Teledermatology: Using Collaborative Technologies to Enhance Public Health Awareness

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Abstract—The benefits of Telehealth is paramount yet, the level of adoption across the U.S. has been modest. The field of Dermatology is known to be a visual specialty and the use of Telehealth has been reported to improve clinical outcomes and increase caregiver satisfaction. This paper presents the efforts to adopt telehealth in the field of Dermatology namely, Teledermatology. A study was conducted in the Minnesota State Fair for four years, and data was collected through paper-based forms and transcribe into electronic format. State Fair goers were asked to participate in the Teledermatology project where they get a free consultation with a Dermatologist at the University of Minnesota. The number of study participants were 863, 60% were females and 40% males, and participants represented all age groups. This study aimed at further understanding the need and challenges of Teledermatology and to increase public awareness about the various uses of Telehealth.

Keywords-component; Telehealth, Dermatology, Public, Health, Teledermatology

I. INTRODUCTION

The adoption and utilization of telehealth solutions has demonstrated to improve clinical management of chronic diseases, expand access to healthcare services and clinicians, and reduce healthcare-related costs [1]. Many telehealth interventions show effectiveness as a care delivery tool for underserved populations in rural communities where patients face major challenges such as geographic distance, lack of specialists, significantly high costs [2]. The application of telehealth technologies enables earlier detection and quicker assessments of patient’s health status using evidence-based health information, which can then serve as preventative care [3].

The ultimate goal of adopting telehealth technologies is to reduce hospitalization rates or visits to the Emergency Departments which in return decreases healthcare-related costs [4]. In order to reach this goal, literature suggests that a successful telehealth intervention requires high quality clinical data is necessary [5]. Providing two-way communication provides rich data to patients and clinicians, which in return improves the overall decision process for clinicians and increases awareness and comfort levels for patients. According to the Agency for Healthcare Research and Quality (AHRQ), an advantage to using telehealth is that it provides clinicians with the ability to manage patient symptoms and co-morbidities, to monitor patients, coordinate care services for patients seeking multiple clinicians in different geographical locations[6]. For that reason, the use of telehealth is necessary to face shortage of medical staff as well as enhance healthcare services in remote areas.

According to the American Academy of Dermatology (AAD), Teledermatology is the remote delivery of dermatologic services through telecommunication technology [7]. Teledermatology can be executed in two main methods, first, is the process of store-and-forward method, which is the exchange of digital images and health information from the patient to the dermatologist for consultation and storage. Second is the live interaction methodology, which provides remote patients and providers to interact via live video and audio sessions. Typically, teledermatology is used to provide direct consultation to remote individuals with skin condition, for general Practitioner (GP) to refer an individual to a specialist for second opinion, and/or to provide individuals with chronic skin conditions with healthcare management through telehomecare or home monitoring services [8].

Over recent years, teledermatology has shown significant promise in improving clinical outcomes and performance. In one study, teledermatology showed major improvement when used as a screening system for cutaneous melanoma with favorable effects on the initial prognosis of patients with melanoma [9]. Another study showed that the use teledermatology in remote areas resulted in shorter time to biopsy compared to the traditional method due to improved triaging metrics [10]. Furthermore, teledermatology is found to yield high satisfaction levels among providers; one study shows that 86% of dermatologist stated that teledermatology was a good addition to clinical services [11]. Another research reported that there was significant correlation between making the correct diagnosis and the quality of the images, this was a hurdle when connectivity and bandwidth is limited [12]. However, in today’s world, teledermatology can be conducted with high resolution images and live videos due to the availability of high-speed internet. Despite the numerous reports discussing the benefits of teledermatology yet the levels of adoption and public awareness are very modest. This paper discusses the efforts done to increase awareness and educate
patients and providers on the advantages of teledermatology through providing first-hand experience to novice users.

A. History of the Telemedicine Program at the Minnesota State Fair

The program started in the mid-’90’s with participants from the Fairview-University of Minnesota Telemedicine Network (FUMTN). The first telehealth demonstrations involved telehome care and tele-orthopedics. These demonstrations were conducted between the state fair and Tri-County hospital in Wadena, MN. Only one physician was involved, the medical director of the network, an orthopedic surgeon. In the late ’90’s, FUMTN started with teledermatology, which seemed the perfect specialty for the program due to its visual component. Fairgoers were able to see the results immediately and understood the benefits of how using collaborative technologies could give them immediate answers for their skin conditions. In 2006 when FUMTN became part of the Minnesota Telehealth Network (MTN), the state fair telemedicine program continued the teledermatology screenings and added pulmonary function testing and stroke screenings. After 2008, teledermatology was the only specialty demonstrated and still remains today.

