Telehealth in Emergency Medicine: a Primer
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American Colleges of Emergency Physicians (ACEP)
Telemedicine Interest Sector

Authors: Neal Sikka, M.D FACEP, Sara Paradise, MSIV, Michael Shu, MSII George Washington University School of Medicine

Purpose

Originally founded in 1998, the telehealth interest sector of ACEP brings together emergency medicine practitioners interested in expanding patient care into the digital world. While not much has changed in the ideology behind telehealth since the group's initial conception in 1999, improved access to high-speed technology and a greater cultural acceptance of digital communication is revitalizing the field. The purpose of this paper, therefore, is to re-introduce the ideas of telehealth, e-care, and mobile health in light of recent advances, and give a modern take on its applications within emergency medicine.

This paper will give an overview on the definition of telehealth, the history of telehealth, current technology, practical uses, cost and reimbursement, quality improvement measures integrated with telehealth, as well as potential risks and opportunities to its use.

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I. Definition

What exactly is telehealth? **Telehealth** is a conglomerate of Health I.T. methods used in modern-day medicine to improve a patient's health via a two-way communication between a patient and practitioner at a distant site[1].

This includes practices already prevalent in many emergency medicine settings, including trauma or stroke neurology consultations via real-time video connections, remote monitoring of patient vitals for ICU patients, and online decision-making aids.

[1] Centers for Medicare & Medicaid Services. (n.d.). *Telehealth*. Retrieved 8 16, 2012, from Medicaid.gov.

Telehealth falls in 3 basic categories of transmission. **Store and forward**, or "e-care" includes 'asynchronous' communication, such as transmitting patient data and/or digital images which are captured, stored, and sent as files to clinicians who responds with assessment. Another category is **remote monitoring,** where a central system feeds patient information from sensors and monitoring equipment. Lastly, **real-time patient management,** or 'synchronous' communication, includes a telecommunication link which allows instant interaction via video conferencing[2].

Aside from these uses of the term, in 2009, the FCC Broadband Plan (LINK), defined telehealth to encompass newer modalities such as electronic health records and mobile health, or "mHealth", currently two booming areas of telehealth.

History of Telehealth

While the concept of telehealth has been around for more than 40 years, it did not become feasible for use until the 1980's with the expansion of digital communication. Some of its earliest applications trace back to the 1970's, including EMS voice-based medical oversight, pre-arrival notifications, and remote transmission of ECG telemetry[3].

Unfortunately, the incorporation of well-established telehealth into practice was slow to be adapted by physicians and hospitals due to concerns regarding cost, privacy, reimbursement, as well as logistics of setting up a telehealth network. Within the past five years, access to high-speed, cost-effective technology such as 3G, 4G, and LTE networks, greater definition on reimbursement policies, and successful models demonstrating its effectiveness have made adoption more feasible.

A list of academic centers currently using telehealth is listed in the index. ACEP is currently surveying the uses of telehealth in the emergency medicine community to gain a better understanding of how these services are being utilized.

Technology

Emergency telehealth faces a new frontier with the installation of high-speed technologies which allow the transfer of images and videos in an efficient fashion. The success of this transfer depends on 3 essential components: the **speed** at which the data can be transferred, the **reliability** of the system, and for patient care purposes, the **security** of the system.

The speed at which data is transferred is known as **bandwidth** or **"pipes"**, and is measured in multiples or diminutives of Bits/seconds. The bandwidth of a system can vary widely based on the type of communication, i.e. radio vs. cellular vs. wired. Here are some typical bandwidth speeds:

Conventional Radios	2 Kbps
Cellular 1G	1200 Bps (1981)
Cellular 4G	50 Mbps downstream, 360 Mbps upstream
Broadband wireless	600 Mbps (2007)
Wired systems (LAN, fiberoptics)	10 Gbps (2003)

(Bashford, 2011)

[2] ATA Wiki. (n.d.). Retrieved 8 16, 2012, from Wiki: http://wiki.americantelemed.org/index.php?title=Main_Page

[3] Zachariah, B., & Pepe, P. (1997, 9). *The development of emergency medical dispatch in the USA: a historical perspective*. Retrieved 9 12, 2012, from National Academy of Emergency Medical Dispatch: http://www.emergencydispatch.org/articles/historicalperspective1.htelehealth

To put this in a telehealth perspective, sending an ECG requires about 1-2 Kbps[4], whereas a complete video telehealth consult requires a higher quality, more secure network; most complete video-based telehealth operations utilize 384 Kbps bandwidth speed, but 1-2 Mbps provides higher definition[5].

