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Linking EMR to Virtual Care of Psychiatric Patients in the Acute Care Setting

Howard Louis Beatty Jr.
Medical University of South Carolina

LINKING EMR TO VIRTUAL CARE OF PSYCHIATRIC PATIENTS IN THE ACUTE CARE SETTING

BY

Howard Louis Beatty Jr.

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Approved by:

Chair, Project Committee	Dr. Abby Kazley, PhD	5/2/16 April 13, 2016
Member, Project Committee	Annie Simpson, PhD	5/2/16 April 13, 2016
Member, Project Committee	Gwyndolan Swain, DHA	April 13, 2016
Dean, College of Health Professions	Lisa K Saladin, PT, PhD	5/9/16 April 13, 2016

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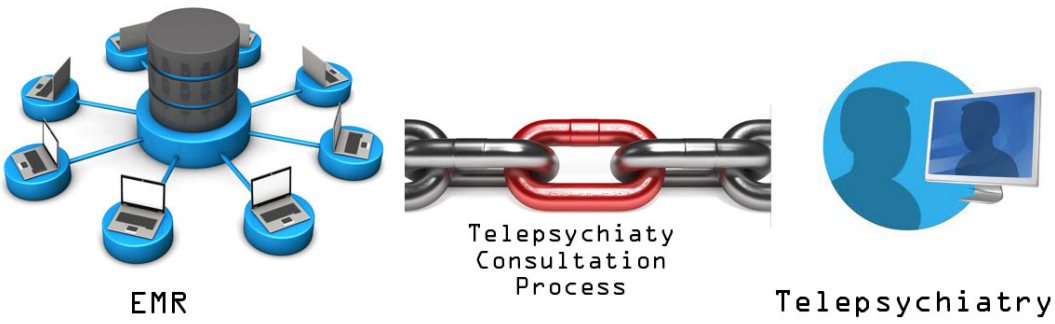
ABSTRACT

The purpose of this study is to test if the implementation of the Tele-Psychiatric Consultation Process (built within the FirstNet (Cerner/EMR) application, which pulls the patient's current EMR encounter from multiple facility locations to a different physical facility location for consultation) provided increased quality by decreasing in total length of stay.

The coordination of virtual care consultations allows for inter-practice data exchange for multi-provider clinical decision support. Documentation of medications and treatment regimens, which may be unfamiliar to the acute care provider, are provided through virtual tele-psychiatric consultations. An eTracking queue within FirstNet was built in-house by Carolinas Healthcare System to bridge the gap by integrating separate dual processes from fourteen emergency departments and behavioral health centers to better coordinate the flow of patient care. This study will examine if the transaction of data and information by this FirstNet (EMR) enhancement of system processes results in a decrease in patient length of stay as an indicator of improvement in quality of care.



LINKING EMR TO VIRTUAL CARE OF PSYCHIATRIC PATIENTS IN THE ACUTE CARE SETTING

CHAPTER 1: INTRODUCTION

1.1. Background and Need

Nationally

Americans who visit a hospital-based Emergency Department (ED) expect a high level of quality and care during their visit. Due to the overwhelming capacity that these hospital-based EDs are providing, American patients are not receiving the quality and care that they expect (McCaig, 2006).For the past 2 decades, emergency departments have seen increasing numbers of patients with psychiatric issues nationally (McCaig, 2006). Patients with mental health complaints account for 7% to 10% of ED visits (Hazlett, 2004). Despite accounting for a moderately small percentage of an emergency department's total count, these high-risk patients provide unique challenges for management. Substantial declines in mental health resources have contributed to increasing numbers of patients with mental health issues in emergency departments (McCaig, 2006). Inadequate outpatient psychiatric services for the uninsured and underinsured contribute to utilization of the

emergency department as a primary source of psychiatric care. Reduced state and national funding and declining reimbursements resulted in inpatient unit closures and therefore prolonged ED stays (Baraff, 2006).

