we aimed to create

these visualizations in a way that would showcase the successes of the AECP to attract more donors and volunteers to the AECP as well as inform potential patients about their services.

The first part of creating the visualization was determining which visualization method to use. We used a few different categories to compare four programs: the price, ceiling of quality available, the learning curve for users, and the ease with which a product could be shared. We easily landed on Tableau, as its relatively low price, impressive visualizations, widely available education materials, and cloud-sharing capabilities made it the most attractive option for our purposes.

Once we had chosen a data visualization program, we had to organize the data we received from the AECP. With the help of our partners from the AUA, we created two different styles of spreadsheets: one for the collection of data and one for the data which would be input into Tableau. We landed on two different methods, as the collection spreadsheets were more intuitive and displayed the data in an easily understandable way, while the spreadsheets for Tableau had to align with the idiosyncrasies of the program. For each of these formats, we created three different spreadsheets of data. These were datasets for the Regional Eye Centers (REC), the school screenings, and the Mobile Eye Hospital (MEH).

With the data organized, we were able to create three different maps in Tableau. The REC and MEH data contained information on a yearly basis, which we displayed as a filter so that users could switch through the years. The REC and school screening data had consistent information on data such as the number of patients and amount of procedures done, which we created as a parameter in Tableau so that users can select which data set they wish to view. The MEH data did not have this consistency, so instead, we put the data into the Tooltip in Tableau, a dynamic text box that appears when hovering over a given region that displays all relevant data for that region. All three maps had this implemented, with the REC and school screening maps only showing data for whichever filter was selected. For these two visualizations, we also included tables that sat beside the maps to summarize the data being displayed. Meanwhile, the MEH visualization included a table to summarize the visits per region in the filtered year being shown, which also functioned as a list of all regions visited by the MEH that year. The REC and MEH maps also contained icons with embedded links to pages on the AECP website that would take the user to the relevant page in a new browser tab. All of these decisions were made based on what information we had available to us in the data received from the AECP.

As we worked on these maps, we also created a user manual for the AECP. Our goal with the manual was to make it so that the AECP could continue to update these visualizations with new data as it is collected. We also included information on how to create their own visualizations so that they may create new ones if they are to collect more data on a new project. The user manual also explained how the AECP could create a Tableau account and how they could embed the visualizations into their website. We also provided template spreadsheets for their data so that the AECP would be keeping their records in a more organized fashion, as well as giving recommendations for data to collect in the future.

Introduction

The method by which data are presented to the general public is essential in the public's understanding of the concepts. The AECP had a lot of informative data on its website but it was under-utilized and difficult to access, as users had to click through many separate tabs in order to learn about different aspects of the program and there was no easily accessible summary of the AECP's efforts. It was important that these data were made more accessible so that the AECP could continue to attract donors and volunteers that are foundational to their success. It also could help patients to understand how much work this project has done.

The overall goal of the AECP is to promote eye health in Armenia. A big part of the issue was that there were not enough resources available online that were not complicated and difficult to understand. Especially on the Internet, users are accustomed to streamlined websites with easily digestible presentations of data. If people cannot understand exactly how to find the information they need on the website, the information is generally rendered useless. Since the AECP relies heavily on donations and volunteers, we recognized that it was extremely important that these users receive information to show how their contributions would create positive change. Additionally, potential patients in Armenia would be able to easily access information about the programs that may be of use to them. It was important that their stories and data could get to people with the means to donate time or money, which is exactly what the interactive visual was intended for.

In order to make these data easily accessible and comprehensible to the public, the AECP was looking for an eye-catching and easy-to-use way of displaying its findings, stories, and knowledge. They decided on interactive visuals to simplify the large amount of data they have collected into something a user can quickly understand. With a striking and simple infographic, users were much more likely to have an easy time finding information. The visual was created with the users in mind, its sole purpose being to help them find what they are looking for and lead them to action, whether it is donating, volunteering, getting educated, or seeking medical help.

Background

Armenia has long experienced political turmoil that has taken a massive toll on the health of its people. Since 1988, Armenia and its neighbor Azerbaijan have been engaged in conflict over control of the Nagorno-Karabakh region. Both countries gained independence from the Soviet Union three years later, which escalated these conflicts until they declared a cease-fire in 1994. This conflict reopened in the second Nagorno-Karabakh War, taking place from September to November 2020. Throughout these wars as well as recurring earthquakes and droughts, Armenia's infrastructure has suffered, particularly in the field of healthcare ("Explore all countries- Armenia").

In 1992 the Armenian Minister of Health, Ararat Mkrtchyan, sent a call out to the world to "help us fight the growing wave of blindness" (The Armenian EyeCare Project- "History"). Not long after hearing this plea, ophthalmologist Dr. Roger Ohanesian from Laguna Beach California was on a plane to Armenia with thousands of dollars' worth of supplies. After witnessing the poor condition of eye care in the country firsthand, he was inspired to create the Armenian EyeCare Project.

The most common ocular conditions seen in Armenia and treated by the AECP include cataracts, glaucoma, macular degeneration, diabetic eye disease, refractive disorders, and trauma-related conditions.

Cataracts are not rare amongst older demographics, with over 75% of people over 65 experiencing them in some form, rising to 90% for those over the age of 75. Cataracts are clouding of the lens of the eye, which can lead to loss of vision (The Armenian EyeCare Project- "Cataracts"). In Armenia, this is the leading cause of blindness and can occur as a part of aging, trauma, or inflammation. The only path of treatment for cataracts is surgery involving the removal of the clouded lens and the insertion of a new plastic one. Eyeglasses and contact lenses can help those without access to this procedure, but they come with their own sets of difficulties and limitations (U.S. Department of Health and Human Services- "Cataracts"). These options are all expensive and require facilities, doctors, and equipment to treat.

Glaucoma is another primary cause of blindness in Armenia, occurring when the optic nerve is damaged, often due to built-up fluid in the eye. Primary risk factors for glaucoma include age, family history, or a history of diabetes, inflammation, or trauma to the eye (U.S. Department of Health and Human Services- "Glaucoma"). It is worth noting that glaucoma occurs at a much higher rate in children in Armenia than in other countries (The Armenian EyeCare Project- "Glaucoma"). Again, treatments for this condition are often expensive, including medicine to reduce pressure in the eye, laser treatment, and eventually, surgery.

Diabetic retinopathy is a leading cause of blindness that affects children in Armenia at higher rates than in other countries. It affects the retina, which allows light into the eye. Some of the symptoms of this disease are not present until later stages, making it difficult to diagnose and important that regular screenings take place. If caught in its early stages, a patient can treat their retinopathy with simple diet changes. If the condition has advanced, costly treatments such as laser surgeries are often required (The Armenian EyeCare Project- "Diabetic Eye Disease").

Macular Degeneration is another blindness-causing condition that often flies under the radar, as it causes no pain and may progress slowly. The macula is responsible for converting light into electrical impulses. If the macula degenerates, then the impulses cannot be sent to the brain. This is another condition that can be treated in the early stages with certain supplements like Vitamin C and E, beta carotene, and zinc. However, similar to the previously mentioned ocular conditions, if treatment is delayed, surgery may become the only option (The Armenian EyeCare Project- "Macular Degeneration").

Refractive Disorders is the all-encompassing term for common vision problems which do not cause blindness. They primarily occur as a result of irregular curvature of the cornea, which results in refractive errors that show up as near-sightedness, far-sightedness, or astigmatisms. These conditions can be corrected with glasses, contact lenses or, in severe cases, refractive surgery. Importantly, patients are treated to specific degrees corresponding to their condition's severity, therefore requiring a specific and accurate diagnosis (The Armenian EyeCare Project- "Refractive Disorders").

