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Uses, Benefits, and Future Directions of Telepsychiatry

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Abstract

The current healthcare system in the United States currently suffers from being medically underserved in a large geographical portion of the country and cost increases. Telemedicine, the providing of medical care over telecommunication medium, has become increasingly viable due to improvements in technology and infrastructure. The use of telemedicine will help improve accessibility and decrease cost. Telemedicine has shown to be useful in various fields of medicine such as emergency medicine, pediatric care, and psychiatry. This discussion will argue that telemedical care is well suited for psychiatry because it often relies on nonphysical diagnoses, is cost effective, and may help decrease the skipping of treatment due to perceived social stigma of mental illness. A review of past research will show telepsychiatry is effectual and increases healthcare accessibility. Finally, a case that telepsychiatry could be best utilized with development of a multipronged infrastructure will be made. This includes a telemedical home intervention infrastructure, employment of telemedical practices at primary care facilities, and app-based telecare.

Introduction

Wide swaths of the US are medically underserved. Healthcare accessibility in rural areas remains especially problematic. Costs have also risen steadily in this timeframe, both in out-of-pocket expenses and premium costs. Recent advances in technology have improved the viability of telemedicine, which is providing medical care over a telecommunication medium. Telemedicine may help address the issues in our current healthcare system involving healthcare accessibility and cost. A discussion on the use of telemedicine will highlight current uses of telemedicine, showcase why telemedicine is well suited for use in psychiatric practices, and propose what ideal telepsychiatry practices may look like going forward. This discussion will act to inform administrators on the benefits and drawbacks of telemedicine and suggest what avenues of telehealth provision could be most useful going forward. The formation of telepsychiatry practices and providing of telemedical care could help to reach underserved populations and help alleviate healthcare disparities.

Increasing costs are a factor for healthcare accessibility. A survey by NORC at the University of Chicago showed 40% of those surveyed skipped a recommended medical test or treatment due to cost. More than half of that group or 27% of those surveyed denoted that they had done this on more than one occasion. Similarly, the survey also found 44% of participants skipped a visit to the doctor whilst being sick or injured altogether[1].

Healthcare costs have increased in the past twenty consecutive years according to the Kaiser Family Foundation. Insurance premiums have increased 55% in the past ten years for family coverage plans. Single coverage plans have also increased, with a 3% rise in costs from 2017 to 2018[2]. Along with rising premium costs, hospital visits are becoming increasingly costly, especially in emergency settings. Inpatient hospital visits have increased 13% for patients with private insurance since 2014. Medicare and Medicaid insurance patients have faced increased costs as well, albeit at a more modest 3% increase[3]. The Health Care Cost Institute estimates that from 2009 to 2016 emergency room facility visits rose from an average of \$600 to an average of \$1,322[4], culminating in a 120% increase in average emergency room facility charge over the course of 7 years. The increasing healthcare costs related to inpatient and emergency medicine has made medical care less accessible for Americans.

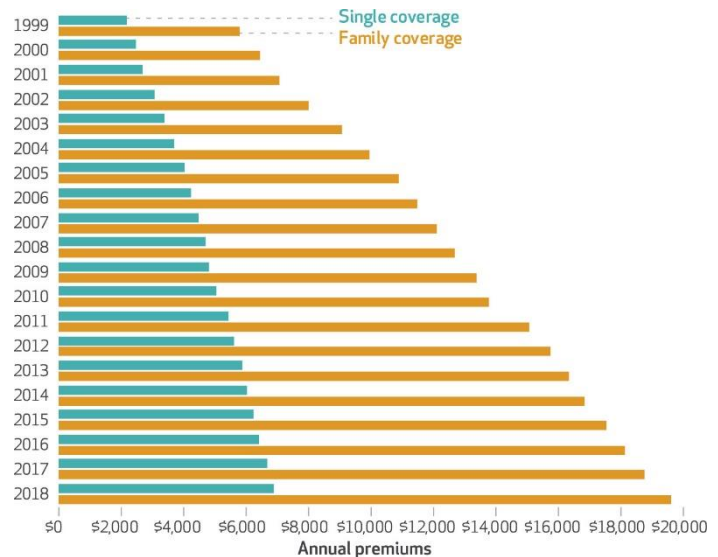
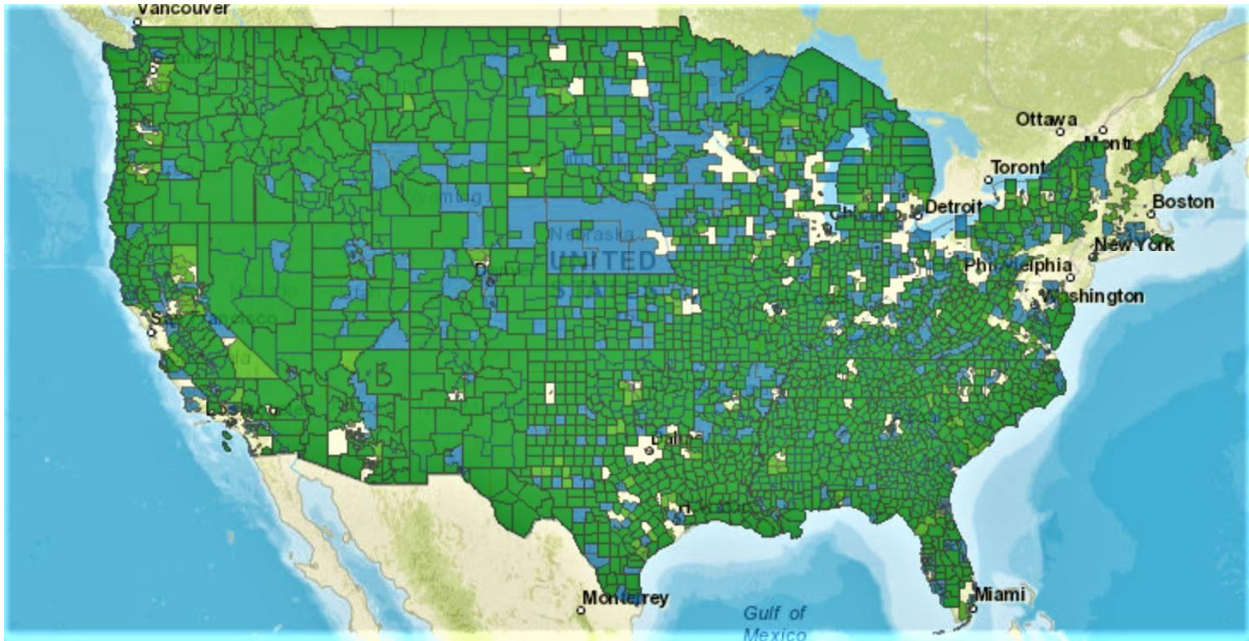


