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# Telemedicine's Effect in Delivering Healthcare to the Underserved

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Telemedicine's Effect in Delivering Healthcare to the Underserved

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### Abstract:

By connecting patients with medical professionals through unconventional means, telemedicine programs make an attempt to bring healthcare to the underserved. The Cinterandes Foundation has constructed a program of mobile surgeries that provides patients with advanced healthcare who would otherwise not have access to any under normal circumstances. Given the prodigious nature of their work (with 18 years of operation throughout the entirety of Ecuador), a closer inspection of the potential benefits and drawbacks to their design was necessary in order to evaluate the quality of their care in this field. The foundation's use of two different forms of telemedicine, mobile health and remote care, showed an improvement in the individual patient's health through surgical operations, but no effect was found on the area's public health. It is clear that for Cinterandes, their work will always be desirable, but whether or not it has a lasting impact has not been determined. In order to continue their work, or perhaps carry this model to different nations or areas, a conscious effort must be made to work on keeping patients out of the operating theater through preventative care.

### Introduction:

Providing medical care to the patients with the most need is one of the most current problems in the field of health care and public health. Telemedicine has taken strides in accomplishing this goal, but the technology, and the application of this technology, is so recent that frameworks for healthcare delivery using these tools are still in their infancy. Through the evaluation of these frameworks, both potential and actual, a standard can be set in order to provide the most competent and compassionate care possible. The American Telemedicine Association defines telemedicine as "the use of medical information exchanged from one site to another via electronic communications to improve patients' health status," and telemedicine can

be further broken down into three main branches. The first is remote care, which involves providing care to patients through intermediaries when hospitals or clinics are not available. A lack of conventional care can most often be attributed to the lack of funding available to set up a clinic, a shortage of doctors, or when distances between villages or towns are too great to justify travel to the nearest hospital. The next is home monitoring or telehealth, which occurs with patients with chronic conditions who need constant monitoring in order to prevent frequent hospital visits. The final branch of telemedicine is mobile health, in which patients and health care providers communicate back and forth using mobile devices. This most often comes into play with both chronic disease patients (diabetes, COPD, etc) as well as surgical patients in order to monitor post-operational recovery. As of now, an international standard has not been set for telemedicine programs, and they function independently and with differing groups overseeing their operations.

This study analyzed the effects of the Cinterandes Foundation's use of mobile health and remote care, an important subject for two reasons. The first is due to the vast amount of patients that the foundation has already provided care for. The foundation has been working for 18 years and has performed over 6800 surgical operations. Missions have been carried out in every province of Ecuador. The next reason is that the foundation has proven to be a standard of care for telemedicine within the Ecuadorian healthcare community. Through the use of mobile surgeries, the foundation has been, and continues to be, highly effective in selecting patients and conducting surgeries. The small team of six permanent staff with a few rotating surgeons has been more effective than any other Ecuadorian program at providing care to poor and underserved communities. Dr. Edgar Rodas, the foundation's director, was contacted by the Ministry of Health (of which he was once the director) in order to reproduce his model of mobile

surgeries within the governmental realm. However, the program lay stagnant after only a few years due to a bloated system that could not maintain itself. For these reasons, the Cinterandes Foundation was the perfect model to determine the effectiveness of a telemedicine program. Through the observation of both their mobile health and remote care, it was determined whether or not a significant effect had been, and continues to be, occurring through the delivery of medical care.

Cases of mobile health and remote care have been analyzed before. In cases where a specific specialty is required, remote care has proved successful in improving patient screening and evaluation (Silva *et al*, Demaerschalk). By putting specialized patients in touch with their medical counterparts, remote care has been shown to improve efficiency and patient status. This can also be done through intermediaries, such as in the States with diabetes patients (Higgins). By having an advocate with a small amount of training relay information to doctors, or general practitioners supply patient information to endocrinologists, patients are able to retain autonomy while still being provided care. The Cinterandes Foundation offers a similar situation in their use of communication with regional health centers to pre-screen patients for surgery. However, surgical procedures have traditionally been thought of as associated with hospital care. Even outpatient procedures require multiple visits to a hospital or clinic in order to pre-screen and for post-op recovery. With patients undergoing surgical procedures, this offered a unique chance to evaluate the use of remote care for pre-op screening.