II. METHODS

As discussed, the adoption of Teledermatology has shown modest progress over the years, and the way to expedite this process is through increasing public awareness on the benefits of Teledermatology. Great Plains Telehealth Resource and Assistance Center (gpTRAC) helps healthcare providers develop and implement telehealth programs. gpTRAC provides support and advice to facilities and organizations as they establish or expand their telehealth programs. Also, it serves six states, namely: Minnesota, Iowa, Nebraska, North Dakota, South Dakota, and Wisconsin. The mission of the center includes advancing telehealth program development by offering resources to healthcare providers and organizations interested in telehealth and telemedicine, and improving access to quality healthcare through collaborative technology.

During the annual Minnesota State Fair, the second largest state fair in the U.S., gpTRAC provides a Telemedicine booth that provides State Fair attendees with the opportunity to experience Teledermatology through a live video consultation with a remote Dermatologist at the University of Minnesota (UMN). Scheduled sessions are posted at the U of MN web site state fair schedule and printed on the state fair program. Additionally, the schedule is posted on the telemedicine program’s web site, blog and Twitter.

The coordination of the program begins with the University Of Minnesota Academic Health Center Office Of Communications, which coordinates all state fair activities for the University. This first step is crucial because this reserves a spot for the program at the University of Minnesota building in the state fairgrounds. A local video conferencing equipment distributor provides the equipment for the Teledermatology program. The coordination details involve scheduling technicians for installation at both sites involved, the University of Minnesota building at the fair and the department of dermatology at the UMN main campus. The installation is scheduled the day before the fair begins and the de-installation is scheduled the day after the fair ends.

The equipment includes two setups: The State fair setup and the Department of Dermatology setup. The state fair setup consists of a telemedicine cart with a large TV screen (54 inches or higher) codec and mounted speakers (necessary because of the loud environment) and an exam camera. The Department of Dermatology setup is located in a designated room, within the department, the chief residents’ room. The equipment consists of a desktop video conferencing unit which has been pre-programmed to display a large image of the fairgoer/patient and a small image of the volunteer dermatologist. Special lighting is positioned next to the screen for best picture.

A. Recruitment of Dermatologists and Participants

A state fair schedule is posted in the department of dermatology at the U of MN, showing the available dates and times for sign up. This is a strictly volunteer sign-up. The sign-up is available to all dermatology faculty, including adjunct faculty. In addition, dermatology residents are also encouraged to sign up. The department of dermatology allows the third year residents to sign up for a session by themselves, however the first and second year residents they must sign up with one of the faculty. The Department of Dermatology project manager works in parallel with the telemedicine project manager. Once a dermatologist or a dermatology resident signs up for a session, the Dermatology Clinic project manager informs the telemedicine project manager and vice versa until the available slots are filled. Important note: Most of the recruiting of dermatologists is usually done by the telemedicine project manager by communicating directly with the dermatologists, either in person, or via phone or email. Recruiting for volunteers is available to telemedicine staff, department of dermatology staff and others, including dermatology nurses and students. A disclaimer is prepared for the fairgoers that participate in the telemedicine demonstration. This disclaimer is approved every year by the U of MN legal department.

B. The Teledermatology Process

Staff volunteers arrive at the telemedicine booth half hour prior to the scheduled session to connect the equipment and set up the “telemedicine booth”. The connection is initiated by the telemedicine staff. The recruiting of fairgoers/patients starts anytime during or after the setup. A staff volunteer is usually in charge of recruiting and talking to the crowd, however all staff volunteers are encouraged to do the recruiting and educating the fairgoers who have questions of “what is this”, “how it works” etc. Once the connection to the department of dermatology has been initiated and the volunteer dermatologist shows on the screen the session begins. The first step is the signing of the disclaimer by the fairgoer, to make sure there is an understanding that during the session there will not be a diagnosis by the dermatologist and this is an educational event to promote to the public the benefits of using technology in healthcare. The second step is “what is the skin problem” which is presented by the fairgoer to the telehealth presenter. The third step is the introduction of the fairgoer to the volunteer dermatologist by the telehealth presenter. Soon after the telehealth presenter explains to the dermatologist the
problem, the location and any of the symptoms, if any. The dermatologist then starts talking to the fairgoer about their skin issue and instructs the telehealth presenter to position the exam camera on the fairgoer’s skin. At the same time, the dermatologist and the fairgoer are discussing the skin issue: the dermatologist educates the fairgoer about their skin issue and states his/her opinion of the suspected skin problem. The approximate time for each fairgoer session is 3-4 minutes.