Most **Eye-related Traumas** that occur in Armenia are preventable, according to the Armenian EyeCare Project. They primarily occur as a result of household accidents, to which children are particularly susceptible to. Other common causes of these traumas include fireworks and sports-related injuries. Preventative education, surgery, and treatments to mitigate the damage done by trauma are the main ways to avoid and treat these traumas (The Armenian EyeCare Project- "FAQ").

With these conditions as the basis of most eye care treatments in Armenia, the AECP's overarching goal is to provide eye care to all Armenians who need it. As stated above, ocular health has troubled Armenia for years and the AECP is set on continuously making improvements. Their plan is to take a proactive approach to reduce the rampant eye disease that is present in their country. In their approach, the AECP uses a five-point system to properly cover the crucial aspects of eye care provision.

Through the five-point system, this organization seeks to educate Armenians on eye care and provide them with sufficient medical care. Their five goals are Patient Care, Medical Education and Training, Public Education, Research, and Capacity Building. In this system, **Patient Care** is a group of programs that are run for people in need of medical assistance. Some examples of these programs are prosthetic eye programs, eyeglass programs, and the Mobile Eye Hospital program (The Armenian EyeCare Project- "Patient Care").

The **Medical Education and Training** point of the system is the cornerstone of the AECP. Originally, U.S. doctors came to Armenia for medical missions, primarily consisting of on-site patient work. Eventually, these doctors began to offer advanced training for Armenian medical staff, and together they established a number of programs for Armenian doctors. Some programs include training for neonatal nurses and family physicians. These programs target the needs based on the pressing conditions that the AECP treats, as stated above (The Armenian EyeCare Project- "Medical Education and Training").

Public Education is another key component, utilizing a country-wide public education and awareness approach. This point educates the overall public, targeting education on specific groups like infants, children, people with diabetes, and older citizens. Since blindness is often preventable if the cause is identified early, this program is focused on being proactive and informing citizens about the importance of eye health. Through country-wide education, the Armenian EyeCare Program has handed out over 800,000 educational materials and visited over 400 schools. To further their reach, the AECP wrote a book in 2017 called "Desunik's Game of Sight," which gives aims to give children a basic understanding of the inner workings of the eye and the proper care it needs. They also campaign on World Sight Day, organizing activities across Armenia (The Armenian EyeCare Project- "Public Education").

The next point of the system that drives all of the programs is **Research**. Employing epidemiology, the study of health and disease in defined populations, the AECP has been researching the extent of visual impairment and eye disease in Armenia. The target of this research is to identify specific aspects of the data. For example, if there are any patterns in the disease, identifying risk factors, or evaluating the effectiveness of certain preventative measures. The AECP has been monitoring and evaluating data for a good portion of time and has been able to really impact epidemiological research in Armenia (The Armenian EyeCare Project- "Research").

The fifth and final point in the Five-Point System is **Capacity Building**, which involves creating an arrangement where medical professionals can deliver proper eye care to the public. This means making sure that these professionals have the means to do so, including material, financial, and human resources. Through Capacity Building, the AECP has built five Regional Eye Centers throughout Armenia, as well as a number of specialty centers in Yerevan (The Armenian EyeCare Project- "Capacity Building").

Another way that the AECP has increased capacity is through their Mobile Eye Hospital. This Mobile Hospital is described as "a fully functional surgical suite on wheels." It increases accessibility to eyecare for those in more remote locations by bringing the facilities right to their doorstep. Through this hospital, the AECP is able to provide basic eye care, annual screenings, eyeglasses, and a variety of different procedures to people who previously would not have had access (The Armenian EyeCare Project- "Mobile Eye Hospital).

In order to support these programs, the AECP operates by utilizing donations and volunteers. In total, around $60 million dollars have been donated since its founding, which has had an incredible influence on its ability to impact the communities it serves. There are many avenues for making donations to the AECP. These donations concretely improve the lives of those they are targeted at

There are a number of different ways to donate to help the AECP achieve its goals. They have options for one-time donation or monthly donations, which they call the "Partner in Hope" option. One-time donations include the "adopt a village" program or sending "gifts" in the form of paying for a specific surgery or a doctor's education. This leads to the other primary method in which the AECP is able to operate: volunteer support. There are many positions available for volunteers. The Medical Missions program specifies a search for photographers, filmmakers, and

writers to help publicize the AECP's efforts. There are also Administrative Internships and Medical Observerships available for those who wish to volunteer their time.

To achieve its overall goal of improving Armenian ocular health, the AECP has had different projects that have been able to help a lot of people. The biggest project is the Five for Five Campaign. As stated before, one of the reasons that blindness has been pervasive in this country for so long is because they do not have the resources to combat diseases that impair vision in the poorer locations in the country. This is a big part of the **Capacity Building** aspect of the AECP Five-Point System. At the request of the Minister of Health, the AECP has been tasked with building five regional eye clinics in Ijevan, Gyumri, Vanadzor, Kapan, and Yeghegnadzor (The Armenian EyeCare Project- "Five Point System"). This affords resources and professionals to these clinics that can provide medical treatment as well as educate the residents. The project was estimated to cost five million dollars and the projected length to instate it was five years, hence the name. It has had a massive impact as many Armenians are unable to travel to Yerevan to get treatment and the Mobile Eye Hospital can only come to each village every two years.

When it comes to expanding and improving their program, it is important that the AECP continues to raise funds in donations. In their most recently released financial statement from 2019, 67.25% of the AECP revenue came from the categories of "Donations" and "Donations in-kind." In 2018, those two categories made up 87.54% of revenue (Financial Statements, Years Ended December 31, 2019, and 2018). Based on those numbers, it is clear that the AECP relies heavily on donations for funding its program. With any donor-funded program such as this, attracting new donors is always imperative, but the AECP members had a more specific issue they sought to address. When meeting with them, they seemed confident that what they have accomplished and what they do now *should* be very clear and easy to understand, and if potential donors had a better understanding of their results, they would certainly be interested in contributing. However, something has seemed to not be translating when it comes to communication with the AECP's target audience, leading them to believe their public awareness is not as high as it ought to be. The issue here, they believe, is rooted in a lack of successful communication of the data they have collected across their various eyecare ventures, and they seek to address this issue via the use of a more accessible format.

Some formats of data are more accessible than others. Visuals are a highly accessible format for sharing data as they don't rely heavily on a user's ability to read and comprehend complex information. Different types of visuals come with their own benefits. Maps generally serve the purpose of displaying community data across a region in a visually digestible format. They can be used to show how various communities are affected, exhibit the reach of a program, and emphasize the relationship between a program and the region it serves. Maps can also be made interactive in a number of ways. One of the most common methods is adding various filters to narrow down the scope of information presented to improve accessibility to a variety of users, while another is adding the ability to select a specific area on a map to show more specific data from a particular region. Any such method goes towards not only making the map more engaging to a viewer but also serving to avoid cluttered and overwhelming visuals that detract from the efficacy of the map.

In order to fulfill this need for improved communication of the AECP's success, we focused on helping them gain outreach through their website using an interactive visual that is easy for different audiences to understand. The aforementioned visual will allow potential donors to understand what they are donating to and where their money will go. It will also help people in Armenia find places to receive eye care and learn about the AECP in an easy way. We created filters so the user can be specific in what they are looking for and not get overwhelmed with all of the information available. The visualization will be user-friendly and follow many heuristics, which are rules to follow when constructing any sort of user interface. The main goal here was to afford ease of use and increase visual appeal.