In mobile health, direct monitoring of patients has been shown to be both effective in improving patient condition (Shea *et al*), and yet costs more (Palmas). With these patients, monitoring was meant to continue for years, since the patients had a chronic disease (diabetes). With surgical patients, monitoring only continues for a relatively short while, with a maximum

length of a few years. As such, prices could potentially decrease while still offering comfort to the patients by not requiring costly and difficult trips to far-flung hospitals or clinics. With the foundation, the use of cellular communication to directly contact patients after procedures offered a unique opportunity to gain perspective on both the cost-effectiveness and level of patient comfort for surgical patients.

The hypotheses prior to the study were in two parts. One, that the use of telemedicine (in both remote care and mobile health) would decrease time spent prepping and screening patients as well as speed up recovery time without jeopardizing patient health when compared to an Ecuadorian hospital surgical ward. The basis for this hypothesis in improvement of individual health care is reasonable when observing that patients do not have to leave the comfort of their own community in order to receive care that they would otherwise be unable to afford as well as gain access to (due to their geographical distance from competent hospitals). Also, with mobile communications, it was hypothesized that patient information would already be available to Cinterandes' surgeons, thereby allowing them to speed up the process of care, saving money while they do as well as retaining patient safety. In the second part, it was hypothesized that the local communities' public health would improve due to access to medical professionals. By having members of the community educated in wound care, it could be inferred that basic hygiene standards would also be gained from the practice. Also, certain procedures, such as the removal of the gall bladder (an operation that is done often in the van), require education in proper dietary standards along with certain restrictions. With these educational measures along with the presence of medical professionals, it was hypothesized that the standard of public health would improve through the use of telemedicine by the Cinterandes Foundation.

This study analyzed the use of both remote care techniques as well as mobile health techniques of telemedicine through the observation of the Cinterandes Foundation. The foundation was observed over a two-month period in both its pre-screening and selection of patients as well as the monitoring of post-operative wound care. During this time, hospitals in Cuenca were visited in order to better understand the standard of care within Ecuador, so as to gather a baseline that the foundation could be measured against. Also, interviews were conducted with health care professionals along with visits to regional public health clinics in order to better grasp the quality of public health teachings and operations within Ecuador. These were all done in the specific pursuit of discovering whether telemedicine provided a more useful model than traditional patient contact and hospital visits.

#### Methods:

The analysis of the foundation's work began with the observation of local hospitals within Cuenca. These hospitals were chosen for their affiliation with Cinterandes (each hospital had administrator permission for students working with the foundation to observe), as well as their representation of the lower socioeconomic class of Cuenca, and Ecuador at large. The hospital that occupied the majority of observation time was the local social security hospital. Time at each location was divided between patient pre-op care and monitoring along with the performing of the actual surgeries. The patients represented a sample population of opportunity, as recruiting patients for this study was outside of the set parameters.

To supplement this observation, time was spent with local public health clinics located in small "parroquias" just outside of Cuenca. The majority of observations consisted of patient consultations for mostly minor issues, the more serious being referred to hospitals in the city. This observation granted access to patient care that was not necessarily specialized, with the

more serious and complicated issues being beyond the doctors present. Also, this sample population consisted of an even lower socioeconomic class than those of the hospitals, since these patients were unable to reach the city hospitals and only had access to regional health clinics. These patients were representative of the patients that the foundation treated, and conclusions can be drawn using these patients as a baseline.

Interviews were conducted with key members of the Cinterandes Foundation in order to gain insight into the effect of their telemedicine program on individual and public health.

Interviews consisted of the 6 following questions, translated to Spanish:

1. How is the state of public health within Ecuador with regards to access to health care, preventative medicine, expenses, and education?
2. In regards to the use of telemedicine, is technology being used to provide care to a broader population base, and bring an urban level of health care to rural residents? Could improvements be made?
3. How is the use of telemedicine altering the field of public health at large within the country?
4. Are you familiar with the Cinterandes Foundation? If so: Do you believe that the Foundation is improving health on an individual basis? On the public at large? Is this effect in correlation with the Foundation's use of telemedicine, or are other factors at work?
5. Are any other significant steps being taken to improve the field either by governmental or non-governmental organizations?