Figure 1. Kaiser Family Foundation. Annual avg. health insurance premium cost in USD 1999-2018.

Along with rises in cost, physician shortages in the current United States healthcare system have limited the accessibility of medical care. In 2018, the Health Resources & Services Administration listed that 6,890 areas within the United States qualified for a Primary Care Health Professional Shortage Area. Additionally, 5,035 areas in the US were listed as a shortage area for mental health professionals[5]. These areas are not mutually exclusive. A large number of Americans live within these areas. The HRSA reports that 79 million Americans live in Primary Health Care Shortage Areas and 115 million live in Mental Health Care Shortage Areas[6]. A map of the aforementioned areas is shown in figure 2 (Hawaii and Alaska are not shown, however, a majority of land areas in these two states are listed as Health Professional Shortage Areas).



[7]

Figure 2. United States Health Resource & Services Administration. Light green areas represent primary care shortage areas. Blue areas represent mental health shortage areas. Dark green areas represent shortages in both areas.

Sociological factors limit an individual's ability to access healthcare. Examples of this are, but not limited to stigma surrounding mental illness, health inequality due to income level, or racial disparities in health care.

Many changes to our system have been proposed to alleviate these current healthcare issues. These fixes can be on a national level such the introduction of a Medicaid-For-All program. This change may help lower costs according to some analysts but does not solve social healthcare disparities such as skipping treatment because of perceived social stigma in mental health. A change that can help to alleviate the current issues of our healthcare system is the use of telemedicine to aid in the treating of patients. Evidence of telemedicine's benefits regarding these issues will be discussed later. While current telemedical practices can utilize newly developed technology, telemedicine's origins date back to the 20th century and are worth exploring.

History of Telemedicine

While the origins of medicine date back thousands of years, telemedicine is a more modern concept. Scannell provided this encompassing definition of telemedicine: "Telemedicine is the use of telecommunications for medical diagnosis and patient care. It involves the use of telecommunications technology as a medium for the provision of medical services to sites that are at a distance from the provider. The concept encompasses everything from the use of standard telephone services through high speed, wide band width transmission of digitized signals in conjunction with computers, fiber optics, satellites and other sophisticated peripheral equipment and software." [8]

The broadness of this definition allows us to include a wide array of current medical practices. Some of these practices have origins that predate traditional telemedicine and have been used for some time. An example is the use of telephones to confer between physicians. Practices such as the use of videoconferencing have only just seen widespread usage in the past 20 years. Other practices, like telesurgery, may only be on the verge of evolving into standard medical practices. The documented use of telemedicine has its origins in the twentieth century. Thus, compared to others practices in medicine, telemedicine is a much younger, and less tested, form of medicine. The modernity of telemedicine is due in no small part to the emergence and standardization of once novel technologies such as high-speed internet and live video conferencing. Increased access to instant telecommunication services in hospital settings have increased the viability and affordability of telemedicine practices.

Although, the use of telemedicine is more expansive today, the origins of the practice date back to the mid-20th century and are worth exploring. In 1950, radiologic images were sent via telephone between Philadelphia and West Chester, PA[9]. In the same decade, Radiologists in Canada set up a similar system in Montreal[10].

A separate facility utilized video feed for communication a short time later. A two-way television system was created at the University of Nebraska to communicate across campus. This system enabled the communication of relevant medical information to medical school students. This system was modified 5 years later to link to the Norfolk State Hospital to aid in the delivery of neurological examinations and consultations of psychiatric patients, in addition to the training of medical students[11]. As discussed later in this review, the use of telemedicine for psychiatry remains advantageous today.

Other early uses include the monitoring of patients with chronic medical conditions such as hypertension and diabetes. Ahring and Marrero both studied telemedicine in diabetic patients. Ahring studied blood glucose in an adult population and saw a significant improvement in HbA1c results within the experimental (telemedicine) group but not in the control group[12]. In 1995, Marrero studied metabolic control in pediatric patients. The study compared blood glucose sent to a physician via tele modem versus given to a physician at 3 month scheduled checkups. The trial showed no significant differences in metabolic control between groups[13]. The incurred cost of the machine used to communicate the results likely discouraged further study as there was no improvement in metabolic control outcomes. If this setup was repeated today with technology already owned by the patient's family, it would be more economically feasible.