With regard to reliability, wired technologies are less prone to latency, dropouts, or complete loss of connectivity, as they provide a constant connection that allows thorough transmission of voice, text, or images. Wireless, as one could imagine, can be more vulnerable to such inconsistencies depending on the service connectivity[3].

Of utmost consideration in medicine is the security of a system. A 3G or 4G public network, such as the Long Term Evolution (LTE) initiative in Mississippi is an example of a public safety system that has high security without sacrificing quality[3]. As with all patient health information (PHI), encryption on telehealth products, following proper HIPAA compliance guidelines should be considered a priority.

Equipment

In addition to appropriate bandwidth speed, security, and reliability, equipment to conduct a proper **videoteleconferencing (VTC)** consult requires either an add-on desktop hardware program or a dedicated system that is sold with remote-controlled camera, control computer, TV monitor, CODEC software/hardware ("Coder/Decoder" which converts analog to digital technology), and microphone[6].

To ease this process, a number of programs have recently been marketed for physician-patient conferencing. Two of which, VSee and Vydio, similar to Skype in their functionality, but are advertised as having the additional benefit of being HIPAA-compliant, encrypted, and run at a lower bandwidth. A teleconference system that may be used on a personal laptop, or downloaded as a free "app" for a 3G/4G cellular phone or iPad, these systems also sync with medical devices such as otoscopes, stethoscopes, and ultrasounds.

Teleconferencing white papers:
http://www.ivci.com/international_videoconferencing_news_whitepapers.htelehealthl

[4] Bashford, C. (2011, 9 28). *Thinking about EMS Telehealth?* Retrieved Sept 26, 2012, from EMS World: http://www.general-devices.com/files/learning_pdf/EMS_World_Article.pdf

[5] *Frequently Asked Questions*. (n.d.). Retrieved September 22, 2013, from University of Kansas Center of Telehealth and Telehealth: http://www2.kumc.edu/telehealth/FAQs.htelehealthl

[6] NSA, N. S. (n.d.). *Video Teleconferencing*. Retrieved 20 9, 2013, from http://www.nsa.gov/ia/_files/factsheets/Video_Teleconferencing.pdf

Modern Applications of Telehealth in Emergency Medicine

The ability to interact with patients remotely is applicable in many emergency medicine settings. Whether in rural or urban settings, access to instant, high-quality medical care may be enhanced through advanced communication techniques. As such, many emergency departments, urgent cares, and ICU's across the country have adopted varying degrees of telehealth, ranging from monitoring vitals from afar to large, video-based telehealth consults from miles away. While the applications are limitless, we will review applications relevant to emergency medicine.

Telehealth Consultations

ED physicians are masters at multi-tasking and triaging patients. However, some diagnoses have beneficial but risky treatments that are best administered in conjunction with other medical specialists. The emergency provider's knowledge and experience, the patient's acuity of care, and available facilities are all factors that may alter level of care. We will examine the role of telehealth in the management of acute stroke, rapid interpretation of radiologic images, and management of traumatic injury as a means to create a standard mechanism for accessing high-quality care in any setting.

Telestroke

The motto "time equals brain" signifies the importance of acute stroke intervention with t-PA, the current thrombolytic agent used for ischemic stroke. With only a 4.5-hour window period to administer from onset of symptoms to presentation, the use of t-PA involves a series of complex decision-making processes, often best managed by an experienced provider. One such method to increase the use of t-PA is the creation of **Primary Stroke Centers (PSC's),** which must meet criteria of providing 24-hour, 7-day-a-week ability to diagnose and treat patients with stroke, among other strict criteria outlined by the Joint Commission[7].

Unfortunately, PSC facilities represent a minority of facilities across the U.S. For this reason, the involvement of remote experts in stroke management, or "**telestroke**" consultations, hope to bring the highest standard of care to patients in rural, community, and urban centers alike. This system functions with a "hub and spoke" model, where the "hub" is the PSC with a vascular neurologist available for consult, and the "spokes" are non-PSC facilities staffed primarily by emergency physicians[8].