Methodology

The goal of our project was to improve the Armenian EyeCare Project's (AECP) communication of its successes to three target audiences: potential patients, donors, and volunteers. We reached this goal by producing interactive data visualizations that detail the AECP's most important projects and their ongoing successes. With input from the sponsors, we created three adaptable interactive visualizations based on best practices for visual representations of data. There were three main objectives relating to the goal of creating these visualizations. In order to be effective, they had to be:

1. Informative to each of the aforementioned target audiences.
2. Visually pleasing and digestible.
3. Easily transferable for the sponsor to continuously update with new information.

Objective 1. The visualizations had to be informative to each of the target audiences.

We began this objective with thorough background research to understand Armenian history and the context that it created for our project. Research was conducted to learn more about Armenian history and the effect that wars and natural disasters have had on healthcare and infrastructure in the country. This research also included searching through the Armenian EyeCare Project's website to learn about the project's origins and the programs that they currently employ. This foundational research was important to our understanding of the sponsor's goals and the AECP website's target audience.

Once the background research was completed, we were able to confirm the main target for the visualizations that would be most helpful for the AECP. The three audiences were potential patients, donors, and volunteers. This was done by conducting multiple interviews with our sponsor. These interviews allowed us to understand where the gaps in the information being conveyed were within their website. With this, we established the main objective of each visualization. We discussed the sponsor's goals and concerns during these conversations, with the ultimate objective of aligning our vision with theirs. This project was a combination of both our efforts and those of the AECP team as we worked together to figure out the best deliverable possible. These interviews were semi-structured utilizing an agenda while asking more open-ended questions so that we could get a broader opinion from the sponsors. Our sponsor also provided us with some examples of different visualizations so that we can learn different aspects they either favored or disliked.

The research and sponsor meetings were key in identifying who the main targets of the visualizations were and determining what data were necessary to display. We also researched how to attract donors or volunteers through websites and what information was good to include. This allowed us to understand the user side of the project and angle our visualizations to impress potential donors or volunteers.

Objective 2. The visualizations had to be visually pleasing and digestible for each of the target audiences.

In order to reach each of the target audiences specified, it was important that the information be presented in a way that can be understood by users of various levels of prior knowledge and technical abilities. The identified target audiences ranged from lay people with no knowledge of eyecare to highly trained professionals who have studied ophthalmology for years. Therefore, it was important to keep adaptability and simplicity in mind with regard to what data visualization program would be best suited for this project.

To determine the desired technical abilities of the visualization program we would use, we requested that the sponsors send us examples of interactive data visualizations which they felt were sufficient examples of the type of visualization they were looking for. We also searched on popular data-visualization websites in order to find examples that were in line with our final goal. We looked at the different programs that were used to create each of these visualizations in order to generate a list of possible data visualization tools.

Once this list was generated, we further searched through the visualization examples produced with these programs to determine the design capabilities of each in order to determine what technical abilities they had to offer. We presented our findings to the sponsor in order to understand what aspects appealed to them in order to ultimately choose a data visualization program.

After choosing the data visualization program that could offer us the most visually pleasing and digestible format, we proceeded to work on organizing the data received from the sponsor in a way that would also contribute to this objective. When we received the data, there were many spreadsheets and pages and it was an overwhelming amount of information, so we sought advice from Monelle Verdolino, WPI's Director for Data Visualization and Analytics, on the best methods of organization for such information. The data visualization program we chose also included methods of data organization, and we utilized their free e-learning site to gain more information on how to use this function. We also received assistance from the students who joined our project from the American University of Armenia: Nane Sargsyan and Aidin Turganbekov. They were taking a course on statistics in humanities, and using this knowledge, they were able to restructure this data into a format that was usable by more clearly organizing the data by locations and years. They also aided with the translation of the data from the AECP, as some of what we were given was not entirely in English.

Due to how widespread the datasets we received were, we decided to make a number of different visualizations rather than one large one as originally intended. One significant factor in that decision was to make the visuals as effective as possible in communicating to the AECP's target audiences. We considered what a visualization of *all* of their data would look like, and decided there would be too much going on for a layperson to be able to easily or quickly figure out what they were looking at. Additionally, certain parts of the data we were provided covered different information and it would be difficult to express multiple sets on the same visual with any sort of coherence. Similarly, with the Mobile Eye Hospital (MEH) data we were provided, we had different priorities in presenting it than for the REC data. For the RECs, we wanted to

place emphasis on how each center has served the given region and improved health over the time they have been established. With the MEH data, due to it being mobile by nature, it was constantly moving locations, so we wished to emphasize the breadth of locations it has served over time, rather than how staying in one place has helped improve the state of health in one given place. Therefore, we decided the data sets would be better communicated if separately.

Objective 3. The visualizations had to be easily transferable to the sponsor as well as able to continuously be updated with new information.

The degree of the sponsor's ease in transferring and updating our visualizations relied heavily on our choice of interface for visualizing the data. Due to the wide variety of options, we initially centered on narrowing down our selection and evaluating the various benefits and drawbacks of different data visualization applications. For this, we communicated the pros and cons of each option with our sponsor and saw how they met their needs. The primary elements we looked for were price, learning curve, and implementation.

While price did not affect the sponsor's experience with the program as much as the other elements here, the budget for our project and what would need to be spent on a given project could not be ignored. Even if a program was perfect for all other needs of this project, if it was out of the project's budget, then it was not an option. We obtained as much price information as was publicly available from each software's website and presented these options to our sponsors, both in USD and AMD, to get their input on any potential budgetary concerns that may arise.

Any program we utilized would be new to us as well as our sponsors. Therefore, the learning curve associated with the program was important to note. To effectively write a user manual that would allow our sponsors to be self-sufficient moving forwards, it was not enough for us to merely be proficient enough to create a visual. We had to become experts in the software of our choosing, and the difficulty of this would vary based on the program selected. Additionally, if a program of our choice was notably challenging, then our sponsors may have had trouble using it even with our user manual. One primary element to this sense of difficulty was the quantity of documentation available for a given software. The more prominent a program was, the more instructional documents and online tutorials there would be for learning how to use it, which would be invaluable to our self-led education on the matter. Learning a new software quickly required utilizing all tools and documents made available to us, and not all software would have an equal number of available tools or documents. Additionally, we looked into WPI-based resources that we may have benefited from, such as any user groups or professors able to assist us in learning our software.

An effective deliverable for this project was one that the sponsor could implement into their own site, for which we produced a user manual. Regarding this, some software is easier than others to implement, and so our choice of software involved ensuring the implementation went as smoothly as possible. Additionally, some software programs offer cloud services that would make it easier for our sponsors to keep the data up to date. This way, the data would be stored online separate from the visualization's own code, and it would allow the sponsors to be able to simply update the form with new data without having to delve into the complexities of the software itself.

As mentioned above, the final deliverable of this project was not just our data visualizations. We have also written a user manual to assist the sponsors in continuing to utilize and update these visuals going forward into the future. In creating this user manual, we created a series of videos to supplement this manual and assist in the explanation of how these products were created. The creation of the manual and videos involved a number of techniques, the primary one being to continuously take notes as we studied our chosen program and designed the visuals. We tracked our thought process so that we could return to make the manual, seeking to maximize its digestibility to a layperson with little to no prerequisite knowledge in data visualization. Another method we utilized in preparation was conducting more background research. We referred to user manuals and literature for our chosen program and researched other comparable user manuals that were designed for inexperienced users. Aspects included a brief background information on the program, data organization, how to add, remove, and edit features of the visual, and how the different filters work.