Long term monitoring of the blood pressure of pregnant women was tested by in a 1992 trial. The study measured the blood pressure of pregnancy women via an in-home device that communicated results to a hospital computer via a telephone modem. The experiment found no significant difference in anxiety between the at-home (telemedicine) group or hospital (control) group. The study did not take into account economic viability[14].

As telemedicine had existed for a half century, one might expect a robust field of literature. However, a literature review in 2000 looking at comparing outcomes in telemedical practices compared to face-to-face practices found only 24 studies met their criteria for inclusion

in their review[15]. The main justification as to why so few studies qualified for the review was inadequate group size, which stems from the limited number of patients seen using telemedical practices prior to 2000. More recently, advances in technology have spurred more interest, participation, and research in telemedical practices.

Current Forms of Telemedicine

As previously mentioned, telemedicine has greatly benefitted from the development and availability of technology. In fact, the use of telecommunication devices is crucial for many medical services. Many of these services fit within our definition of telemedicine. The use of telephones is not novel in the field of medicine, but this form of telecommunication remains among the most crucial forms of communication within the medical system. Telephones allow easy access to specialty consultations and can aid in the diagnosis of ailments, especially at the primary and emergency levels of medicine. Telephones allow quick communication between patients, physicians, and medical specialists. Another use of telephones in medicine is the use of translation services. Health care facilities can contract out translating services to commercial companies that can translate over 200 languages. These services are performed in real time and offer an effective line of communication between patients and physicians.

The increased availability of highspeed broadband and livestreaming devices have helped the viability of another form of telemedicine. Teleconferencing, often referred to as videoconferencing, is the use of live video streaming to communicate. These services are now available on a variety of devices, even modern cell phones are capable of reliable and high-quality videoconferencing. The use of videoconferencing has many uses in the field of telemedicine and we will review some specific uses later in this paper.

Telemedicine allows the delivery of medical care over great distances and span over state and country lines. One intriguing area where telemedicine may be used in the future is between physicians on earth and astronauts aboard the International Space Station (ISS). Robonaut 2 is a humanoid like robot whose movement and function are comparable to a human. Robonaut 2 has the capacity to be controlled remotely by physicians on earth to treat a patient aboard the ISS[16]. While Robonaut 2 has not been utilized as a medical device, it is plausible telemedicine could help treat patients in outer space in the coming century. Robonaut 2 is currently under maintenance back on Earth, but it, or an upgraded version, will return to the ISS.

Fields of Telemedicine

While telemedicine has potential for use in all fields of medicine, particular fields have a greater practicality for telemedicine. As previously mentioned, there is a shortage of primary care physicians and mental health professionals in the US, especially in rural areas. This statistic does not include medical specialists such as neurosurgeons, cardiologists, dermatologists, etc. Many specialty practices choose to operate, out of necessity, in larger urban areas, thus exasperating the disparity between care in urban vs. rural areas. Telemedicine is particularly useful for alleviating this disparity by connecting specialized care to rural areas.

Telemedicine for Rural Trauma

Emergency medicine provides crucial care for minor ailments to severe trauma. While rural emergency departments (ED's) are likely prepared for minor ailments, it is much less likely a rural ED will be equipped to handle severe medical trauma with the resources on hand. A study by Mohr in 2018 that analyzed ED visitation in North Dakota Critical Access Hospitals showed that "Telemedicine utilization independently associated with decreased initial ED length of stay for transfer patients." Additionally, the use of telemedicine increased the likelihood of a transfer to another hospital. While the use of telemedicine did not decrease transfer rates (considered to be a possible advantage of telemedicine), it did give patients faster access to more advanced trauma care by expediting transfer to more prepared hospitals[17].

Although telemedicine is useful for sharing knowledge about the patients' conditions and treatment, it does not compensate for the lack of resources that a larger hospital would be able to provide for emergency trauma care. Telemedicine may be useful in aiding physicians in corresponding to a trauma patient, but it does not overcome the stratification of resources away from rural hospitals. Therefore, the use of telemedicine in resolving trauma in rural populations is limited.

Telemedicine for Other Emergency Department Visitation

While use in traumatic injuries may be limited, use of telemedicine in other emergency areas may be more effectual. A systematic review by Ward in 2015 summarized 38 studies performed in various emergency departments. Ward characterized these reviews into three groups. Two of these groups included studies within the United States. The two groups, "general ER use (GEN)" and "Special Patient Populations (SPP)", were characterized by typical patient populations and connecting ER providers to medical specialists for treatment of special conditions, respectively. SPP use included the use of telemedicine for stroke(5), trauma(4), ophthalmology(3), dermatology(1), and airway management(1). Ward stated the clinical processes and outcomes in GEN use of telemedicine were moderately positive, although only 54% of GEN studies reported these measures. SPP trials had strongly positive clinical processes and outcomes with 89% of SPP trials reporting measures in this area. On SPP clinical processes and outcomes, Ward reported "Timely interventions, minimal complications, and adverse outcomes associated with tele-emergency across medical conditions. Good inter-rater agreement between providers at different sites, and provider-reported improvement in patient care." [18]

In addition to generally positive clinical outcomes for the GEN and SPP groups, the study reported user satisfaction across both patients and health professionals. Especially popular amongst the Special Patient Populations, was the reduction in travel time and costs associated with a trip to a medical specialist.