One such successful program includes Remote Evaluation of Acute Ischemic Stroke (REACH), a low-cost, web-based system that provides such a link between the Medical College of Georgia and eight rural community hospitals in east central Georgia. In this model, the vascular neurologist at the "hub" site logs into the REACH website to access patient vitals, review CT images via DICOM software, and perform a video consultation over Broadband internet to determine an NIHSS score and give the appropriate t-PA recommendations. In addition to improving patient outcome through rapid treatment, the requirements of the "spoke" hospital are feasible: a CT scanner capable of transmitting DICOM imaging, broadband Internet access, and equipment costs below $10,000[9].
It is important to highlight that PSC-underserved areas exist even in urban environments; unfortunately, a major limitation of the current model is that reimbursement is limited only to

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[7] The Joint Commission. (2013). Advanced certification for primary stroke centers. Retrieved 2/20/2013 from http://www.jointcommission.org/certification/primary_stroke_centers.aspx
[8] Demaerschalk, Bart M (2009). Stroke telemedicine. *Mayo Clinic proceedings (0025-6196)*, 84(1), 53.
[9] Hess, D., Wang, S., Gross, H., Hall, C., & Adams, R. (2006). Telestroke: extending stroke expertise into underserved areas. The Lancet Neurology, (5), 275-78. Retrieved from http://www.reachhealth.com/press/2006.03.pdf

services performed in a "rural health professional shortage area" or in a "county not classified as a metropolitan statistical area"[8]. This loophole must be addressed to allow greater access to stroke consultation.

Teleradiology

Teleradiology is a branch of telehealth in which radiologists provide remote reporting on radiologic images. The field has been widely used for well over a decade, providing good hindsight on the rapid change in infrastructure and the aftermath of transitioning from an on-site to remote form of communication.

Indeed, teleradiology exploded in the early 2000's; between 2003 and 2007 the number of providers utilizing teleradiology jumped from 15% to 50%, respectively[10]. This rise in the use of these services was initially related to the rise in CT scanners in emergency departments, with "night hawks" available for off-hours shifts. As the market increased, many hospitals saw an advantage to utilizing such services at all hours; their interpretations were affordable, and provided a rapid turn-around time of 30 minutes for preliminary reports and 24 hours for final reports. The Joint Commission (TJC) began to accredit companies providing teleradiology services starting in 2004, further establishing their place in the world of radiology[10].

One of the largest providers of teleradiology currently includes the Minnesota-based VRad, which partnered with NightHawk in 2010 to expand its coverage to over 2,700 healthcare facilities nationwide. According to the CTO Rick Jennings, VRad has spent $50 million over the last eight years building out its I.T. infrastructure, stating "we were cloud before it was called the cloud"[11].

While teleradiology surely is an added benefit to emergency situations when Radiologist interpretations of studies are limited, limitations to patient care exist. Coordination of care, such as compiling final reports based on follow-up examinations, imaging study comparisons, and collaborations across specialists, is difficult to achieve. Additionally, multiple radiologists reviewing a patient's images across time may create incongruence in treatment and care. Such considerations should be taken into account as EMR's develop to provide more patient-focused care that reduces interpretation difficulties.

Teletrauma

The "golden hour" is an important concept in trauma, as it provides rapid, excellent care to critically injured patients and improves outcomes by 25%. Unfortunately, only some 30% of the U.S. population has access to designated trauma centers within the first sixty minutes of their trauma[12], posing a major public health concern.

Teletrauma, therefore, is an especially exciting field in the spectrum of emergency medicine, as it allows remote regions of the country to stay interconnected to provide a high standard of care. One large scale example of such a facility is Eastern Maine Medical Center (EMMC) in Bangor, Maine. As one of the state's three regional trauma centers, it serves as the referral center for over 20 community-level hospitals. In 2004, they became the first center to conduct telehealth consultations through live audiovisual connections at eleven sites throughout the state. With initial start-up costs totaling $70,000, maintenance of the system has been facilitated by internet

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[10] Steinbrook, R. M. (2007). The Age of Teleradiology. *The New England Journal of Medicine* , 5-7.

[11] Versel, N. (2011, Sept 12). VRad Extends Cloud Radiology Services.

[12] Zamora, D. R. (2011). "iPod Teletrauma: the $229 130-million sq. foot Trauma Room". Dirigo, Maine, USA.

provider-based services, utilizing large video screens that display the trauma bay to trauma consults at distant sites[13].