Patients with psychiatric care needs who visit the ED experience a longer length of stay (3.2 times longer) than patients who are not seeking psychiatric care (Weiss, 2012). Not only are these EDs experiencing an influx in capacity with non-psychiatric patients, there is also an astounding growth in psychiatric visits to EDs (23% growth between 2000 and 2007). The high demand for services at EDs results delays in care and ultimately, leads to care that is not optimal (Weiss, 2012).

In medicine, delays in care for critically unstable patients is problematic. A Washington State judge recently proposed, and won, a ruling that stated it was unconstitutional for a patient with psychiatric needs to be held in an ED without immediate or long term treatment for the condition due to the fact that EDs with psychiatric admissions held 25% of their patients for over 24 hours (Enguidanos, 2015). While the ruling was intended to reduce length of stay for patients seeking psychiatric help, possible consequences may soon follow. Homicidal, suicidal and extremely disabled patients may be discharged without proper treatment due to lack of resources within psychiatrics. The shortage of psychiatrics includes a lack of funding for psychiatric wings at institutions and beds to fill wings in almost all ED's. From 1995 to 2013, the number of adult and child psychiatrists rose by only 12

percent, from 43,640 to 49,079. During that span, the U.S. population increased by about 37 percent; meanwhile, millions more Americans have become eligible for mental health coverage under the Affordable Care Act (Enguidanos, 2015).

While there are psychiatric specialists in the field, the numbers are low and these specialist are not accessible in every ED (Yamamoto, 2001). To address the lack of psychiatric specialists, telemedicine can be applied to connect patient, nurse and doctor in a timely manner and with success. As defined by the American Telemedicine Association "telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve a patient's clinical health status" (Yamamoto, 2001). While telemedicine seems to be the solution to the problem at hand, the reality is that it is underutilized and is not considered routine. One study identified the three major factors that hinder the habitual use as well as an increase in telemedicine: high cost of telemedicine systems, high complexity of telemedicine systems and limited telemedicine access to consultants (Yamamoto, 2001). To address the first two factors, they compared low cost and moderate cost videoconference devises that reduce cost as well as complexity by containing all of the components in one box to perform automated telemedicine functions; they called the concept telemedicine in a box. The study showed that the high cost of telemedicine systems as well as the complexity of said systems can be solved by the telemedicine in a box concept (Yamamoto, 2001).

Telemedicine can be utilized by more than just funded units and practices with higher than average budgets, it is also just as important to recognize how effective telemedicine can truly be when there is a lack of resources. In a recent study, it was proposed that real-time visual and verbal communication using telemedicine would improve trauma care during initial screening and evaluation of the trauma patient. The study was exhibited on a rural community hospital with no trauma care center or surgeon and was then connected via telemedicine to a larger hospital with a trauma center and trauma surgeons on hand 24/7. During the time of the study, there were 26 telemedicine trauma consultations and 96% of the injuries were by blunt mechanism. It was judged that two cases out of 26 consultations were potentially lifesaving due to the telemedicine connection between the trauma surgeon and the nurses at the community hospital. The success of this study further illustrates how telemedicine can be utilized in a time sensitive environment as well as conveys success to psychiatric treatment.

As previously mentioned, there have been large numbers of visits to EDs in the past decade with a 30% increase (Van Vonderen, 2008). One review explained how Telemedicine could be used to manage the influx in patient numbers. It has been suggested that the cost to equip all US emergency departments with hybrid telemedicine technologies could easily be covered by savings from a reduction in transfers between emergency departments (Van Vonderen, 2008). From a baseline

of 2.2 million patients transported each year between emergency departments at a cost of $1.39 billion in transportation costs, hybrid technologies would avoid 850,000 transports with a cost savings of $537 million a year (Van Vonderen, 2008). Decreasing the number of transfers from rural EDs to academic health centers (AHCs) where trauma, pharmacology, specialist, and mental health consultations taking place could reduce the influx of patients to the AHCs when done via telemedicine. The use of telemedicine may also increase the likelihood of a physician choosing a rural area to practice (Van Vonderen, 2008). Telemedicine has proven successful in many situations and has been actively used for over 40 years (American Telemedicine Association). What have not yet been routinely done within telemedicine is link electronic medical records (EMRs) to the telemedicine devises (Van Vonderen, 2008). To examine the relationship and use of telemedicine in EMRs, an application in a specific health care system will be explored.