Telemedicine for Intensive Care Units

Critical-access hospitals are hospitals defined by the Centers of Medicare and Medicaid Services that are 35 miles away from the nearest hospital and provide 24 emergency care services, along with other limiting factors[19]. 92% of critical-access hospitals are found in rural

areas[20] and are much less likely to have an on-site intensive care unit (ICU). The use of telemedicine is and could be more extensively used to bring critical care to rural communities.

A study in 2016 found a small, yet significant, improvement in the 90-day mortality rate in intensive care units that utilized telemedicine. ICU telemedicine mainly involves physician collaboration. The effect of telemedicine was not uniform across hospital settings. Urban hospitals saw a greater proportion of this benefit while other smaller hospitals found no benefit or increased mortality[21]. This effect may be similar to factors causing a lack of better clinical outcomes in rural emergency medicine in association with telemedicine. That being, a lack of resources in rural critical-access hospitals as compared to larger hospitals. Therefore, the use of telemedicine in intensive care facilities may not be the most effective use of telemedicine to tackle the discrepancies in care between urban and rural settings. Although telemedicine may not help with quality of care for all hospital settings, there is evidence that there may be economic benefits. A separate study reported evidence that current use of telemedicine in an intensive care setting can be cost effective for health care providers, although the exact degree to which the practice is cost effective has yet to be determined and can vary based on specific hospital conditions[22].

Telemedicine for Pediatric Populations

One of the more researched and tested forms of telemedicine is in its use in pediatric care, especially in rural areas. Research has shown the effectiveness of telemedical care of pediatric patients in diabetes[23], spirometry[24], transport of critically ill children[25], mental health emergencies[26], and cardiology[27], among others.

The use of telemedicine in pediatric care is not without its drawbacks. A study in 2018 reported more than 66% of physicians voiced concerns about making remote diagnosis without a physical examination[28]. This is not unexpected. The use of physical examinations to diagnose ailments is a central component to today's physicians and has been for centuries. The removal of this aspect of a medicinal intervention is certain to cause concerns. Another issue regarding remote diagnosis is the hesitation of physicians in making a misdiagnosis or underestimating the severity of an illness. This may be especially apparent in younger children as they may not be able to effectively communicate information about their symptoms.

From the amount of literature available, these drawbacks seem to be outweighed by the advantages that telemedicine provides. As novel technologies are developed and/or infrastructure is improved, we may be able to find solutions to these problems.

Telemedicine in Surgery

In contrast to the use of telemedicine in rural medicine which is a widely expected use of telemedicine, the use of telemedical technology in surgery is a much less conventional field. As surgery is the use of physical incision or manipulation to treat injuries, the general population may assume that telemedicine would not be useful in surgery rooms, however, the development of precision robotics, such as the da Vinci System, has brought telesurgery into plausibility. The

da Vinci system has documented use in current surgical procedures such as in inguinal hernia repair.

Evans, et al. in 2018[29] outlined five ascending categories of use of telemedicine in surgical procedures: telepresence, telementoring, telestration, teleproctoring, and telesurgery. Telepresence is the groundwork with which the other categories are built off. It involves the simulation of another remote location/environment in order to fabricate a feeling of presence within that environment. Telementoring involves the instruction of a novice surgeon by a tenured surgeon throughout a part of, or entirety of a surgical procedure. Telestration builds off the mentoring principle, by allowing the mentor to annotate real time images from the procedure.

While the categories mentioned so far rely on videoconferencing technology, teleproctoring and telesurgery rely on more advanced robotic technology. These practices have only become available with the invention of precise robotic surgical instruments. Teleproctoring involves the performance of a portion of a surgical procedure via remote robotic technology. Telesurgery differs from this as it involves the completion of the majority or entirety of the surgical procedure. These two fields are much younger and have had limited clinical usage. As the use of robotic surgery becomes more prevalent, the use of remote surgery will likely follow. Current issues limiting the use of telesurgery procedures involve instrumentation lag, regulatory approval, and financial accessibility.

Advantages of Telemedicine

When looking cumulatively upon the fields of telemedicine, some common advantages emerge. Telemedicine connects areas with a shortage of medical professionals to crucial medical care. This is especially salient for medical specialists and for special populations such as pediatrics. The use of telemedicine is also increasingly cost effective. In the past, startup and equipment costs decreased the feasibility of telemedical care, however, with the wide availability of high-speed broadband networks and capable technology have all but eliminated these concerns. Furthermore, these advances have gone beyond being cost effective and have approached cost saving, which may further aid in bringing telemedical care into more hospital settings. Another common advantage is the decreased need for transport. By connecting patient populations to medical specialists, the need for medical and self-transportation is greatly decreased. This may be, collectively, the greatest advantage for patients. Decreased transportation needs will decrease both out-of-pocket cost and time spent seeking treatment.

Disadvantages of Telemedicine

Common disadvantages also emerge when looking broadly at many fields of telemedicine. The incorporation of new technology and programs will require training for the professionals utilizing the technology. The training required may be extensive and will be time consuming for the available professionals already working in medical shortage areas. Staff familiar with servicing and troubleshooting the technology will also need to be employed or contracted out. Additionally, there will be a learning curve for patients who utilize the programs. Patients will have varying degrees of familiarity with the use of technology. There will likely be

a portion of the population who is hesitant to using telemedical practices, or who may decline to use it altogether.