If the dermatologist suspects a cancerous lesion, he/she asks the telehealth presenter to use a ruler and measure it and describe it in detail. The fairgoers who have a suspected cancer, are given an “ABCD” dermatology bookmark (developed by the American Academy of Dermatology) which shows the different shapes and colors of dangerous lesions.

In 2012, the state fair telemedicine program conducted a 3-hour session using a mobile app. The app was developed by one of the volunteer dermatologists, and it was used for the first time, after its development, at the state fair. At that time, the app was available only on the iPhone and the iPad. The iPhone was used at the fair and the iPad was used by the Dermatologist, at the department of dermatology. Images of the fairgoer’s skin were taken by the iPhone, at the fair, and viewed within 1-2 minutes the dermatologist using the app on the iPad. Worth noting that due to the large number of people using cellular connections all over the fair, the connection for the iPad was switched to the U of MN Wi-Fi instead.

C. Data Collection

The gpTRAC staff uses a tally form for each telemedicine session. This form has three (3) “checklist” parts: Gender (M/F), Age group (1-20 yrs, 21-40 yrs, 41-60 yrs and 60+) and Referred (Y/N). This form is completed for each fairgoer who sees the dermatologist by one of the telemedicine staff volunteers. It’s very important that the staff volunteer pays close attention to that the dermatologist says, e.g. if this is a benign lesion or something that needs a follow up by the patient’s physician or a dermatologist.

In addition, the gpTRAC staff provides the volunteer dermatologist with a form, which is filled by the dermatologist for each fairgoer they see. The form has two columns: Name and Opinion/Suspected Diagnosis, the fairgoer’s first name, and the dermatologist’s suspected diagnosis. This information then is “matched” and cross-referenced with the information that was collected with the tally form.

III. RESULTS

This study was conducted for 12 days over four years, 2010-2013, and there were a total of 863 participants. In 2010, 291 patients were recruited, 61% were females and 39% males, the highest age group that participated in the study was 41-60 years old representing 43%, while the lowest group was under than 20 years old. Most of the suspected diagnosis was Benign (Cancer-free) at 77%, 14% were evaluated to have cancer, and 8% were Pre-cancer. In 2011, there were 226 participants, 59% were females and 59% were males. Most of the participants belonged to 41-60 years old category, and the second largest representation was from individuals in the 21-40 years old category. 76% of the suspected diagnosis was benign, and 12% were evaluated as cancerous, and 10% were pre-cancer.

Similarly, 77% of the participants were not referred while 23% of the individuals were referred for further investigation.

In 2012, there were 185 participants, 55% were females and 45% males. Similar to previous years, the largest age group was 41-60 years old individuals and only 10% were under the age of 20 years. Only 8% of participants were evaluated with Cancer and 14% were evaluated as Pre-cancer and 77% were benign. Approximately 21% of participants were referred to their primary care doctor for further investigation as a result of their Teledermatology screening.

In the final year of the study, 161 individuals participated in the study, 63% were females and 37% were males. Similar to previous years, the bulk of participants were individuals between the ages of 41-60 years, next came younger adults between the ages of 21-40 years. There was an increase in cases evaluated as cancer, 18%, and 10% were pre-cancer, and 72% were benign. 28% of participants were referred for follow-up appointments with their providers since they had either pre-cancer and cancer signs.

Table I shows the level of participation over the years, there has been a minor drop in the number of participants progressively; the reason for the drop is the challenge to find sufficient numbers of Dermatologist to participate in the study.