Its implementation demonstrates a number of valuable lessons on the impact of teletrauma. By involvement in the initial patient survey, experienced trauma surgeons can bypass obsolete practices such as "spine clearance", suggest against CT scans and X-rays in certain cases, and provide current guidelines for reversal of therapeutic anticoagulation, all issues that have been found in less-experience providers[13]. Additionally, their experience with teletrauma has created an enhanced, rather than decreased sense of teamwork and partnership amongst those participating in the interactions. EMMC coined the term "the 130 million square foot trauma room" [13] to describe the success of their collaborative efforts.

A challenging aspect to the teletrauma program at EMMC is that the trauma surgeons, while available 24/7, were often not physically able to get to computer sites which interconnected to the remote hospitals at the time of trauma; additionally, some providers noted difficulty navigating cumbersome computer menus[13].

More recently, a solution to this problem emerged with expanding iPhone technology with programs such as Facetime, which allow face-to-face video interaction with a simple WiFi connection. In the first-ever launch of its kind, EMMC began to supplement their desktop-based trauma consults with iPod touches, where they are able to perform assessment of patients via crystal-clear video and audio capacity[14]; i.e. zooming on a patient's pupils during a neurological exam for a boy with craniofacial injuries[15].

As with all considerations, while such programs will likely result in an overall decrease in cost, financial reimbursement for services is a concern and will likely drive the expansion or demise of such programs.

To view a video regarding telehealth and use of Ipods at EMMC, visit:
http://www.youtube.com/watch?v=_9QW5jhuPKI

Mobile Health (mHealth) and Medical Apps

As was already alluded to, an exploding area of telehealth is **mobile health** or simply "**mHealth**". Recently named one of the top healthcare initiatives by the director of the NIH, Francis Collins[14], an estimated 84% of physicians are already using smartphones, with 25% more also using tablets to access the over 13,000+ smartphone apps available for medical-decision making[16]. Collins states that mHealth apps are just beginning to transition from "gee-whiz toys" to a low-cost, real-time ways to assess disease, movement, images, behavior, social interactions, environmental toxins, metabolites and a host of other physiological variables[14].

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[13] Bjorn, P. R. (2012). Rural Teletrauma: Applications, Opportunities, Challenges. *Advanced Emergency Nursing Journal* , 232-237.

[14] Collins, F. (2012, 7 10). *The Real Promise of Mobile Health Apps* . Retrieved 9 28, 2012, from Scientific American: http://www.scientificamerican.com/article.cfm?id=real-promise-mobile-health-apps

[15] *Eastern Maine Medical Center First Ever Use of iPod® For.* (3, 17 2011). Retrieved 9 16, 2012, from www.emmc.org/: http://www.emmc.org/assets/0/274/306/3268/6904/20940/888c720f-cfff-41e6-9160-1f78bc69aa9f.pdf

[16] Dolan, B. (2011, 22 9). *Report: 13K iPhone consumer health apps in 2012*. Retrieved 9 13, 2012, from Mobile Health News: http://mobihealthnews.com/13368/report-13k-iphone-consumer-health-apps-in-2012/

A promising use of mHealth in the emergency setting is for acute wound assessment. A recent study at the George Washington University in Washington, D.C. studied images taken by 94 patients with acute wound lacerations over an 8-month period. Patients provided a medical history, took four pictures of their lacerations, and were assessed by ED providers about need for repair; the same provider then assessed the patient in-person. The study found concordant decision-making between mobile and in-person assessments to be 87% (κ statistic=0.65), with the degree of under-triage due to poor image quality or poor representation of the problem to be 5 out of 94, or 5%. Limitations included variety of phones used for assessment, differing picture quality, and lack of safety and cost impact assessments[17].

Medical Apps

"The use of mobile medical apps on smart phones and tablets is revolutionizing health care delivery," said Jeffrey Shuren, M.D., J.D., director of the FDA's Center for Devices and Radiological Health"[18]. With the advent of the iPhone and iPad manufactured by Apple Inc., software has specifically been made to give emergency physicians the ability to view patient sensitive images for use in medical management.