Results

Our first goal was to produce interactive visualizations in the form of a map of Armenia displaying a wide array of data provided by the AECP, using filters and other available functions that would display a wide variety of information to viewers. *The Science of Visual Data Communication: What Works*, an in-depth study of the impacts that various mapping techniques can have in the creation of data visuals, outlines how an effective visualization can "leverage the human visual system's massive processing power, allowing rapid foraging through patterns in data and intuitive communication of those patterns to other viewers"(Franconeri). Data are often complex and, if poorly presented, can be inaccessible. The average person may have trouble immediately understanding the raw data collected by the AECP. The ability to accurately and simply display complexity in communication is significantly higher with visuals than with other formats of data, and the AECP sought to utilize this fact to improve their presentation for donors and to help educate the general public of Armenia on their projects.

We explored a number of options when it comes to data visualization tools, but we had to narrow the options down to a few selections for review. The first, and arguably best known, option was **ArcGIS**, often cited as the industry standard for creating a Geographic Information System (GIS). Initially released in 1999, ArcGIS is a software suite that specializes in geographic data representations and cartography. The main benefit that would have come with using ArcGIS was that there are an abundance of reference materials and accessible information regarding learning and using the program, as a result of its longstanding prominence in the industry. Additionally, the scale on which ArcGIS operates means that it would likely be the most reliable option with the highest quality ceiling for our results. However, there were also a few issues with it as an option, the most prominent being its price. Just a basic account with ArcGIS Pro will cost $700/year (ArcGIS Online) which is a higher price than most other comparable software on the market, especially considering it was the lowest tier level offered. Another issue would be that it is only currently available for use on Windows operating systems (ArcGIS Online), and we use MacOS devices. This issue didn't eliminate ArcGIS as an option, but choosing a program able to run natively on the computers we own would save time and work for us all.

Another option we explored was **Leaflet**, an open-source JavaScript library specifically designed for the creation of interactive maps. The open-source nature of this program meant that it would be usable at no cost, which would be a significant benefit to the sponsor. A JavaScript-based language would also give an advantage in the learning process, as it is one we were more familiar with than that of ArcGIS. Additionally, something that was highly important to this project was the accessibility of our deliverable when it came to handing it off to our sponsors. If this project was to be a success, then our sponsors needed to be able to effectively implement and continuously update the visual. It is not unreasonable to assume that it would be easier to embed a visual created within a specialized JavaScript library into the sponsor's website than it would be for a more specialized format like those produced by some other programs. Leaflet is designed for map-making, which would have limited the options for visualization styles. The AECP mentioned having looked into some other interactive maps and found most of them to be visually unappealing, so we knew they had a high expectation of quality. And having looked at various visualizations created with Leaflet, it appeared to have a much more limited

scope of visualization capability for the type of visuals we sought to create than our other options.

The final options we explored were **Tableau** and **CARTO**. Both companies specialize in data visualization, with products that concentrateoin mapping spatial data and have an emphasis on utilizing cloud servers to simplify the management and usage of data. Both of these options seemed comparable to ArcGIS in terms of what the programs are capable of, and seemed to be more streamlined for our sponsors to update their data in the future. Additionally, both options, especially Tableau, offered a much wider variety of visualization tools and options than any other program we looked at. If our sponsors wanted our final product to be any data graphic other than a map, Tableau had a clear advantage. Tableau had options that were cheaper than ArcGIS, while CARTO was between the two (Tableau, CARTO).

After looking into all of these options, we presented the options to our sponsors in a slideshow. After discussing, we agreed with the sponsor that Tableau seemed to be the best option for the quality we hoped to create while keeping the price within a reasonable range. Along with these factors, Tableau's cloud-based infrastructure would allow for easy updates to the final visual (so that our sponsors would not need to be experts to keep the data current), and had a variety of options for visualization style. Interactive map creation was certainly one of the primary selling points for the software, but it could also be used to make other types of data visualizations.

Objective 1. The visualizations had to be informative to each of the target audiences.

In order to make a deliverable that was usable and helpful to our sponsors we had to identify what audiences we needed to target. In order to do this, we researched the AECP and identified the main purposes behind their website. The website is primarily for communicating information and we were able to divide their target audiences into three groups: Patients, donors, and volunteers. Patients go to the website to search for information containing the locations of the eye hospitals, information about what and where treatments are available, and much more. Donors are primarily looking for the many ways they can donate money in order to help. We also wanted to convince people to donate using our visualization by communicating the success the AECP has had. Volunteers are looking for different ways to participate in AECP events, and we similarly wanted to compel more people to volunteer for the AECP by displaying their impact.

Once the target audiences were determined, we researched the most practical methods to display different information to the specific users. The donors and volunteers should be targeted by showing the impact in a visual way in order to persuade them to give the AECP their time and money. This would allow them to see the positive change that they would be able to make within the organization. We provided this change through time-based data so you can go through the years and understand how the AECP has impacted Armenia.

The research provided more insight into what these audiences want to see, so then we had to organize the data to make sure that we were following the methods previously learned. We made sure that we displayed important data that shows the influence of the organization as well as all the necessary locations and treatments available.

Objective 2. The visualizations had to be visually pleasing and digestible for each of the target audiences.

One of the primary reasons for choosing Tableau was the variety of visualization style and options and the level of quality available with the program. In order to create the final visuals, we had to organize the data in a way that it could be input in Tableau. Our partners from the AUA (Nane Sargsyan, Aidin Turganbekov, and professor Dmitriy Kha) helped by organizing the data received from the AECP in order to be used in this way and in a way that could be relevant to their class, Statistics for Humanities. The first dataset we received from these students was the number of patients, visits, laser procedures, and surgery procedures accomplished by each of the five Regional Eye Centers from 2016 to 2021.

As we imported the data into Tableau and learned how to utilize its different functions, we realized that the data needed to be organized in a different fashion to function properly. We met with Monelle Verdolino, the director for Data Visualization and Analytics WPI, and she taught us about the ways that we could organize the data in order for it to be most useful in Tableau. One of the most helpful tips she provided was that data were most easily accepted into the program if they were vertically oriented while ours were horizontal at that time. Rather than repeating each category being counted for different years in the columns, and Eye Centers in the rows, we switched to having categories only once in columns, while the Eye Centers were repeated with different years in the rows. She also informed us that data represented as the letter Xs would not be accepted by Tableau, and that if we needed to have a null data point, we had to leave the cell blank instead. The updated figures can be seen in Appendix B.

We relayed this information to the AUA students so that they could help organize the remaining data in this fashion. With these data organized, we were able to create other maps in similar fashions for the Mobile Eye Hospital and school screenings. The primary difference was that the school screenings map did not include any temporal element to the data, so there was no filter based on year as we see on the other two maps.

Objective 3. The visualizations had to be easily transferable to the sponsor as well as able to continuously be updated with new information.

The initial step in tackling this objective was choosing a program to create our data visualization. As mentioned before, we opted to use Tableau for this project, and our third objective played a significant role in this decision. Tableau offers cloud service functionality, making the process of uploading and visualizing additional data streamlined. Additionally, we were first introduced to Tableau as a program by our peers, and ID 2050 professors both recommended it, specifically emphasizing how easy it was to use. Ideally, the process of updating the visuals with new data should be as easy as possible for our sponsors, and both of these factors indicated that would be the case for Tableau.