Carolinas HealthCare System (CHS)

A report released in June by the Centers for Disease Control and Prevention found that while the rate of people arriving in emergency departments with mental health issues has increased throughout the country, North Carolinas' EDs reported double the national rate (Hoban, 2013). North Carolina based Carolinas Healthcare System (CHS) in recent years requested assistance several times to its EMR vendor

(Cerner) to help bridge the gap between Tele-psychiatry and EMR in efforts to improve quality and reduce LOS. Cerner explored the option and concluded that it was not a request that they could fulfill. CHS as an organization is a comprehensive, integrated system of inpatient, outpatient, school-based, crisis and residential treatment programs, makes it the most comprehensive behavioral healthcare provider in its region. CHS's integrated team is made up of a network of professionals, including physicians, Doctoral and Masters-level mental health professionals, substance use disorder specialists, pharmacists, registered nurses, social workers, recreational therapists, psychiatric technicians, peer specialists, and health coaches. CHS advertises and promotes a commitment to early identification of mental illness and early intervention (and treatment) which is based on the belief that recovery is possible. At CHS the journey to behavioral health spans across a continuum, ranging from community awareness and education, to services integrated into primary care, to interactive online therapies, to outpatient therapy for mental illness and substance use disorders, to intensive outpatient programs, and at its most intense, to inpatient care and emergency services.

In regards to emergency services, the coordination of virtual care consultations allows for inter-practice data exchange for multi-provider clinical decision support. Documentation of medications and treatment regimens, which may be unfamiliar to the acute care provider, are provided through virtual tele-

psychiatric consultations. CHS's utilizes Cerner for its Electronic Medical Records (EMR) system. Built within Cerner is the FirstNet application. FirstNet is a comprehensive emergency department (ED) information management system that helps CHS improve ED workflow from triage through discharge. Cerner's emergency information system (FirstNet) is specifically designed to not only meet today's challenges, but also provide a growth platform for the future. Specific functionality includes:

- Integration of pre-existing documentation into the patient's electronic emergency record (prior hospitalizations, discharge summaries, results, allergies, diagnoses, etc.)
- Registration and clerical functions
- Triage and tracking
- Electronic orders and result viewing, including laboratory, radiology, consult, and diet orders and results
- Electronic medications management
- Emergency specific nursing and medical documentation
- Discharge summaries
- Decision support, including alerts and notifications
- Operational and regulatory reporting
- Seamless integration with PowerChart, the electronic medical record

FirstNet originally did not have the capability or scalability to incorporate all of its functionality into the existing CHS ED Tele-psychiatry process. CHS was advised by Cerner that a merger between the two processes were not possible. As a result an eTracking queue within FirstNet was built in-house by developers in the CHS Information Services department to bridge the gap by integrating the separate dual processes, from 16 CHS Emergency Departments (this study will focus data from the CMC Anson, CMC Lincoln, CMC Northeast, CMC Pineville, CMC Steele Creek Health Pavilion, CMC Union, CMC University, CMC Main, and CMC Mercy locations) and the CHS Behavioral Health to better coordinate the flow of the patient's care. This study will perform an analysis to exhibit if the transaction of data and information by the standardization of system processes has decreased patient length of stay for an improvement in quality of care in ED psychiatric patients.

1.2. Problem Statement

The purpose of this study is to explore the relationship between telemedicine with EMR use and quality of care within a single integrated health system. Specifically, we will examine implementation of the Tele-Psychiatric Consultation Process built within the FirstNet application which launched on January 1st 2015, which pulls the patient's current EMR encounter from multiple facility locations to a

different physical facility location for consultation, and to determine if it increased quality of care by decreasing total acute care length of stay.

1.3. Research Hypotheses

Hypothesis: The use of EMR reduced LOS for tele-psychiatry patients post January 1, 2015.