Mobile MIM is one such free app. Approved for use by the FDA in 2011, it transfers radiologic images from the hospital and transfers them securely to other appropriate portable wireless devices via cloud-based DICOM software. "This important mobile technology provides physicians with the ability to immediately view images and make diagnoses without having to be back at the workstation or wait for film," said William Maisel, M.D., M.P.H., chief scientist and deputy director for science in the FDA's Center for Devices and Radiological Health[18]. Following its induction in February of 2011, a six month analysis of its portable device characteristics and accessibility showed that all performance requirements met intended specifications, and "that Mobile MIM (RT) provides a safe and effective diagnostic viewer of the following medical imaging modalities: SPECT, PET, CT, MRI, X-ray and ultrasound" [19].

Patient use of mobile health apps is also on the rise. The market for medical applications for patients reached $718 million in 2011; Apple and Google serving as vanguard with over 500,000 apps each[20]. One such consumer app is iTriage, a free app created by two ED physicians in 2008 that "helps you answer the questions: What medical condition could I have? Where should I go for treatment? Save, easily access, and share the healthcare information that's most important to you." Acquired by Aetna in 2013, criticism of such apps includes patients being directed to specific "endorsed" EDs, introducing financial influences outside of a patients' care[21].

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[17] Sikka, N., Pirri, M., Carlin, K., Strauss, R., Rahimi, F., & Pines, J. (2012). The use of mobile phone cameras in guiding treatment decisions for laceration care. *Telemedicine Journal and e-health* , 554-7.

[18] Jefferson, Erica. *FDA clears first diagnostic radiology application for mobile devices*. Retrieved 1 17, 2013 from FDA, http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm242295.htm

[19] Hanigan, Lynn. *510(k) Summary of Safety and Effectiveness*. Retrieved 1 17, 2013 from FDA http://www.accessdata.fda.gov/cdrh_docs/pdf11/K112930.pdf

[20] Obiodu, Vivian. & Obiodu, Emeka. (2012 12 21). *An Empirical Review of the Top 500 Medical Apps in a European Android Market*. Retrieved 1 17, 2013 from Journal of Mobile Technology in Medicine

[21] *itriage health*. (n.d.). Retrieved from https://www.itriagehealth.com/

Integration with Quality Drivers: Electronic Health Records

Electronic Health Records are a large part of the revolution of telehealth, and while a thorough discussion of their implication is not the intent of this paper, we will discuss their importance in addressing some relevant quality improvement issues of which emergency physicians should be aware.

In February 2009, the American Recovery and Reinvestment Act (ARRA) published the Health Information Technology for Economic and Clinical Health (HITECH) provisions, which established financial incentives of up to $44,000 per provider for demonstrating "meaningful use" of electronic health records (EHR's); and if not met by 2015, financial penalties[22]. This effected a rapid increase in use of EHR's, jumping provider and hospital use from 17 and 8 percent, respectively, to a goal over >50% of providers and 80% of hospitals demonstrating meaningful use as of 2013[23].

Much of this was in anticipation of the 2010 passage of the Patient Protection and Affordable Care Act (ACA), which focuses on incorporating public health measures into our current healthcare system. Specifically, the Centers from Medicaid and Medicare Services (CMS) has begun a quality improvement process that includes quarterly reporting and publication of specific data measures related to diseases such as acute myocardial infarction, heart failure, pneumonia, and surgical care. For example, all patients admitted to the hospital with a diagnosis of congestive heart failure must receive smoking cessation counseling if currently smoking, prescription of an ACE-inhibitor or ARB if ejection fraction is <40%, and appropriate discharge education and follow-up is established. Additionally, for Medicare patients >65 years of age, all-cause mortality and readmission rates are reviewed as part of reimbursement[24].

The aforementioned examples present a unique challenge for facilities, as these new guidelines require extensive implication of processes to ensure that measures are being met and to avoid financial penalties. Concerns about privacy and security, legal and regulatory barriers, and technical concerns all factor into the implementation of what federal government, patients, and physicians alike hope will provide a more quality, coordinated care system through more robust use of EHR's[24].

The impact that quality drivers will have on emergency departments has yet to be determined, though most likely will be similar to inpatient parameters: decreasing repeat visits for same problem and focusing on outpatient-based care for non-emergent problems.