6. Are the expenses accrued by telemedicine procedures justified? Do the potential or realized benefits of these technologies outweigh the financial costs to NGO's?

Prior to questioning the interviewees, an agreement form was signed and the interviewees were read a statement that explained what research was being conducted, why the research was being conducted, and exactly what would be included in the interview. The interviewees were reminded that participation in the interview was entirely voluntary. By questioning these members of the foundation, it was possible to gain insight into what the foundation was attempting to accomplish. Whether or not they were meeting these goals was evaluated by comparing what they were attempting with what was actually occurring on surgical missions. Also, a general view of the state of public health and health care within Ecuador was garnered from these doctors, as they have had an intimate relationship with the health care of all of the different provinces throughout Ecuador for many years.

The bulk of information gathered occurred during surgical trips. One long trip (three days of surgical procedures) as well as two short, one-day trips were conducted, and patient histories and physicals were gathered before all surgeries were conducted. The Cinterandes staff selected for sample populations. Any patient that did not pass the initial screening for high Body Mass Index (BMI), high blood pressure, current infection, history of adverse reaction to anesthesia, or anything that presents a significant risk for complications during the procedure were removed from the surgical schedule. Observation of this population represented the crux of the research conducted.

## Results:

The local hospitals of Cuenca are structured very similarly to hospitals in the States. Emergency room visits are triaged, with the most severe cases being sent to a trauma ward. Within the surgical ward, doctors perform rounds at specified times of the day, going over the patient's current condition and advising on any change in condition. Patients are often not addressed directly, and needs are not always taken care of in a timely manner. If a patient requires a certain item (a type of suture, bandages, etc.) that the hospital does not have, the patient's family is asked to go to a local medical store to purchase the required item. If they are unable to, the patient must wait, or go to another hospital. During and just prior to surgery, the medical staff does not often comfort patients. A patient's emotional well being is not considered when in the operating theater. However, the level of surgical care provided is almost on par with the States surgical care. Operations are conducted efficiently, effectively, and with minimal complications. Patients were all non-scheduled in the surgical ward, but approximately half of the patients seen in the operating theaters were from other departments and had planned surgeries, some elective.

In the public health clinics, patient care took an assembly line format, since a large number would come in on any specific day. The nurses and medical students screened incoming patients, while general practitioners consulted with patients as quickly as possible. Although the system was not designed to care for all of the patient's needs, the medical issues at hand were dealt with in a timely manner, and many patients were seen on any given day. On certain occasions, the doctors and/or nurses presented health lessons to the patients and surrounding community. These lessons were focused on important public health goals: proper hygiene, vaccinations, diet, oral hygiene, sexual assault prevention, and sexual health. The varieties of

conditions presented in each of the clinics were vast. On any given day, doctors will consult with babies and young children, pregnant women, the mentally handicapped, patients with gastrointestinal distress, dermatological issues, patients who are having trouble with their medications, diabetics, patients with chronic obstructive pulmonary disorder (COPD), and basic sinus infections. The vast majority of patients were in a very low socioeconomic group. This seemed to be their only option for health care, as travel to the city was most likely beyond their means.

The interviews garnered much information about the state of public health and telemedicine within Ecuador. Dr. Edgar Rodas believes that health should be free for everybody, yet recognizes that there is not enough money to provide health care to all. He believes that access to health care is the greatest problem facing Ecuadorians at this time, in that there are not enough rooms within hospitals as well as lacking in available medicines. In his opinion, the governmental programs that are most effective at this time are the community medicine programs, as there is a neglect of primary care in public health. Telemedicine has been in use at the foundation since 1995, and began with simple landlines and fax, then went to satellite lines, then to internet use, and finally has reached cellular communication. For Rodas, cell communication is the best way to maintain telemedicine practice, as there are more cell phones than people within Ecuador, with the exception of the rare issue of access, but for the most part, using cell phones to maintain post-op care is the most efficient way possible. He knows that the government is putting better access into place, and when complete, will provide much better service and will support such advancements as being able to send photos of wounds to better improve care. For him, telemedicine has improved patient care a great deal, but only on an individual level, not in the realm of public health. He wants to see an improvement to the

primary care/family care programs that are in place. These programs act like satellite operations, with primary doctors caring for a large geographical area and requesting more advanced care when needed. This is opposed to the building of more hospitals, which people cannot access already. For the near future, Rodas sees little change from the cell phone plan already in place, as there are no extra expenses on either end. He does anticipate investing in more advanced cell phones, ones that will be able to transmit photos for improved post-op care.