Within our visuals in Tableau, we made design choices with the intent of making things as straightforward as possible for our sponsors to work with. In Tableau, updating visuals with new data is as simple as updating the connected spreadsheet and clicking the refresh button, but often there are additional steps to fully incorporate new data into the visual. We looked to make

the process for our sponsors as close as possible to simply just updating data and refreshing. One significant part of this is in our reorganization of data, pivoting to a vertical structure as recommended by Monelle Verdolino. This structure is somewhat harder to immediately read as data compared to how it was before, but the design is set up in a way that minimizes the effort it will take to get the data into Tableau. Additionally, we made a number of elements within the visuals, such as the region surrounding each REC, based on information from the data itself, which serves two purposes. The first is making it easier for new data inserted by the sponsor to visually fit into the map without any additional steps (so long as it contains whatever field the visual element is based on). The second is that it strengthens the visuals as well, allowing a viewer to parse data comparisons immediately without needing to look at the numbers but by just quickly surveying the visual.

Additionally, we wrote a user manual to guide our sponsors through each of the processes we completed during this project in Tableau. First and foremost, we provided information on Tableau itself, as they need to have their own account and maintain their subscription after the project. We then covered how to organize the data, in general, as well as specifically for Tableau. From there, we covered loading the data sets into Tableau and the creation of data visuals, being sure to cover what we did to create ours. We also included videos that explain the steps in a visual way that might be easier to comprehend for some of the more complex parts. In these videos, it is important to be as thorough as possible so that the sponsors have our manual and videos as a key resource. Next, we ran through the process of updating their visualizations with new data. Finally, we walked them through the process of connecting the visuals to their website. We created this user manual and the videos by taking notes throughout our learning process with Tableau so that they know exactly what to do and where to do it within the program. We reviewed this manual with our sponsors as well as our advisors to ensure it is easy to follow along with and does not have any significant gaps in information or leave questions they would need answered. These videos and manuals are in a separate supplementary document that we sent to the AECP.

Visualizations: Where we implemented the three objectives to create the deliverables.

The first visualization we created covered the work of the Regional Eye Center (REC) (Figure 1). This visualization contained a filter for the year of data being displayed, and a parameter to allow the user to select which data set is being shown. In Figure 1, the year displayed is 2021 and the data parameter is set to "Visits". The bottom left chart shows a summary of the data being currently displayed. The title is also dynamic, clarifying what exactly is being shown on the map, along with instructions for use. A user can hover over a region to see the tooltip displayed, a dynamic text box which shows all relevant data for the associated region. Each AECP icon is placed on the city where the center is located, and clicking on them will take a user to the page on the AECP website that contains details about this REC.

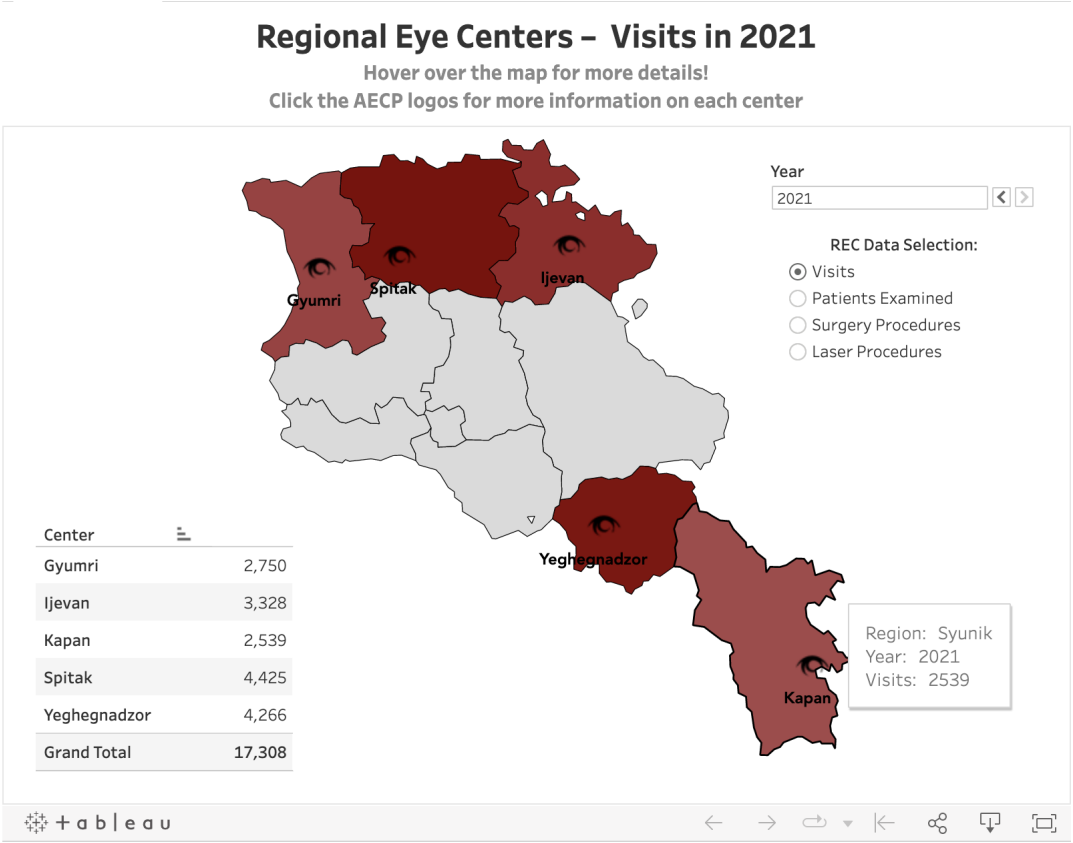

Figure 1. Regional Eye Center Visualization

Figure 2 displays the data for the school screening program run by the AECP. This dataset did not contain any information associated with year, so the only dynamic data for the user to select is the data set parameter. Again, the user can select which dataset to view in the top right corner and there is a chart in the bottom left summarizing what is being displayed, and the tooltip shows relevant data for the region being hovered over.