1.4. Population and Assumptions

Patient selection includes all Carolinas Healthcare System psychiatric ED patients seen at participating facilities (listed in section 3.2) during the month of October 2014 and were compared with patients seen in October 2015. Patient selection included all ages (including pediatrics), races, and sex.

CHAPTER 2: LITERATURE REVIEW

2. 1. Literature review objection

The purpose of this study is to look at quality improvement initiatives and examine the outcome of linking EMR to tele-psychiatry and its effect on LOS. A literature review was conducted to provide background and justification of the outcomes being measured. In this section, I examined the scholarly literature as it related to: (a) tele-psychiatry (b) ED quality improvement (c) and other factors that affect ED psych patient care in regards to tele-medicine and maximizing EMR utilization.

2.1.1. Telemedicine

Telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve a patient's clinical health status. Telemedicine includes a growing variety of applications and services using two-way video, email, smart phones, wireless tools and other forms of telecommunications technology (American, 2016). Patient consultations via video conferencing, transmission of still images, e-health including patient portals, remote monitoring of vital signs, continuing medical education, consumer-focused wireless applications and nursing call centers, among other applications, are all considered part of

telemedicine. Telemedicine is not a separate medical specialty. Products and services related to telemedicine are often part of a larger investment by healthcare institutions in either information technology or the delivery of clinical care. Even in the reimbursement fee structure, there is usually no distinction made between services provided on site and those provided through telemedicine and often no separate coding required for billing of remote services (more on reimbursement in section 2.8.) (American, 2016). Generally the goal of telemedicine have been to offer four fundamental benefits:

- Improved Access – Not only does telemedicine hope to improve access to patients but its purpose is to also allow physicians and health facilities to expand their reach, beyond their own offices. Given the provider shortages throughout the world (in both rural and urban areas),telemedicine has a unique capacity to increase service to millions of new patients (American, 2016).
- Cost Efficiencies – Reducing or containing the cost of healthcare is one of the most important reasons for funding and adopting telemedicine technologies. Many studies have resulted in telemedicine proving to reduce the cost of healthcare and increase efficiency through better management of chronic diseases, shared health professional staffing, reduced travel times, and fewer or shorter hospital stays (American, 2016).

- Improved Quality – Studies have consistently shown that the quality of healthcare services delivered via telemedicine are comparable to those given in traditional in-person consultations. In some specialties, particularly in mental health and ICU care, telemedicine delivers a superior product, with greater outcomes and patient satisfaction (American, 2016).
- Patient Demand – The greatest impact of telemedicine is on the patient, their family and their community. Using telemedicine technologies reduces travel time and related stresses for the patient. Over the past 15 years, many studies have documented patient satisfaction and support for telemedicine services. Such services offer patients the access to providers that might not be available otherwise, as well as medical services without the need to travel long distances (American, 2016).

For many years, telemedicine has been commonly used to conduct business. Somewhat more recently though, it is becoming used more routinely in the medical world and more specifically in the specialty field of mental health. The early use of telemedicine in mental health can be documented as far back as the early 1960s (Wittson, 1961). It is helping bring together clinician and patient when they would be otherwise separated mainly due to geography.

With the explosive increase in technological capabilities such as increased network bandwidth and speed and significant enhancements to camera and audio

components, telemedicine has experienced significant growth over the last decade. There are 3 main types of telemedicine systems:

- Desktop/laptop telemedicine – this technology allows users to access telemedicine via their PC.
- Set-tops videoconferencing systems – These are placed above a TV monitor in a room and are useful in small boardrooms.
- Integrated Videoconferencing Systems –used in conference rooms or classrooms, where you have multiple participants.

For the purposes of this study, the desktop/laptop version is most like the clinical use described herein as it is provider to provider based.