The interview with Dra. Anita Vicuña, the chief anesthesiologist, offered more information on public health and telemedicine. In her opinion, there is a major deficit in access to medicine in the rural areas of Ecuador. Similar to Dr. Rodas, she believes that there is not enough primary care medicine implemented, and that the organization of public health within Ecuador is chaotic at the moment. Due to great distance or a lack of proper care, it is difficult for certain population bases to gain access to care. Also, health education is very deficient in the population, and especially in the rural areas. Dra. Anita believes it is very difficult for them to follow even simple health guidelines due to their lack of proper health education, which puts them in a precarious health position (high weight, increased risk of infections, etc.). As for telemedicine technologies, there are large areas of the country that either have no access to internet or very limited access, but, thankfully, telephone service covers most of the country. However, she thinks that the population only has access to simple technologies when it comes to cell phones. She also thinks that the population would benefit from phones that can receive and transmit photos. In her opinion, information received from regional public health clinics is not frequent enough. Clinics provide information with the foundation every month, but for certain patients, they need more information and much sooner. She would prefer to have direct communication with all of the foundation's patients, as it would greatly help with post-op care.

Since these patients and the doctors have such a great distance to travel, it is important that they have relevant and up-to-date information on all of their patients. The entire remote care plan (having regional clinics contact to advocate for patients) works very well, in her opinion.

However, when it comes to public health, she does not think telemedicine can be much use, with the exception of a catastrophic scenario, such as an epidemic.

Information about the foundation's work became much clearer during the surgical trips. During histories and physicals, the foundation ensures that patients are selected who present the smallest possibility of complication. This rules out the very young, the very old, the sick, and the unhealthy. The hardest thing that the foundation has to deal with is the selection of patients, as often the clinics do not provide complete or up-to-date information. If patients present with complications or a procedure that is too difficult to be done in the van, the doctors often referred patients to other doctors or directly to their main office in the city. That is why an in-depth history is taken for every patient. First, a relevant telephone number was always taken, yet when the patients responded that they did not own a cell or landline phone, the staff asked for any phone that they might be able to reach them on. In each H+P, the previous diagnosis is confirmed, the heart, lungs, and any area related to the issue are checked, and the BMI is taken. Also, any hospitalizations, allergies, or prevalent medical issues are checked for, along with a family history of illness. A signature for consent is required for every patient. After the whole patient list is completed with H+P's, the complete and final surgical schedule is compiled. Of this list, a few will not show or be unable to have the procedure due to an unforeseen issue (infection was the most common).

Procedures either take place the next day if the van is not prepped, but can occur as early as a few hours after the H+P's are completed. After every procedure, the patient is monitored in

person for at least an hour if general anesthesia was used. Heart rate, respiration, and blood pressure were monitored to ensure that the patient had no adverse reaction to the surgery or anesthesia. After the surgery, every patient was given Dr. Rodas's telephone number so that they could call him with any questions and to check in for their post-op recovery. Before one procedure, a time-out was done to check who was in the operating theater and for what purposes as well as to ensure that the patient was the correct one. This is standard operating procedure in the States, but the first I had seen in Ecuador. During a few other procedures, the lights went down due to the generator becoming overloaded. The power remained out for a few minutes each time, but the problem was always fixed. The majority of post-operative care was taken care of by Cinterandes, however, some care at later dates from the surgery was done in conjunction with the regional clinics. Often, people would approach the van looking for a medical consult, and the doctors would take them on a case-by-case basis. Some people they turned away, but some they provided with medical information.