While telemedical practices help alleviate the disparity in medical care across populations, it does not overcome the stratification of resources amongst these populations. It is not currently economically feasible, nor will it be in the near future, for rural communities to have access to the latest advancements in medical technology and practices. Therefore, the complexity of medical procedures that rural clinics and hospitals can provide will continue to lag behind those at their metropolitan counterparts. As stated, a central disadvantage of telemedicine is the inability for physicians to perform physical examinations on their patients. Technology is likely decades away from alleviating this issue from the field of telemedicine. There may be some potential infrastructural changes that may help with this issue that will be commented upon later in this paper. While many practices in medicine will continue to see this disadvantage in telemedical practices, there is one field of medicine that does not require physical examinations in many of its medical practices. This field, the field of psychiatry, is well suited for telemedicine interventions.

Psychiatric Telemedicine

Psychiatry is the study of mental illness. It is estimated that approximately 1 in 5 US adults live with a mental illness. There are over 200 psychiatric illnesses and there are many symptoms that relate to these illnesses. Some of these symptoms include extreme mood changes, detachment from reality, confused thinking, feeling sad or down, excessive anger, and suicidal thinking[30]. Symptoms of mental illness are generally not conveyed with physical measures and are often assessed through dialogue rather than with a physical test. The American Psychiatric Publishing Textbook of Psychiatry states that beyond some light bloodwork, such as blood glucose and Blood Urea Nitrogen, broader screening tests are generally unnecessary and costly for patients with no other physical complaints[31]. As this bloodwork could be drawn at a satellite clinic or during an annual check-up, the treatment of psychiatric illness, especially long-term care, is well suited for telemedical practices. The treatment for psychiatric illness is generally treated with medication and psychotherapy[32] which could be updated and conducted, respectively, via telemedicine. It should be stated that not all psychiatric symptoms are a result of psychiatric illness, for this reason, a visit to a physician is still recommended for acute onset of psychiatric symptoms.

As discussed, telemedicine has been shown to be effective in lowering the costs of various types of medical practices. There is evidence that this is also true for psychiatric practices[33]. There have been conflicting studies of the economic viability of telepsychiatry, however some of these studies assume the cost of providing the patient with the equipment necessary for video conferencing. Advancements in technology have brought video conferencing capabilities onto mobile devices and laptops. A survey by the Pew Research Center places “smartphone” ownership at 77%[34], which suggests videoconferencing technology would

already be available to a wide majority of Americans, although this number may not be characteristic of all subpopulations. A study on depression by Bounthavong showed that telebehavioural health care is not cost effective (\$71,974 telehealth, \$20,322 without) if the patient is supplied with videoconferencing technology, however, if the patient already has access to videoconferencing technology the practice of telemedicine was cost effective (\$19,177 telehealth, \$20,322 without)[35].

Stigma is especially relevant when considering health care accessibility in the field of mental health. Corrigan argued, regarding mental health, that, “stigma is a significant barrier to care seeking and participation.”[36, 37] The social stigma around mental illness limits patient involvement in treatment, leads to defaulting on clinic visits, and even hiding the illness from others[38]. Clement et al. authored a meta-synthesis analyzing the impact of mental health stigma on help-seeking. The study compiled 144 total studies (90,189 participants) on the topic, 56 of which were quantitative association studies. From these quantitative studies, a small negative association was found between stigma and help-seeking (median Cohen’s *d* of $-.27$). “A majority of the association studies reported a negative association, with the majority being statistically significant.”[39] This suggests that stigma is a significant hindrance to the mental health population in the seeking of treatment for mental health disorders. Furthermore, a study by Shrivastava in 2012 suggests stigma is more than a social factor and can be thought as clinical condition and should be addressed as such[38]. Health care providers should actively look for ways to limit or eliminate stigma in their care. Telemedicine gives patients the ability to seek psychiatric treatment in a discrete manner. This discreteness could potentially alleviate social stress stemming from stigma by eliminating the need to seek out treatment in the open eyes of the public, and instead give patients the ability to connect to health care providers from within the privacy of their residence/satellite clinic. The reduction of this social stress would be a benefit to psychiatric patients and the physicians who treat them. Unfortunately, the effects of telepsychiatry on social stigma remain poorly researched. It would be prudent of the field to invest in research that studies these benefits, as it may help eliminate a problem that has plagued the field seemingly since its inception.

Telepsychiatry has been shown to be equivalent to traditional methods. Data collected as early as 2001 showed that the efficacy of telepsychiatric care was equivalent to face-to-face interactions when looking at clinical outcomes. Both groups had a 20% improvement in “the change from a positive psychiatric diagnosis to functional status, or a patient’s moving from being a case to a noncase.”[40] This study looked at a wide array of psychiatric diagnoses with the most common being depression, bipolar disorder, adjustment disorder, and anxiety disorders. Additionally, this study reported that the consultations were not only cost effective but that telepsychiatry services cost an estimated 10% less per patient. As accessibility to videoconferencing technology has improved since 2004, these cost savings have likely persisted or increased. This metric is based on costs to healthcare providers, the study did not include any mention or evidence of decreased cost for patients. A more recent review of outcomes, based on

134 telepsychiatry studies, in 2016 showed that telepsychiatry has high patient/physician satisfaction, has reliability comparable to face-to-face consultations, has similar treatment outcomes, and is cost effective[41]. Finally, there is data that suggests telemedicine can decrease the amount of time it takes to access psychiatric services. A study by Greenberg found that telemedicine decreased the time it took for pediatric patients to access a psychiatric consultation[42]. A decreased wait time is a benefit as it could increase accessibility to mental health services.