With multiple telemedicine software providers in the current market, it is difficult and cumbersome to pinpoint and exact regular user base of telemedicine. While Skype, possibly the most recognizable of these providers, has reported that their product has been downloaded by nearly a half billion users, usage reports show that a mere 8 million are regular users (Grabham, 2007). A survey performed by hardware provider, Hewlett Packard (HP), surmised the same trend. This survey was performed via a questionnaire to their own workforce and results showed that an astounding 68% had never participated in a video conference (Hirsh, 2005). HP is a technological company, so this leaves the question of what would the percentage be in other industries such as healthcare. Further, it was found that 3% considered

themselves regular users (Hirsh, 2005). That 3% did report some expected benefits of telemedicine such as accessibility, the reduction in the need for travel, and the ability to see the other participants' gestures and demeanor. Among those who were not regular users, or had never participated in a video conference, some drawbacks were reported. These were mostly technologically based, such as unreliability with connections and little working knowledge of the equipment and its setup (Hirsh, 2005). Increasing healthcare staff experience with telemedicine should be examined more in the future. Emergency tele-psychiatry has the potential to improve patient care in many settings. Although experience is limited, it has been found to be safe and effective, as well as satisfactory to both emergency department staff and the psychiatric patients treated. The development of comprehensive and standardized guidelines is necessary. Telemedicine is becoming part of routine emergency medical response planning in many jurisdictions. Emergency tele-psychiatry has the potential to reduce emergency department overcrowding, provide much needed care in rural areas and improve access to psychiatric care (Yellowlees, 2008).

2.1.2. Tele-psychiatry

Tele-psychiatry encompasses any psychological health services provided electronically using a network or the Internet. Some examples of tele-psychiatry are:

1) Email – the most commonly used form of tele-psychiatry communication between patients and clinicians and physicians, email offers a suitable alternative to non-emergency situations such as if a patient has just a question or needs confirmation of instructions previously provided. This is also a cost-effective means of communicating.

2) Secure web-based message systems – Communication is the same as email, just with an added layer of security. Use of this tool is constrained by its high cost.

3) Chat or instant messaging (IM) – this is the written exchange of text in a real time mode. Its greatest limitation is that both the patient and the physician or clinician needs to be online simultaneously.

4) Video-conferencing – allows the transmission on video and voice via the Internet (see 2.1.1) (Manhal-Baugus, 2001).

It is not possible to know precisely when mental health professionals began interacting with patients on-line. As long as psychotherapists have participated in on-line activities and have been known to be psychotherapists, they have probably received requests for help, and some have probably responded. Thus, the earliest history of tele-psychiatry is lost in confidential obscurity (Sucala, 2012).

Tele-psychiatry is progressively materializing as a favorable substitute to traditional in-person therapy (Skinner, 2006). Telemedicine appointments are easier to attend, leaving little need to miss work or other engagements patients might have. Patients are also reporting telemedicine to be more efficient and readily available to millions of people previously disenfranchised by steep costs, travel costs, limited access and the stigmas associated with seeking treatment (Skinner, 2006). Further, evidence is developing that shows that tele-psychiatry can be clinically effective with clients experiencing flourishing therapeutic relations. (Skinner, 2006).

Tele- psychiatry is defined as a licensed mental health care professional providing mental health services via e-mail, telemedicine, virtual reality technology, chat technology, or any combination of these. The use of telepsychiatry has been rapidly expanding in the last two decades, yet there are still unanswered concerns about tele-psychiatry, including whether it is possible to develop a successful therapeutic relationship over the Internet in the absence of nonverbal cues (Sucala, 2012).

2.1.3. ED quality improvement

There have been several recent studies that have demonstrated the effectiveness of tele-psychiatry in assuring quality care for mental health patients in the ED setting. One recent study conducted was a retrospective chart audit of

mental health evaluations in a rural ED (Southared, 2014). After implementation of tele-psychiatry, a significant reduction in time to treatment, length of stay, and door-to-door consult time was recognized. Several large hospital systems in the US are also reporting improved quality of care through ED tele-psychiatry. After implementation of tele-psychiatry at the Albemarle Hospital Foundation in rural North Carolina, the ED length of stay for mental health patients was reduced by more than 50 percent and there were documented decreases in repetition rates and involuntary commitments (Davies, 2013). South Carolina has launched a state-wide initiative in 18 (rural and urban) EDs with tele-psychiatry. Since March 2009, the program has served over 18,000 patients with outstanding results when compared with matched controls. The results include a decrease in length of stay to 0.43 days from 1.35 days, a drop in admissions from 22% to 11%, and follow up rates of 46% from 16% (Letvak, 2015).