#### Discussion:

Looking at the standard quality of care within hospitals in Ecuador, it becomes apparent that Cinterandes at least matches that quality in their surgical van. Considering that items are often not available for patients that need them in the hospitals, in this area the foundation exceeds the standard of care. The foundation always had a stock of surgical equipment and sterile tools for any scenario that could arise, and was never lacking equipment for a procedure. In the case of patient comfort, the foundation far exceeded the hospitals' standard of care in this respect. Patients of the foundation were always treated with the utmost respect from screening and evaluations to post-op recovery. Patients in the hospital were often ignored with no regard to their level of comfort. As for the quality of surgical procedures, the foundation at least met

the standard of care. Dr. Rodas is a renowned surgeon with an incredible level of experience, and the rotating surgeons were of a very high quality. All of the surgical tools, most importantly the laproscopic equipment, were on par with the equipment in the hospitals. The only issues that came up would have been the limited cases of power outage. However, the power was always available, connections simply became overloaded a few times until compensations were made. None of the patients involved in these procedures had harmful outcomes due to the loss of power. In standard of care, Cinterandes provided just as high quality, if not more so, than hospitals were expected to provide. The public health clinics near Cuenca supported this point. In the clinics, patient's emotional well-being was not considered a factor of health care, which was not the case for the foundation's patients.

In the case of public health, the foundation proved to be lacking a great deal. The regional health clinics made strides in disseminating health information to the public at many different times. Their work had the potential to spread many topics important to public (maternal health, hygiene, oral hygiene, vaccinations) to a great deal of people. The foundation, however, made no attempt to educate any group of people on the importance of any of these topics. Individuals and certain family members were told how to keep wounds clean and change dressings, but beyond that, public health topics were not covered. This is true for both in-person health care as well as when using telemedicine. Any use of technology to contact patients or consult about a patient was done with only that specific patient in mind, and no regard to the community. This is not necessarily a negative situation, since the care of the patient takes precedence, but the health of the community is not being improved. Even Dr. Rodas stated that the foundation's use of telemedicine had no effect on public health. Dra. Anita even went so far

as to say that telemedicine could not help public health in Ecuador except in extreme circumstances.

Both of the doctors agreed on other certain principles and ideas. When it came to the state of public health in their country, they argued for a greater use of the primary care model in order to meet the needs of the people in rural areas. One fact that was significant was that neither doctor mentioned the potential of telemedicine to gain access to a broader population base. In each case, the doctors' main thought was how telemedicine could be used to provide better care to individual patients, which was for the use of more sophisticated cell phones in order to transmit photos in the hopes that wound care would be improved. Neither doctor considered telemedicine to be especially useful, or a potentially useful tool, in bringing medical care where it was needed. They did, however, believe that telemedicine was especially effective in improving the health of individual patients, especially in their own use of technology to keep in touch with patients during post-op recovery. They also advocated for the continued use of the remote care strategy to pre-screen and select patients.

The effect of the remote care strategy became apparent during the surgical trips. By already having the list of potential patients, histories and physicals were conducted very quickly, on the level of hours for greater than 20 potential patients. With having the parameters for patient selection already given to the regional clinic operating in the area, patients that would never be selected for a procedure due to their risk of complication were already screened out of the list given to Cinterandes. However, patients did present with infections, excessive BMI's, and high blood pressure, which ruled them out of any surgical procedure. Use of the remote care strategy streamlined this process and gave the doctors more time to conduct their surgeries instead of dealing with multitudes of patients they could not help. Although patient information



was compiled prior to Cinterandes's arrival, in the interest of having their own information, the foundation collected detailed patient information on their own. While this may seem redundant, collecting patient information multiple times in order to ensure that nothing was missed is common medical practice, and shows that Cinterandes has an interest in the safety of their patients.

Conclusion:

It is now clear that the Cinterandes Foundation provides excellent medical care to populations that are sorely in need of their help. By bringing modern health care to areas that are far removed from traditional health care facilities, they are able to let patients stay in their own communities, which allows for patients to save costly and, in the case of post-op follow ups, potentially dangerous trips to urban centers. Also, the care the foundation provides is at least equivalent to the care that these patients would receive in an urban center, if not better in certain ways.