Security and Risk in Telehealth

Similar to conventional medicine, a telehealth clinician has the same duty to safeguard a patient's medical records and keep their treatments confidential under **The Health Insurance Portability**

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[22] Adler-Milstein, J., DesRoches, C. M., & Jha, A. (2011). Health information exchange among us hospitals. *American Journal of Managed Care*, *17*(11), 761-8. Retrieved from http://www.ajmc.com/publications/issue/2011/2011-11-Vol17-n11/Health-Information-Exchange-Among-US-Hospitals/

[23] U.S. Department of Health and Human Services. (n.d.). *Doctors and hospitals' use of health it more than doubles since 2012*. Retrieved from http://www.hhs.gov/news/press/2013pres/05/20130522a.html

[24] Centers for Medicare and Medicaid Services, Health Services Advisory Group. (2012). *National impact assessment of medicare quality measures*. Retrieved from website: http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityMeasures/Downloads/NationalImpactAssessmentofQualityMeasuresFINAL.pdf

and Accountability Act (HIPAA) of 1996. All patient data, including electronic files, images, audio/video tapes, etc., must be handled with utmost confidentiality[25]

Telehealth presents some unique challenges to security. The method of telehealth may change the security concerns; i.e. a patient participating in a video consultation may be concerned about other persons in the room, whereas someone with remote monitoring might worry about physical safety and reliability of the device. Without affecting any of the implications for providers, many of the security concerns may be related to patient demographic. Research suggests younger patients are familiar with the use of such advanced technology and therefore may be less concerned about confidentiality than older generations[26], though this does not change how the clinician should handle patient data.

Regarding legal implications to ED providers, as of 2009, there had been no malpractice claims related to the use of telehealth, attributed to the fact that it is a relatively new technology[27]. One can imagine that with increasing use will come increasing concerns over malpractice.

For more on legal and regulatory barriers to the expansion of telehealth, visit www.ctel.org/

Cost of Telehealth

While current studies are equivocal on cost savings of telehealth, it is often touted as a means to reduce spending. Remote access to patients can theoretically save travel time, result in fewer transfers, earlier intervention and access with lower "global cost" for services and social consequences, and lower readmission rates, among others[28].

Of course, there are expenses to the set-up and maintenance of such systems. Standard equipment needed for a full telehealth suite include televideo monitor with camera, initial network setup, patient monitoring devices, a room with well-adjusted lighting, security, and sound for clinical events. Operational costs include telehealth personnel, consultant costs, I.T. support, equipment licenses, monthly connectivity charges, and clinical/medical records management to get info to and from distant sites.

Different sites have used different means to offset the costs of building and maintaining a telehealth suite. Federal or state grants, in addition to foundation grants, venture capital, internal funds, or other private donations are all viable options[29]. The Southern Arizona Telemedicine and Telepresence Association (SATT), for example, received generous donations from private insurance companies and also receive state and federal funding totaling $1.2 million/year in their first 4 years[30].

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[25] *Privacy, Confidentiality, and Security*. (n.d.). Retrieved 9 30, 2012, from Telehealth Resource Centers: http://www.telehealthresourcecenter.org/toolbox-module/privacy-confidentiality-and-security

[26] Garg, V., & Brewer, J. (2011). Telemedicine Security: A Systematic Review. *Journal of Diabetes Science and Technology* , 768-777.

[27] Natoli, C. (2009, 12). *Summary of Findings: Malpractice and Telemedicine.* Retrieved 10 5, 2012, from CTeL: http://www.ctel.org/research/Summary%20of%20Findings%20Malpractice%20and%20 Telemedicine.pdf

[28] Telehealth Project of MN . (n.d.). *TeleHealth Project.* Retrieved 10 5, 2012, from Health.state.mn: http://www.health.state.mn.us/divs/orhpc/rhac/minutes/handouts/51909/brand.pdf

[29] Informatics, U. o. (2007, 8). *Minnesota Telehealth Inventory 2007*. Retrieved 10 5, 2012, from Minnesota Department of Health:

[30] Latifi, R. e. (2004). Telepresence and telemedicine in trauma and emergency care management. *Studies in health informatics and technology* , 193-9.