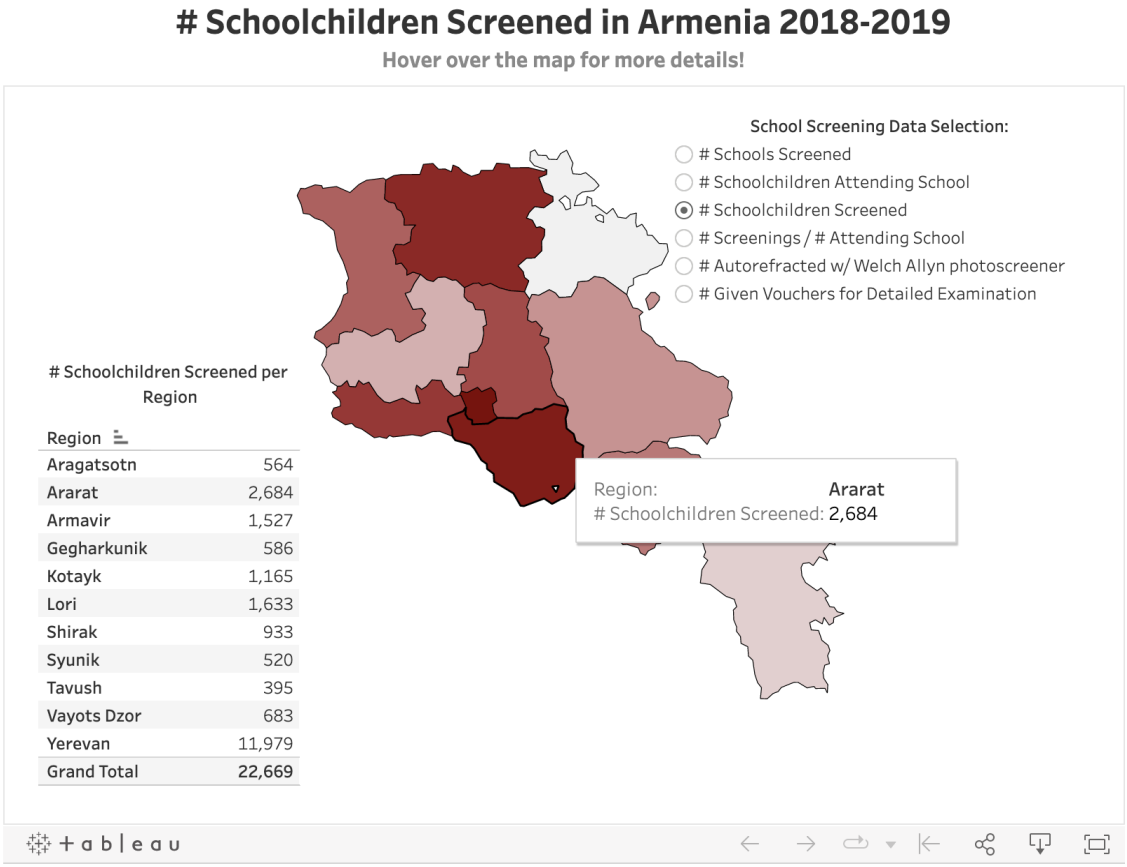

Figure 2. School Screening Visualization

The third visualization we created displays data for the Mobile Eye Hospital (Figure 3). This visualization contains a filter in which the user can select which year to observe. The chart in the bottom left shows a summary of the patients screened in each region for that year. Users can hover over the region for the tooltip to display all available collected data in that region, such as how many surgeries or laser procedures were done in that region in that year. There are also icon on the map, representing patient stories in their given region and, like in the REC map, there are embedded URLs which will take them to a webpage on the AECP website with a personal story from those who have been personally affected by the works of the AECP.

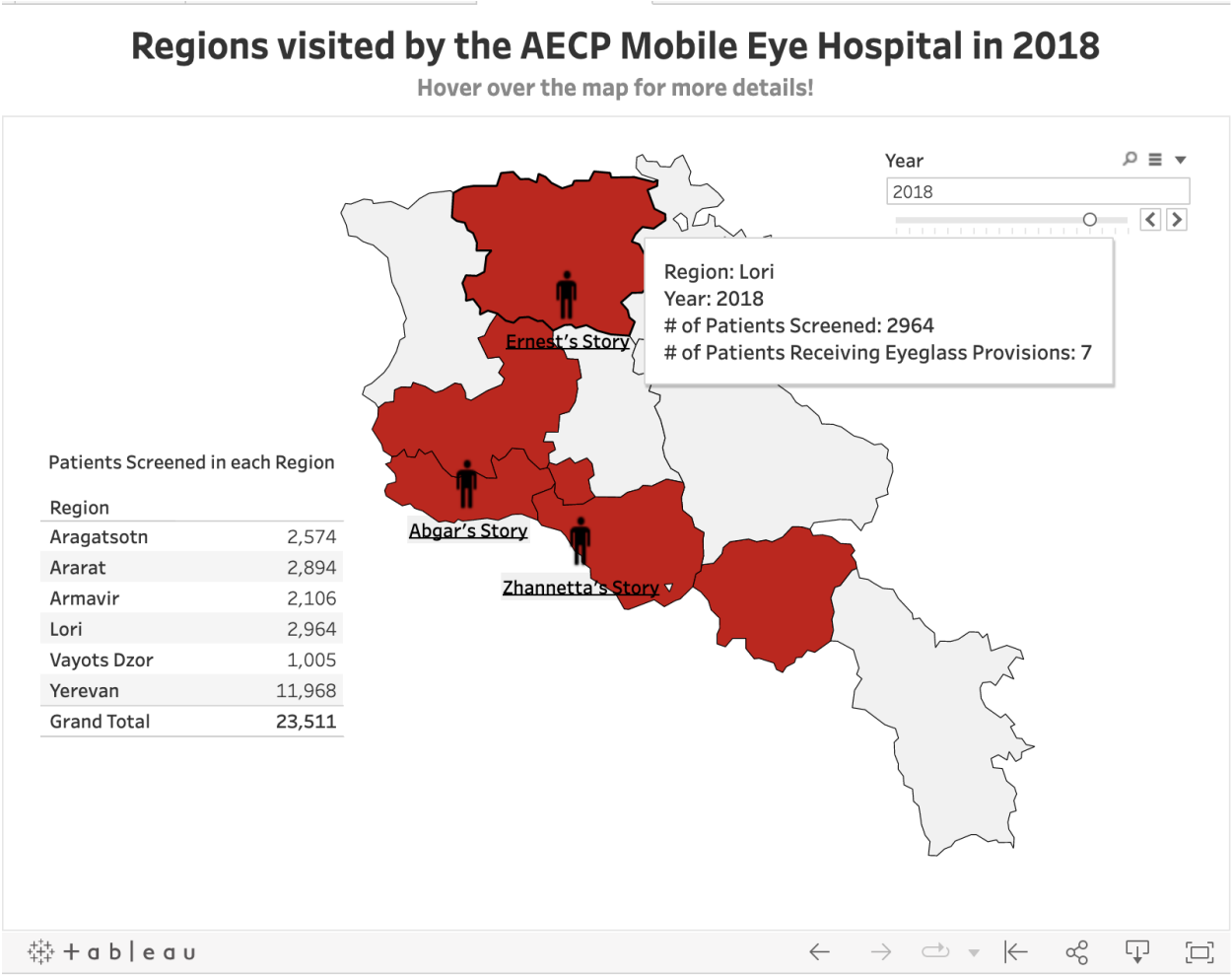

Figure 3. Mobile Eye Hospital Visualization

Overall, we have created three interactive data visualizations in order to display the AECP's impact on Armenia. This project has developed a new method to showcase this information and with this new method, our group has formed a few recommendations for the AECP moving forward.

Recommendations

One of the most important stages of the methods utilized to create these visuals was the re-organization of data provided by the AECP. For this reason, we recommend that the AECP alters the organization of the data collected. Tableau requires data to be in a specific format in order for all of the functionalities to be usable. This method of organization is not very intuitive or clear to look at, so we recommend that the data be collected into one spreadsheet and when the time comes to enter it into Tableau, copied into the Tableau-specific spreadsheet.

With the help of our partners from the AUA, we reorganized the data into two spreadsheet styles (Figure 4 and Figure 5). The Regional Eye Centers (REC), Mobile Eye Hospital (MEH), and School Screenings data sets all contain different data. The REC and MEH data followed their works throughout the years; meanwhile, all three sets of data tracked the locations in which the programs have been offered. The Mobile Eye Hospital was unique in that it travels to different locations, so the temporal and geographical data are tied together. All of these factors play into how the data collection should be organized and how it had to be reorganized to input in Tableau.

We created new spreadsheets for data collection, which contain the original data we were sent by our sponsors. Therefore, our recommendation for how the AECP should organize their data would be very simple for them to follow successfully, as they will possess a template into which to input any new data they collect. The students we worked with from the AUA were part of a class in which they studied statistics for humanities, which was quite helpful in determining which categories should be looked at in these organized sets of data. The first example we utilized was for the Regional Eye Centers, which can be seen in Figure 4.