As shown in Figure 2, large areas of the US are medically underserved. Specific populations within the United States are at higher risk for being underserved. The basis for why a specific population is underserved varies but can be due to geographical location (such as professional shortages in rural areas), sociological causes (such as race, ethnicity, age, or socioeconomic status), or other life factors (such as incarceration). One of the largest benefits of using telemedicine in psychiatry is the ability to reach underserved or difficult-to-reach populations.

Low accessibility to psychiatric services for rural populations is due to a variety of reasons including cost. Telepsychiatry is useful for lowering costs associated with this care. A study by Rabinowitz et al. found that between \$13,000 and \$232,000 could be saved if telepsychiatry services were used in lieu of face-to-face consultations for rural nursing home patients. Additionally, physician travel time was greatly decreased, which allows physicians to see more patients[43]. Telepsychiatry was found to be effective and cost-saving in treating combat veterans with PTSD[44]. It also was comparable in senior veterans with major depressive disorder and helped overcome barriers these patients had associated with accessing psychiatric care[45].

The use of telepsychiatry in rural areas has grown rapidly. Between 2004 and 2014 the number of US rural Medicare mental health patients with a telehealth consultation increased from 2,365 to 87,120. 1,040 and 50,050 of these patients, respectively, had serious mental health diagnoses[46]. Medicare users reported utilizing telepsychiatry 5.3 times for every 100 beneficiaries in 2014, up from 0.2 in 2004. The use of telemedicine has not seen growth in every state. Connecticut, Delaware, and Rhode Island had no reported telepsychiatry visits in 2014, while Iowa and South Dakota had over 10 per hundred beneficiaries.

The use of telepsychiatry in rural health care is especially useful for reaching pediatric populations. Connecting rural pediatric patients to psychiatric services has been shown to be an effective use of telemedicine. A study out of Queensland, Australia showed weekly one-hour teleconferencing between health care facilities was effective in providing specialist mental health care to remote areas[47]. The description of these teleconferences is vague, but the article does mention that the conferences were used for both administrative and clinical purposes. A separate study that followed 248 psychiatric consultations in children/adolescents found that parent satisfaction was very high with an overall satisfaction rating of at least 4.5/5 in all age

groups[48]. In addition to long term care, rural facilities can utilize telemedicine for psychiatric emergencies. A study by Roberts et al. found that telepsychiatry services were safe and effective for assessing and following-up on mental health emergencies in pediatric cases[49]. Another for use of telepsychiatry is in association with school-based therapists. A study by Cunningham showed that psychiatrists are generally positive in survey responses about using telepsychiatry specifically for use with students[50]. The study listed a self-reported child comfort level of 7.25/10, 10 being the highest level of comfort, however, a limitation of this study was a small sample size of only four participating psychiatrists.

Telepsychiatry may be effective in promoting access to underserved racial groups. A study aimed at targeting telepsychiatry to low-income Hispanic patient was performed by Chong and Moreno at the University of Arizona Tucson. The study found that telepsychiatry an acceptable motility for reaching this population. While the 2012 study questioned the feasibility of telepsychiatry's usefulness in reaching the population, it found statistically higher levels of satisfaction within the telemedicine experimental group as compared to the traditional control[51]. The telemedical intervention group reported a similar, yet statistically faster, improvement in depression symptoms. A study in low income perinatal pregnant Hispanic women showed telemedical practices were effective in identifying and addressing depressive symptoms during the perinatal and post-partum periods[52]. The study of videoconferencing technology in psychiatric care was found to be “..worthwhile and an asset among coalition partners.” in a study looking at increasing access to mental health services in the medically unserved “Alabama Black Belt” African American population[53]. Studies such as these highlight that telepsychiatry may be useful in reaching historically underserved ethnic populations.

Another population which could benefit from robust telepsychiatry services would be incarcerated persons. Model telepsychiatry programs were studied in a study in Columbia. Synchronous vs. asynchronous models of telepsychiatry were compared. Synchronous telepsychiatry is similar to videoconferencing techniques discussed earlier. Asynchronous techniques film an interaction or interview with an inmate, presumably by a trained health provider, which will be viewed at a later time by a psychiatrist or other mental health professional. The study found that clinical effectiveness was similar across both types of telepsychiatry and the control in-person group but found that asynchronous techniques cost significantly less[54]. Asynchronous techniques have their downfalls. As the consultations are not seen live by the psychiatrist, the questions asked to the patient and information gathered cannot be directly controlled, however, there was no measurable decrease in effectiveness. Physician and patient satisfaction may be decreased in more general populations, where everyday life is not as controlled. Telepsychiatry was also studied in incarcerated youth in a youth correctional facility. The study found that, although there was a slight preference for face to face consultations, incarcerated youth were satisfied with the service. The study also

suggested a need for these services with time slots being quickly saturated, 2.4 diagnosed disorders per visited youth, and 2.4 visits per visited youth[55].