On its website, Eastern Maine Medical Center detailed start-up costs approximating $70,000 and monthly charges for network maintenance averaging $1,000. Oklahoma State University Center for Health Sciences details the costs of its telehealth suite to be approximately $25,000 plus maintenance costs, with the following estimates in 2013[31]:

- $8,000 for telehealth consultant suite ($7,000 for the interactive video display, $1,000 for telecommunications)
- $16,600 for their patient suite ($9,600 for a video cart, $6,000 for an AMD Derm Camera, and $1,000 for telecommunications)
- Maintenance fees of $400/month (for ~30 patients with an average visit length of 30 minutes)
- Optional additional teleradiology costs: $12,000 for the hospital suite site and $15,000 for the patient site

In addition to mobile health apps, aforementioned technologies such as VSee provide a less expensive alternative to implementing entire telehealth video consultations. Basic VSee telehealth "kits", which include a laptop, HD webcam, electronic stethoscope, otoscope, and 1-year subscription cost $6,000, whereas an advanced kit containing a pan-tilt camera, portable EKG, and portable ultrasound cost about $18,000[32].

Reimbursement

Telehealth reimbursement is a separate enigma, as no consistent pattern of reimbursement has emerged for the variety of applications of telehealth[33] However, with more government support of telehealth, private insurers are following suit.

Medicare & Medicaid

In recent years, congressional legislation has further defined physicians' Medicare policies for reimbursement to encourage use of telehealth services and ensure sustainability of telehealth as a mode of healthcare delivery[34]. The legislation states that you can be reimbursed for real-time, video-based consultations at the same rate as face-to-face care, but will not reimburse for store-and-forward applications such as audio, video, or images captured (unless in Alaska or Hawaii).

Some regulations are in place regarding coverage. The originating site (where the patient is located) must be an eligible Medicare beneficiary in an eligible facility located within a primary care Health Professional Shortage Area (HPSA), and/or outside of a Metropolitan Statistical Area (MSA). These criteria include sites with <1 primary care physician per 3,500 people, and no city with >50,000 inhabitants[34]. In contrast, the referring site (where the consulting physician is located) has no limitations on location.

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[31] Oklahoma State University Center for Health Sciences. (n.d.). *Services and Costs*. Retrieved 10 5, 2012, from Telemedicine and Distance Learning: http://www.healthsciences.okstate.edu/telemedicine/services_cost.cfm

[32] *VSee*. (2013). Retrieved 9 23, 2013, from VSee: http://www.vsee.com

[33] Bjorn, P. R. (2012). Rural Teletrauma: Applications, Opportunities, Challenges. *Advanced Emergency Nursing Journal* , 232-237.

[34] Britain, C. (n.d.). *Medicare & Medicaid Telemedicine Reimbursement: An Overview*. Retrieved 5 10, 2012, from Upper Midwest Telehealth Resource Center: http://www.umtrc.org/clientuploads/directory/Resources/Medicare%20&%20Medicaid%20Telemedicine%20Reimbursement%20An%20Overview.pdf

Claims for reimbursement must be submitted with the appropriate CPT code, in addition to a GT modifier to indicate that care was delivered via an interactive audio and video telecommunications system. The originating site can additionally bill a telehealth facility fee using the HCPCS code Q3014 (about $20.00).

Below are billing codes used for telehealth interactions[35]:

2012 Medicare (HCPCS) Telehealth Descriptor Codes for the Emergency Department			
Code	**Descriptor**	**Time spent**	**RVU's**
G0425	Emergency Departelehealthent or initial inpatient telehealth consultation	30 minutes	2.96
G0426	Emergency Departelehealthent or initial inpatient telehealth consultation	50 minutes	4.03
G0427	Emergency Departelehealthent or initial inpatient telehealth consultation	70 minutes	5.92
GT Modifier	"Via interactive audio & video telecommunications system"	Used by providers at distant site to bill for real-time consultations	
GQ Modifier	"Via asynchronous telecommunications system"	Used by providers participating in federal telehealth program in Alaska or Hawaii to bill for store-and-forward technology	

For **Medicaid**, each state sets its own reimbursement policies, which can vary depending on if it is a fee-for-service or a managed care provider, with fee-for-service providers traditionally being more willing to reimburse. Within the US, 39 state Medicaid programs provide at least some reimbursement for telehealth services, with behavioral health experiencing the most rapid expansion of reimbursement policies[35].

For state-by-state policies, visit the ATA wikis at www.americantelemed.org/i4a/pages/index.cfm?pageID=3604 , or visit http://ctel.org/expertise/reimbursement/medicaid-reimbursement/ .