While the ratio of mental health-related ED visits to total ED visits in the U.S. has remained relatively unchanged, the overall increase in visits will continue to add strain to EDs (Allen, 2007). In addition, many hospitals have reported that the presentation of mental health-related patients in the ED disproportionately affects the operation of the ED for other patients in terms of space, staffing, and resources. Safety issues arise for these patients, other patients, and staff. To further complicate matters, many EDs are not properly equipped to handle most mental health

emergency patients, which has led to improper diagnoses and prolonged ED stays (Stefan, 2006).

In hospitals across the nation, ED patients are routinely boarded for hours or even days, while awaiting admission to an inpatient bed (Institute, 2006). Boarding is the practice of holding patients in beds (in rooms or hallways) until an inpatient bed becomes available. In recent years, the boarding of mental health patients in the ED has become an important issue for hospitals. A 2008 survey by the American College of Emergency Surgeons (ACEP) found that 79 percent of mental health patients in an ED are boarded. In addition, over 60 percent of the mental health patients that require admission will stay in the ED at least four hours after the decision of admittance has been made. An estimated 33 percent of those patients are boarded for longer than eight hours and 6 percent are boarded for longer than 24 hours (American, 2008). A 2006 study of California ED management of suicidal patients discovered that they accounted for only 1.7 percent of ED visits. However, mental health professionals (MHPs) did not perform 50% of the evaluations and 23 percent of EDs reported sending patients with suicidal ideation home without an evaluation by an MHP. In addition, when these patients required transfer, the estimated mean wait time for transferring was seven hours (Baraff, 2006). The boarding of ED patients is a result of a reduction in available ED and inpatient beds, which can cause longer ED throughput times and in some cases hospital ambulance

diversion. In addition, the patients can receive delayed medical treatment, increasing the potential for poor outcomes. The boarding of patients has been widely reported and is becoming more prominent in hospitals struggling to manage increasing patient volumes while simultaneously providing quality care.

Many advocates of telemedicine have stated that the use of remote technology will provide higher quality care through better access to specialists and also assist in reducing the number of boarders and thus ease overcrowding (Yellowlees, 2008).

2.2. Benefits of using telemedicine

Several benefits have been identified when telemedicine/tele-psychiatry services are introduced into a care delivery system. The most notable benefits include improved access to care, provision of a higher level of care locally or in a more timely fashion, timely medication management, improved continuity of care, improved treatment compliance, coordination of care, and cost savings (McLaren 2009).

From its beginnings, one of the major objectives of telemedicine has been that it would improve access to health services for people living in rural or remote areas where medical professionals and facilities were scarce or absent. This objective has been the rationale behind decades of demonstration projects targeted

at rural areas. More recently, the potential for telemedicine to improve access for other groups, such as the inner-city poor and the urban and suburban homebound, has attracted interest. (World, 2009) Historically barriers to access has included:

- Significant distance from primary, secondary, and tertiary medical services
- Poor transportation (lack of an automobile, limited or nonexistent bus service), even for relatively short distances
- Inadequate financial resources
- Family, educational, and cultural factors (lack of knowledge)
- Delivery system characteristics, including poor coordination of care, long waiting times for appointments, inadequate numbers or kinds of specialists, and bureaucratic obstacles to services
- Timely frequent follow-ups required/scheduling issues(World, 2009)

Telemedicine aims to deliver the best care with the least inconvenience and eliminate these barriers. An opportunity to reduce staffing costs for rural facilities also exists; telemedicine makes it easier to lean on the entire network for support versus staffing locally (World, 2009).