Eyecare Center	Patients Examined	Patient Visits	Surgery Procedures	Surgery Patients	Laser Procedures	Laser Patients
	2016					
Spitak	460	1198	240	238	20	12
Ijevan	590	1206	226	192	30	20
Kapan						
Gyumri						
Yeghegnadzor						
Total:	**1050**	**2404**	**466**	**430**	**50**	**32**
	2017					
Spitak	630	1938	473	418	55	27
Ijevan	720	1303	178	175	58	29
Kapan	91	191	28	28	12	8
Gyumri						
Yeghegnadzor						
Total:	**1441**	**3432**	**679**	**621**	**125**	**64**
	2018					
Spitak	1371	3526	680	679	74	59
Ijevan	637	1047	130	130	17	10
Kapan	1416	1664	76	76	25	10
Gyumri	350	392	14	14	0	0
Yeghegnadzor						
Total:	**3774**	**6629**	**900**	**899**	**116**	**79**
	2019					
Spitak	1209	3559	757	750	71	50
Ijevan	750	1385	177	175	90	55
Kapan	1872	2282	120	120	32	25
Gyumri	930	1926	332	332	0	0
Yeghegnadzor						
Total:	**4761**	**9152**	**1386**	**1377**	**193**	**130**
	2020					
Spitak	1300	2928	523	520	51	34
Ijevan	795	1600	207	205	163	95
Kapan	1300	1543	75	73	25	12
Gyumri	890	1740	280	280	5	5
Yeghegnadzor						
Total:	**4285**	**7811**	**1085**	**1078**	**244**	**146**
	2021					
Spitak	2962	4425	771	758	126	78
Ijevan	2194	3328	237	237	158	73
Kapan	2151	2539	122	118	60	26
Gyumri	1690	2750	465	451	56	39
Yeghegnadzor	3692	4266	244	235	44	34
Total:	**12689**	**17308**	**1839**	**1799**	**444**	**250**

Figure 4. Regional Eye Center Data Collection Spreadsheet

Another way to improve the data sets for input into the visualizations would be to collect the data, in the same way, no matter the category of information. As previously stated, the same categories were used for both the REC spreadsheet and the MEH spreadsheet so Tableau could process and utilize all of the data. When creating any new spreadsheet, the categories should also be the same. This allows all of the data to be easily added or removed from the program and Tableau will have no errors during the updating process. Location and time-based data should be

recorded for all different categories so that each data set can be compared to one another and potentially compiled into a "master map" at one point, as our sponsors at one point suggested.

One of the big challenges was how we could best present data that are given in terms of both time and location. The data we received from the AECP was organized by years, so we chose to continue with this method, compiling each year vertically, rather than horizontally which they had initially presented us with. This way, the totals throughout the years can be compared more easily.

For Tableau to properly recognize these data, however, some adjustments had to be made. First, the different years could not be separated in the manner shown above. The organization we used for Tableau can be seen in Figure 5. Instead of separating each year in rows, each region had to be repeated for each year, and a new column needed to be added for the years, which had to be repeated for each region. In order to have the other regions without Regional Eye Centers appear on the map we had to add them for each year and leave each of the columns associated with projects at each center blank. Clearly, this was not an intuitive way to look at and summarize data, which was why we recommended keeping the spreadsheets for data collection separately from those for Tableau.

Region	Year	Patients Examined	Visits	Surgery Procedures	Laser Procedures	Eyecare Center
Aragatsotn	2016					
Ararat	2016					
Armavir	2016					
Gegharkunik	2016					
Kotayk	2016					
Lori	2016	460	1198	240	20	Spitak
Shirak	2016					Gyumri
Syunik	2016					Kapan
Tavush	2016	590	1206	226	30	Ijevan
Vayots Dzor	2016					Yeghegnadzor
Yerevan	2016					
Aragatsotn	2017					
Ararat	2017					
Armavir	2017					
Gegharkunik	2017					
Kotayk	2017					
Lori	2017	630	1938	473	55	Spitak
Shirak	2017					Gyumri
Syunik	2017	91	191	28	12	Kapan
Tavush	2017	720	1303	178	58	Ijevan
Vayots Dzor	2017					Yeghegnadzor
Yerevan	2017					

Figure 5. Regional Eye Center Tableau spreadsheet for years 2016,2017

Each data set was repeated in both the data collection and Tableau-formatted spreadsheets in order to maintain consistency. We provided all of these spreadsheets to the AECP in order to show them how we recommend organizing each of the different sets of data, as they have different characteristics.

Another recommendation would be regarding what other types of data the AECP could collect. In order to get the most compelling visualizations, there are specific types of data that are

better than others to collect. The type of data that would be most beneficial to collect is result-based data. This type of data would show the numbers before and after AECP involvement or the changes through the years AECP is active. This way it allows anyone looking at the statistics to see the impact of the organization. This is very advantageous when looking to attract donors and volunteers. Visualizations utilizing the results-based data would be more impactful and would drive more people to lend their time and money. It also is a good way to show patients how effective the treatments are and how necessary eyecare health is. A good way to show result-based data is through percentages, such as how many people are reached per area or how many people who would benefit from care are actually able to receive it. Comparisons like these would help contextualize the reach of these programs and accurately display their growth over time. This also would allow for different types of visualizations to be created through Tableau with ease.

As one may infer, it is not enough to simply create a visualization and wait for users to stumble upon it independently. The placement of any created visual on the sponsor's website is important to the efficacy of the visualization. As it currently stands, the AECP website was not designed with the implementation of these visualizations taken into consideration. Therefore, we recommended they restructure their website to some degree, either directly showcasing the visuals or making it very clear where they are located. One suggestion we had was to make them a part of the slideshow that appears on their home screen to take people to their "Accomplishments" page. Then, by adding the visualizations to this page, a user could click on the visualizations and be taken to the page with the interactive maps, as well as their existing page of accomplishments. To determine how well they are leading their users to the visuals, we also recommend they organize a user study with the target demographics they are seeking to assist, allowing users to provide feedback as to how easily they are finding the data they wish to see.

Finally, we recommended that the AECP makes sure to frequently update the data as well as the corresponding visualizations. Additionally, they must communicate to their users when exactly the visual was last updated with new data. When users come across data visualizations, they need to know from what range of time the generated visuals are relevant. No matter how high-quality visualizations are, if they are embedded in the website now and never updated, they are not likely to convince any potential donors in the future.

Conclusions

With the deliverables that we have created for the AECP, they should be able to better track their data in order to monitor their progress over the years. Our recommendations for how they record their data moving forward will be more effective than their current methods and will make it easier for them to continue to add new data in an organized manner. It would also help to guide them in future data collection should they start new projects or track more sets of data for their current projects in order to make their results more compelling.

Along with this, the user manual and recommendations will help guide the AECP in a direction that will help to show the successes of the AECP and the areas in which they would benefit from growth. The way that data they already have collected is organized should help to show which different locations and projects are strong, and where there are areas to improve the capacities so they know where to direct fundraising and volunteer efforts.

Not only will the AECP benefit from having these data displayed in a way that is accessible and clear, but patients will also be able to see what services are available through the AECP. By having access to how many people's lives have been improved by the AECP, they could be inspired to seek help with their own eye care concerns. The visuals created can also help to clarify the works that the AECP has done in order to encourage people to donate and volunteer to contribute to these efforts. Showing the locations and details of services provided can help show those target groups the great impact that the AECP has had as well as highlighting areas where they may benefit from volunteer and donor assistance.

This project reaches further than the AECP, conveying the importance of the use of interactive visualizations and their effectiveness within organizations. The methods we have utilized can be used for other similar programs for the same reason. Other organizations could benefit from this type of display of data as well as the storage and organizational aspects. Using this report, a lot of Non-Government Organizations could create compelling visualizations in order to draw in donors and volunteers alike. The organization of the data that goes along with it allows the user to be neat and cover all necessary aspects we have established during this project. Even without using Tableau, people can benefit from an organized and useful template for collecting data.