Private Insurance

Historically, a large barrier to growth of telehealth has been the conceived lack of private payer reimbursement. As of July 2012, 15 states require third party payers to reimburse for teleconsult as they would for in-person consults, including Michigan, Maine, Oregon, California, Colorado, Georgia, Hawaii, New Hampshire, Kentucky, Louisiana, Texas, Oklahoma, Virginia, Vermont, and Maryland[36].

[35] Association, A. T. (2012, 1). *Medicare Payment of Telemedicine and Telehealth Services, January 2012*. Retrieved 10 5, 2012, from American Telemedicine Association: http://www.americantelemed.org/files/public/policy/medicaretelemedicine2012.pdf

[36] Billings, G. (2012, 7 9). *Private Payer Reimbursement.* Retrieved 10 5, 2012, from Center for Telehealth and e-Health Law (CTEL): http://ctel.org/category/telehealth-private-payer-reimbursement/

Challenges and Opportunities

There are many exciting opportunities and remaining challenges to the continued implementation of successful telehealth programs within the field of emergency medicine. Opportunities include creating a more cost-effective healthcare system by reducing unnecessary transfers, consolidating healthcare records and visits through EMR's, and increasing access to high-quality stroke and trauma care regardless of a patient's geographic location.

Major challenges to the field have historically included a lack of financial reimbursement for telehealth visits, social adaptability to such changes both within and outside of the healthcare community, and the technology itself being too expensive or cumbersome.

Many of these challenges are soon to be overcome. For example, reimbursement is becoming more widely adopted following Medicare's lead; 17 states now require private insurance coverage for telehealth services as of September 2013, and many others are quickly following suit[37].

Interestingly, social acceptance of telehealth has been a large barrier to its growth. In an era where video chatting, social media, and movies like Avatar are commonplace, it is surprising to think of this as a major limiting factor in its widespread adoption, but deep-seated feelings by both patients and providers have been noted. Many providers, for example, have misconceptions that the use of a video-based telehealth visit or consult will decrease patient-provider relationships, and be poorly accepted by patients. In fact, research both in the U.S. and worldwide has soundly shown a high acceptance and satisfaction, in general, with telehealth interactions. Suggestions to overcome the potential discordance have been introduced, and include beginning with a pilot launch and then expanding as needed[38].

Future Innovation within Telehealth

Indeed, just as the use of IPod's to perform trauma consults was an easy solution to connection problems experienced by surgeons in Maine, there are many other common-sense, affordable solutions to inefficiencies in healthcare.

Many examples of this are proposed through research by Dr. Joseph Kvedar, Director of the Center for Connected Health. He has taken the conversation regarding social adaption of technology one step further to research automation in the healthcare world, and why we feel a "face-to-face" interaction is necessary to form a relationship with a provider, and how we can incorporate digitalization into our clinical encounters.

By comparing pet rocks and Tamagotchi's to our trusted pets, he demonstrates that humans are able to connect with automated figures in a "real" way. For example, when diabetic patients met with a virtual coach, "Karen", three times a week, they increased their step counts by three-fold as opposed to those who didn't. Surprisingly, they also state a preference for an automated coach as opposed to a human, as the "robot" was non-judgmental, and had time to coach the patient without

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[37] *National Conference of State Legislatures (NCSL)*. (n.d.). Retrieved from State Coverage for Telehealth Services: http://www.ncsl.org/issues-research/health/state-coverage-for-telehealth-services.aspx

[38] Whitten, P., Holtz, B., & Laplante, C. (2010). Telemedicine: What have we learned? *Applied Clinical Information*, 132-141.

rushing. Perhaps, he argues, automation can be used to augment patients' satisfaction with care rather than detract from it[39].

For telehealth reimbursement state-by-state, go to: http://www.ncsl.org/issues-research/health/state-coverage-for-telehealth-services.aspx

Conclusion

Telehealth is an exciting, continually evolving endeavor that provides an innovative way of organizing emergency room workflows across the country, allow for optimal and efficient patient care. Continued funding by state, local, and private sectors will permit widespread adoption of telehealth.

[39] Kvedar, D. J. (2010, Oct 21-22). Emotional Automation: A Critical Component of Healthcare's Future. Boston, MA. http://www.youtube.com/watch?v=7DQGNQRVhjI