The foundation's strategy of remote care in telemedicine has been shown to be highly effective in reducing time spent outside of the surgical theater, which allows the foundation to provide as much care as possible to the area they visit. Also, by compiling patient lists and data on each patient, it allows them to prepare for certain specific surgeries and potential complications for any particular patient. Working in conjunction with regional medical centers allows for the pre-screening of patients before the foundation even sets foot in the area. All of these benefits indirectly provide a positive benefit to the individual health of each patient the foundation works with. If the foundation were to not use this strategy, potential patient lists would be longer, making for a situation in which patients who would otherwise need to be screened out of a surgery in order to protect their health ended up in the operating theater. This

would be a great disservice to the patient, and would compromise the health of all of the foundation's patients by forcing the surgical team to rush through surgeries instead of focusing their efforts on the patients that can receive the most benefit from their work.

The foundation's other use of telemedicine, in the mobile health form of retaining contact with a patient, has shown to be the most fruitful in potential and actualized benefit. By retaining contact with patients after a procedure, it retains continuity of care with the surgeons that performed the operation instead of with a less specialized medical professional who has no intimate knowledge of what occurred during the procedure. Were the regional clinics be left to their own devices to handle post-op check ups, they would be able to handle the majority of the foundation's patients, but if anyone presented with a difficult complication, the surgeon would need to be available to handle it. When the patient receives the personal telephone number of Dr. Rodas, as well as Cinterandes having the number of the patient and maintaining contact, problems like these can be avoided before they occur. Maintaining contact with patients and keeping continuity of care improves individual health.

However, this is not a perfect system. In a few cases, patients did not have a home or cell phone number to give to the foundation staff. When this occurred, the best option for the staff was to continue asking for any number that they could possibly reach the patient on. This is not an adequate system, as the numbers given could belong to anybody; a neighbor, distant relative, etc.; and is not a guaranteed way to contact the patient. Although using the current system of cellular communication within Ecuador is a brilliant way to cut costs while maintaining contact with the majority of patients, those that are left out do not have any recourse.

One result that is surprising is that the use of telemedicine showed no effect at all on the public health of Ecuador. Although many of the foundation's goals are in accordance with the

basic tenants of public health (food, health, safety), there was no visible effort on the part of the foundation to educate the areas they visited whether that is through technology or in person. Both Dr. Rodas and Dra. Anita stated that telemedicine offered no benefit to the field of public health in Ecuador. Given that the foundation is readily embracing telemedicine, this is a surprising finding. The doctors did not say whether or not they would not be open to using telemedicine to support public health goals, so it is possible that they simply do not see any possible avenue to using technology to improve public health at this time. Were they to be asked years in the future, when, hopefully, Ecuador's infrastructure has grown to support more advanced technologies, it could be possible that they would answer differently.

Although this study has gathered some insightful conclusions, it still remains a single case study. In order to find a more concrete solution to the issue of telemedicine operations worldwide, let alone in South America, more programs like Cinterandes must be studied, in both governmental as well as non-governmental fields. By only looking at Cinterandes, although the foundation has a long history of active telemedicine use, this study has a narrow view of the field at large in both South America and other locations outside of the United States.

In order to go forward from here, studies must be conducted with other organizations similar to Cinterandes, although not necessarily in the same field of medicine. Although an interesting case study, mobile surgery has proven to be an insufficient field when attempting to analyze the impact of telemedicine on public health. Both South American programs and those in other locations around the world should be structured in such a way that the local people have autonomous control from Western nations. Europe and the United States have many organizations that attempt to provide healthcare to populations outside of their own borders, including but not limited to: Doctors Without Borders, the Red Cross, and the Peace Corps. This

is noble work. However, by analyzing programs like Cinterandes, which is entirely ran and founded by Ecuadorians, it provides a unique view of an indigenous population making connections and networks where outsiders may find it more difficult to operate. That being said, the work that groups like the Red Cross are doing in telemedicine should not be looked over. This relatively new field offers exciting solutions to problems that have plagued healthcare for millennia, and the solutions are waiting to be found.

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