Other Avenues of Telepsychiatry

Recent increases in utilization are likely due to increased acceptance and accessibility. Improvements in technology that can expand the field of telepsychiatry are not limited to traditional physician to patient videoconferencing. New platforms of telepsychiatry have/are being developed. Telepsychiatry was shown to be effective in teaching parenting skills to parents of children with ADHD[56]. It was shown to be as effective and as accepted as face-to-face encounters. The parental training helped parents to develop better discipline techniques. In a similar study, the use of telecommunication was used to train parents in Reciprocal Imitation Training (RIT) techniques. RIT is useful for developing imitation behavior in children with Autism Spectrum Disorder. Telehealth was shown to be effective in “disseminating training in a naturalistic imitation intervention to parents of young children with ASD.”[57] Telehealth consultations were also found to be effective in the training of caregivers of dementia patients. A study by Finkel found telehealth training was effective in training relatives of Alzheimer’s or related dementia disease in the support of said patient[58]. Studies such as these point to the validity of telemedicine not only in patient-care, but also in the training of caregivers for people of mental illness. Telemedicine can be used to ensure a good environment and social support structure for mental health patients.

Another recent development in the delivery of telehealth care is the usage of mobile phone applications that can be used to monitor or track symptoms or patient behaviors. A study by Kim et al. tested the validity of a mobile app that allowed the screening of breast cancer patients for depression symptoms. The app took daily ratings of anxiety, mood, and sleep satisfaction and administered the Patient Health Questionnaire (PHQ-9) twice a week. The study followed 78 patients and found that all three measures were “statistically significant in predicting the mental status of patients.”[59] The study also found that adherence to recording the daily measures increases the accuracy of screening for depression. While this study relied upon subjective self-reported measures, some mobile applications have begun to use objective measures to find behavioral indicators of mood disorders. A noninvasive mobile application gathered user data on 73 participants who had previously reported a PTSD or depression symptom. The program took data such as physical location, time of active usage vs non-usage, phone usage for phone calls and SMS messages specifically, and physical handling of the phone. In addition to objective measures, audio logs were recorded that could be studied using further computer analysis. These measures were fitted to clinician-assessed symptoms such as not leaving home often, or for long periods of time. Models were found to be “predictive of clinician-assessed symptoms of depressed mood, fatigue, interest in activities, and social connectedness.”[60] While these methods are not designed to replace clinician input, they can provide valuable insight for clinicians to support treatment and care.

Among the forefront of practices in mental health services is the use of Virtual Reality (VR) for delivering care, such as VR-based exposure therapy. Exposure therapy is used in the treatment of anxiety disorders by mimicking the source of anxiety without any intention of causing harm/injury[61]. A review of VR usage in psychiatric treatment was authored by Maples-Keller et al.[62]. The review found evidence of a wide range of disorders for which VR-based exposure therapy was useful. The use of VR was found in treatment for symptoms in anxiety disorders, phobias, social anxiety disorder, PTSD, panic disorder, addiction disorders, eating disorders, autism, and schizophrenia. User satisfaction was stated to be high in many of the studies and refusal rates were significantly lower in VR therapies compared to traditional therapies. The use of VR in exposure therapy is exceptionally useful because of the modality and interchangeability of elements within VR software. A program can be constructed using a variety of scenes and elements to meet the needs of a particular patient. These therapies can be delivered over distance, and thus the use of VR has the potential to expand and improve practices within telepsychiatry.

Discussion

This review offers evidence of the effectiveness of telepsychiatry. Telepsychiatry has been shown to be effective in clinical outcomes. Studies have shown that telepsychiatry has similar clinical outcomes when compared to face-to-face consultations[40, 41]. There is some evidence to suggest telepsychiatry might have a beneficial effect on clinical outcomes. One such study found a faster rate in alleviation of depressive symptoms in low-income Hispanic populations[51]. It can be argued that because of other benefits of telepsychiatry that an improvement, as compared to equivalence, over traditional methods in clinical outcomes is not necessary for adoption of the technology.

There was mixed evidence of cost effectiveness in the literature for the field of telemedicine, however, telepsychiatry was generally shown to be cost effective. The review by Hubley[41] suggested the practice was cost effective, and a review by Rabinowitz[43] suggested that the practice could be cost saving, with maximal savings estimates of over \$200,000 per patient. Cost effectiveness may rely upon availability of capable technology. Bounthavong[35] found telepsychiatry was cost effective only if capable videoconferencing technology was not provided by the health care provider. There were limitations to these studies on cost effectiveness. Studies look at institutional cost effectiveness/savings but do not look to see if cost savings are passed on to patients.

A large benefit of telepsychiatry services is the increased availability of mental health care to underserved and/or isolated populations. There is much evidence to conclude that telepsychiatry is indeed effective in reaching isolated populations such as rural population[43, 46, 47, 49], pediatric populations[47-50, 55], and underserved ethnic/racial populations[51-53]. The ability for telepsychiatry to reach these underserved populations is the greatest benefit of the practice and provides the greatest upside to the use of this technology.

An increase in availability of the technology provides a promising future. Prior research found the practice is becoming utilized more often [46, 63]. This would suggest the practice is becoming more accepted by health care facilities and professionals. The growth of telepsychiatry services will not only benefit psychiatric patients, but also their caregivers, by allowing effective communication in the training of caregiving techniques. Advancements in technology, such as in mobile platforms, would make forms of psychiatric telecare widely available. Bringing symptom monitoring to personal devices through apps and programs could be used to help professionals diagnose illnesses, track patient progress, and perhaps even help alert providers of relapse in symptoms.

There are benefits associated with telepsychiatry that have been shown throughout the literature, but there are still questions that need to be addressed with further research. Telepsychiatry has been shown to be cost effective and even cost saving in some instances. To what degree this cost savings is passed on to the patients is not widely discussed. Cost savings from telepsychiatry passed on to patients may make mental health care more available in low income populations, and therefore the study of the effect of telepsychiatry on up-front patient cost is worthwhile.