<table>
<thead>
<tr>
<th>Year</th>
<th>Teledermatology Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
</tr>
<tr>
<td>2010</td>
<td>291</td>
</tr>
<tr>
<td>2011</td>
<td>226</td>
</tr>
<tr>
<td>2012</td>
<td>185</td>
</tr>
<tr>
<td>2013</td>
<td>161</td>
</tr>
</tbody>
</table>

Table II shows a breakdown of participants by gender, the majority of participants were females (60%) compared to males (40%). We do not have a justification for those numbers however, from experience more females were willing to participate and try Telemedicine relative to males. However, the percentages are close to normal distribution since approximately 50% of the population in Minnesota is females.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Teledermatology Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
</tr>
<tr>
<td>Male</td>
<td>345</td>
</tr>
<tr>
<td>Female</td>
<td>518</td>
</tr>
</tbody>
</table>

Overall, the study included participants from all age groups; the youngest group had the lowest participation numbers because skin conditions are relatively rare in that age group. The majority of individuals were in the 41-60 years old range with approximately 41%, next were the 21-40 and 61+ age groups at approximately 25% each. When plotted on a graph, this is considered as a normal distribution.

TABLE III. PARTICIPATION BY AGE
Most of the participants (75%) were evaluated as Benign, meaning cancer-free, while 13% were evaluated to have cancer, and 10% were evaluated to be pre-cancer. These results are closely tied with results shown in Table V because if the individual was evaluated as Pre-cancerous or to have Cancer they were referred to their primary care physician or dermatologist. If the individual was benign they were not referred for further investigation.

### Table IV. Suspected Diagnosis

<table>
<thead>
<tr>
<th>Categories</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>115</td>
<td>13.3%</td>
</tr>
<tr>
<td>Pre-Cancer</td>
<td>91</td>
<td>10.5%</td>
</tr>
<tr>
<td>Benign</td>
<td>655</td>
<td>75.9%</td>
</tr>
</tbody>
</table>

### Table V. Referral

<table>
<thead>
<tr>
<th>Category</th>
<th>Teledermatology Data</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Referral</td>
<td>660</td>
<td>76.5%</td>
</tr>
<tr>
<td>Referral</td>
<td>203</td>
<td>23.5%</td>
</tr>
</tbody>
</table>

Over the four year period, an interesting finding was that the percent of suspected diagnosis was decreasing and the percentage of individuals evaluated with Cancer remained the constant and in some years it increased, Figure 1. While an explanation to this pattern could not be developed, a future direction of this research is to further investigate this observation.

Currently, there are major challenges hindering full utilization of Teledermatology. One challenge is the lack of support from health insurance organizations; Teledermatology, store-and-forward method, is not recognized as a covered service by the majority of insurance companies which means that providers do not receive reimbursement for using store-and-forward teledermatology. However, the live interaction methodology is reimbursed by insurance companies whose telmedicine policy covers telmedicine consultations when live interaction technologies are used. Even though research shows that using Telehealth in Dermatology yields better clinical outcomes, higher satisfaction levels, and lowers costs yet, there is a widespread lack of insurance coverage for such service. However, through increasing public pressure it will be inevitable that technology will be leveraged as a mean to improve access to care.

Another challenge is the complex U.S. policies and regulations with regards to medical malpractice. Each state has its own set of rules and guidelines, most states require that physicians limit their practice to the state in which they are licensed at, which in return limits the use of teledermatology to state boundaries. Also, there remain cultural uncertainties that diagnosing or treating a remote patient without an in-person physical exam might increase malpractice levels. For that, more studies are needed to show that the use of Telehealth technologies such as a Tele-stethoscope can yield similar results as in-office exam.

Also, the high-cost associated with Teledermatology causes lower adoption rates and modest patient engagement levels.
Providers need to build a Telehealth environment that is HIPAA compliant, has fast-speed connectivity, and trained clinicians and technicians. On the other side, patients are required to have high-speed internet, which can be a challenge in rural areas, and Telehealth equipment’s installed to a personal computer, as well as train the patients on using the Telehealth system. Furthermore, building a rapport between providers and patients might be more difficult than in-person visitation and hence, patients prefer traditional intervention.

Teledermatology is an effective solution for triaging purposes. Patients who seeking quick consultation and who are unwilling to commute to their provider may find Teledermatology a convenient intervention to get quick consultation and based on the recommendations by the clinician, a patient can decide whether it is necessary for them to be “seen” by their provider.

In conclusion, the future of Telehealth will be in the incorporation of mobile health (mHealth) so that individuals are able to virtually visit their provider through their smartphone applications. The convenience to receive quick consultation regardless of the location and through high-speed cellular network connection will add a new innovative and attractive dimension to Telehealth that will encourage more patient and provider engagement. One size fits all model will not succeed in healthcare, from some people telehealth might be the correct medium and for others the traditional care model works best. It is our responsibility to provide the right medium to the right person.

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