Along with other organizations, other countries can take advantage of the project for their eye care. This also could be applied to other forms of health care to show the change in different medical trends. In any topic, the project can be utilized to show upwards trends and point out places that need improvements. There are many countries, in several settings, that could use this plan to raise awareness and bring in outside sources, all while conveying useful information. Although the project was intended for the AECP, the overall goal could be paired with many countries or organizations to help convey their data in a meaningful way.

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Appendix A

	Number of schools screened in region	Number of students attending school	Number of students screened	Percent of students screened per students attending school	Number of students who received auto-refraction with Walch Allin photoscreener	Number of students provided with vouchers for detailed examination
Aragatsotn	4	619	564	91.1%	100	97
Ararat	6	2900	2684	92.6%	410	344
Armavir	5	1818	1527	84.0%	314	299
Kotayk	4	1530	1165	76.1%	258	244
Gegharkounik	3	689	586	85.1%	111	111
Shirak	5	1263	933	73.9%	159	162
Tavush	2	417	395	94.7%	80	81
Lori	6	1845	1633	88.5%	204	133
Vaiots Dzor	2	738	683	92.5%	114	105
Syuniq	3	567	520	91.7%	110	88
Total, regions	**40**	**12,386**	**10,690**	**86.3**	**1,860**	**1,664**
YEREVAN	18	15,808	11,979	75.8%	2,447	2,065
TOTAL ARMENIA	**58**	**28,194**	**22,669**	**80.4**	**4,307**	**3,729**

Figure A1. School Screening Data Collection Spreadsheet

The recommendation we have proposed for data collection regarding school screening information.

Region	Subcategory (if Applicable)	Period	Population	Number of Patients Screened	Percent screened of population	Number of Kids Screened	Number of Patients Referred to MEH	Number of Patients Operated on	Number of Patients who received laser	Number of Patients who received eyeglass provision
			2003							
Aragatsotn		June-July	138500	7190	5.2%		680	227	92	
Armavir		October-November	276800	6810	2.5%		1,300	424	111	
Vayots Dzor		September	55900	5000	8.9%		826	296	100	
Total		**Total 2003**	**471200**	**19000**	**4.0%**		**2806**	**947**	**303**	
			2004							
Ararat		March-April 2004	272,100	8,199	3.0%	3800	1,200	275	111	
Kotayk		October-December 2004	272,400	5830	2.1%	2384	720	317	105	
NKR		May-July 2004	150,000	4000	2.7%		1190	334	50	
Syunik		July-August 2004	152,800	2,856	1.9%		470	188	34	
Tavush		September 2004	134,300	4,101	3.1%	1002	511	165	55	
Yerevan	Orphanages		212	200	94.3%					
Yerevan	Nursing Homes	December 2004	450	250	55.6%		90	32	10	
Total		**Total 2004**	**982,262**	**25,436**	**2.6%**	**7186**	**4181**	**1311**	**365**	
			2005							
Aragatsotn	(+Geghadir, etc)	Octover-November	138,500	6545	4.7%	3708	653	127	89	90
Gegharkunik	(Vardenis & Chambarak)	April-May	54,500	1,358	2.5%		400	107	38	
Kotayk	Pyunik	December		387		350		2		30
Lori		May-July	285,000	5,911	2.1%	1,775	1,276	273	91	
Shirak		July-October	282,500	9,712	3.4%	2,194	1,960	575	178	
Yerevan	Shengavit	March-April		3,756		3386	40	6		
Yerevan	Norq Schools	May		687		672				
Yerevan	Nursing Homes	March		111			30	18	4	
Orphanages, Boarding schools and Camps (Hermon and Tsaghkadzor)		February, July-August		569		569				
Total		**Total 2005**	**760,500**	**29,036**	**3.8%**	**12,654**	**4,359**	**1,108**	**400**	**120**
			2006							
Ararat		October-December	272,100	14,146	5.2%	8084	1,244	349	124	1718
Armavir		March-May	276,800	15,917	5.8%	10,736	805	203	126	322
NKR		July-August	150,000	3,220	2.1%		675	323	80	73
Syunik		September-October	152,800	7,867	5.1%	4662	721	160	96	948
Vayots Dzor		June	55,900	3,637	6.5%	1944	330	69	32	123
Yerevan	Nork Nursing Home	March		90			65	9	4	
Yerevan	Malatia Sebastia	January-March	11,389	11,004	96.6%			19	6	50
Orphanages		March		350		350				
Summer Camp		March		166		166				
Total		**Total 2006**	**918,989**	**56,397**	**6.1%**	**25,942**	**3,840**	**1,132**	**468**	**3,234**

Figure A2. Mobile Eye Hospital Data Collection Spreadsheet

A sample from the proposed spreadsheet for data collection on the Mobile Eye Hospital.

Appendix B

Region	# Schools screened	# Students attending school	# Students screened	% Students screened / # attending school	# Autorefracted w/ Walch Allin photoscreener	# Provided with vouchers for detailed examination
Aragatsotn	4	619	564	91.1	100	97
Ararat	6	2900	2684	92.6	410	344
Armavir	5	1818	1527	84.0	314	299
Gegharkunik	3	689	586	85.1	111	111
Kotayk	4	1530	1165	76.1	258	244
Lori	6	1845	1633	88.5	204	133
Shirak	5	1263	933	73.9	159	162
Syunik	3	567	520	91.7	110	88
Tavush	2	417	395	94.7	80	81
Vayots Dzor	2	738	683	92.5	114	105
Yerevan	18	15,808	11,979	75.8	2,447	2,065

Figure B1. School Screening Tableau Spreadsheet

The spreadsheet we used to input school screening data in Tableau.

Year	Region	# Patients screened	# Kids screened	# Referred to MEH	# Operations	# Patients receiving laser treatments	# Patients receiving eyeglass provisions
2003	Aragatsotn	7190		680	227	92	
2003	Ararat						
2003	Armavir	6810		1,300	424	111	
2003	Gegharkunik						
2003	Kotayk						
2003	Lori						
2003	Shirak						
2003	Syunik						
2003	Tavush						
2003	Vayots Dzor	5000		826	296	100	
2003	Yerevan						
2004	Aragatsotn						
2004	Ararat	8,199	3800	1200	275	111	
2004	Armavir						
2004	Gegharkunik						
2004	Kotayk	5830	2384	720	317	105	
2004	Lori						
2004	Shirak						
2004	Syunik	2,856		470	188	34	
2004	Tavush	4,101	1002	511	165	55	
2004	Vayots Dzor						
2004	Yerevan	450		90	32	10	
2005	Aragatsotn	6545	3708	653	127	89	90
2005	Ararat						
2005	Armavir						
2005	Gegharkunik	1,358		400	107	38	
2005	Kotayk	956	919		2		30
2005	Lori	5,911	1,775	1,276	273	91	
2005	Shirak	9,712	2,194	1,960	575	178	
2005	Syunik						
2005	Tavush						
2005	Vayots Dzor						
2005	Yerevan	4554	4058	70	24	4	
2006	Aragatsotn						
2006	Ararat	14146	8084	1244	349	124	1718
2006	Armavir	15,917	10,736	805	203	126	322
2006	Gegharkunik						
2006	Kotayk						
2006	Lori						
2006	Shirak						
2006	Syunik	7867	4662	721	160	96	948
2006	Tavush						
2006	Vayots Dzor	3803	2110	330	69	32	123
2006	Yerevan	11829	11354	65	28	10	50

Figure B2. Mobile Eye Hospital Tableau Spreadsheet
A sample from the spreadsheet we used to input the Mobile Eye Hospital data in Tableau.