The invention of new mobile applications and programs is a promising, yet under researched, field. It would be prudent to research which diagnoses and populations would most greatly benefit from mobile applications aimed at monitoring symptoms/aiding in a diagnosis. It would also be prudent to be wary of security issues, such as personal information leaks, that may be of concern with the usage of third-party apps and the data with which they collect.

Stigma remains a large issue within the treatment of mental illness. Telepsychiatry could increase the availability of care by allowing access to mental health services out of the public eye, thereby decreasing perceived social stigma. Unfortunately, telepsychiatry cannot aid in the total eradication of stigma, especially that one might feel through being diagnosed with a psychiatric disorder. Still, research aimed at maximizing telepsychiatry's reduction of social stigma surrounding mental health treatment seeking would be greatly beneficial.

Challenges of telemedicine include the inability of physicians to provide physical examinations over telemedical practice, inability to properly care for acute onset mental health symptoms, skipping treatment due to stigma or low accessibility, and preference for face-to-face consultations.

Ideal Practices

Going forward there are multiple potential uses of telepsychiatry. The use of videoconferencing telepsychiatry from within a residence is the most convenient avenue for the patients and deserves heavy consideration in treatment going forward. This avenue also has the most potential for eliminating skipping treatment because of perceived social stigma. Unfortunately, in-home use of telepsychiatry does have its limitations. Acute psychiatric

symptoms may not be caused by psychiatric illness but rather by underlying physical causes. For this reason, it is still recommended to visit a physician for the onset of psychiatric symptoms. This may decrease the effectiveness of telepsychiatry on skipping treatment because of stigma, as people may choose to forego seeing a provider for psychiatric symptoms to avoid stigma. Fortunately, there is potential for a middle ground in primary care setting, but for now in-home telepsychiatry is best utilized for long-term treatment of chronic, diagnosed psychiatric illnesses.

Telepsychiatry could also be utilized in a primary care setting at existing clinics or stand-alone facilities. Use in existing local clinics could connect isolated populations with psychiatric care for acute and chronic treatment. As noted above, in-home telepsychiatry would be well suited for treatment of chronic mental illnesses. They are instances where clinic uses may be necessary. For example, high risk substance abuse patients or severely impaired schizophrenics present treatment complications that may require support staff to measure level of intoxication or efficacy of current treatment. The use of telepsychiatry is well suited for primary care settings and widespread use could help solve some challenges associated with telepsychiatry. Using telepsychiatry in existing primary care facilities will connect patients with mental health professionals while also providing a setting and personal for physical examinations. Primary care clinics would serve as a place of care for the onset of acute psychiatric symptoms and could immediately connect patients to mental health professionals and eliminate further time requirements and travel costs. Physicians could rule out physical causes and connect patients to a psychiatrist/mental health professional in the same appointment. Having mental health care in a primary care clinic may help provide some privacy for patients as primary clinics treat a wide array of conditions. It would provide anonymity for what type of condition a patient was suffering from that a stand-alone mental health clinic couldn't provide. Telemedicine would be especially useful for facilities that could not afford to have a psychiatrist on staff.

Stand-alone telemedicine clinics that offer connection to a wide range of specialty services could offer more advanced care options. Para-professionals could be trained to perform physical examinations and clinical testing for distant physicians. They could also help in the providing of high complexity care such as VR-based exposure therapy and telesurgical-operations. As mentioned above, telemedical care has shown to be satisfactory for both patients and physicians. Some studies have shown a preference for face to face consultations. VR based telecare may act as a middle ground for people with these preferences. Realistic virtual environments could be constructed to increase the modality of telepsychiatry. Augmented reality may be possible with technological advances. This would allow VR headsets to present a live image of a mental health professional and their office. While stand-alone specialty telemedicine clinics could provide high-level, advanced care, they are also the option that would require the most investment. This type of facility is currently only a concept and has no documented current infrastructure.

The last avenue would be the increased usage of mobile applications that help track symptoms. This avenue could be highly accessible through third party applications. It would

allow real time tracking of relevant objective and subjective data. The largest upside of this technology is the ability to track symptomology without a lot of effort from the patient or physician; making this technology extremely convenient to use. This technology has a large upside in that it will help to track data that can be used to screen for disorders, track treatment progression, and help to diagnose patients. Data from apps could help alert physicians of symptomology relapse. Apps could utilize messaging features that allow for facilities to keep patients updated about medication and/or treatment reminders. It could also allow for facilities to contact patients about missed appointments, which could potentially decrease treatment skipping. The use of this technology does have its limitations as it will likely not replace professional input in the making of diagnoses.

Future Directions

These avenues of telemedicine may be effective moving forward alone, in combination with other telemedical techniques, or with other traditional medical practices. Telemedicine could be especially useful in combating current mental health epidemics such as depression in farmers, rural opioid addiction, and youth depression and suicides. The field of telepsychiatry will grow with greater utilization of telemedical practices in primary care facilities. As VR the ownership of VR headsets increase, the use of in-home VR-based psychiatric care could replace the need for trips to psychiatric care facilities, which is advantageous because of the ease of accessibility. The building of advanced telemedicine clinics could employ VR technology as well as paraprofessional staff to aid in physical examinations and specialty care. Telemedicine clinics could be designed as mobile clinics, decreasing brick and mortar costs.

Future research should look at the effects of telepsychiatry on treatment skipping due to perceived social stigma. Research should look to find which psychiatric diagnoses would most benefit from the creation of mobile tracking applications.

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