For specialists, this is a great advantage because local patients can relocate and rural patients that have very limited access to specialists are now capable of increasing business. Also, by saving time not traveling between facilities, physicians

can increase the number of patients they treat. This benefits the physician in both quality of life and creates an ability to increase billable time. Physicians can also increase capacity through less travel/weather condition schedule disruptions.

Another key advantage of telemedicine, which benefits both the doctor and the patient, is the ability to get a real-time second opinion. Doctors benefit from minimizing a delay in care and also simply sharing knowledge. Patients can feel more confident in an opinion validated by another doctor (World, 2009). For psych ED patients, this benefit could potentially be very valuable.

2.3. Current Climate

As psychiatric hospitals and outpatient clinics close for financial reasons, mental health services for those most in need are declining at an alarming pace. In 1955 there were nearly 600,000 beds in state psychiatric hospitals, compared to only 43,000 state psychiatric beds in 2010 available for use (Panero, 2012) This makes the emergency department seemingly the only viable option for emergency treatment and medication of psychiatric patients. While emergency departments were originally established to provide acute episodic care, they have evolved into a catch all for those without insurance, cannot afford traditional health services or are unable to understand and navigate the nation's complex healthcare system. Anyone can come into the emergency department at any time of day or night and expect

treatment if medical assistance is required. Unfortunately, studies have shown that emergency department personnel, particularly nurses, operate on a distinct hierarchy of preferences for and against certain types of patients (Ross, 2009). These healthcare professionals are often hesitant to care for those whose medical problems are not easily settled or controlled, which describes can describe many psychiatric patients. Although emergency department personnel are healthcare professionals, they lack the specialized understanding that psychiatric patients need for accurate and empathetic diagnosis. They can see the psychiatric patient as an unnecessary drain on emergency department resources. Because many nurses are anxious and unsure about caring for psychiatric patients and providing holistic versus evidence-based care, creating standard nursing and triage procedures for psychiatric patients in the emergency department would benefit all patients and staff in the current emergency room environment (Ross, 2009).

It has been documented in numerous places that the number of psychiatric patients seen in emergency departments has increased markedly during the past decade. Between 1997 and 2007, total annual visits to emergency rooms in the United States increased by 23%, which was a rise from approximately 94.9 million to about 116.8 million (Tang, 2010). According to one analysis, this increase is nearly double what would be expected due to population growth during this period, which would have resulted in a 12.5% increase (Tang, 2010). Some hospitals report

boarding psychiatric patients in their emergency departments, sometimes for up to two days, due to lack of space and improper triage and diagnosis (Manton, 2010). During that time, they are inclined to receive minimal medical care and almost no psychiatric care or diagnosis. An ACEP 2008 survey reinforced the commonality of these practices with findings that better than 60 percent of psychiatric patients requiring hospital admission have drawn out stays in the emergency department after a decision to admit them is made. In some cases, these prolonged stays can measure more than 24 hours (Manton, 2010).

One of the accelerating factors in the chronic upswing in the number of psychiatric patients seeking care in the emergency department is financial resource allocation at the state and federal levels related to care of the mentally ill, especially reductions in Medicaid reimbursements. Across the country, inpatient beds for psychiatric patients are decreasing and replacement community resources are just not available (Manton, 2010). A recent study by the University of Pennsylvania School of Medicine found that the majority (up to 66 percent) of psychiatric patients referred to community psychiatric services upon discharge from the emergency department are typically likely to reach only an answering machine, and only about 33 percent of Medicaid patients were actually able to make an appointment. Ironically, many who reach answering machines or who are unable to make an

appointment are ultimately referred back to the emergency department for further care (Manton, 2010).

It is clear that this handling of psychiatric patients increases the length of stay for all patients, which inflates the already crowded condition of many emergency departments ultimately affecting the timeliness of care for psychiatric patients. This overcrowded chaotic environment can have a negative impact on the already agitated psychiatric patient possibly exacerbating an already precarious situation. While some emergency departments do have dedicated areas for psychiatric patients, the majority of respondents, upwards of 60 percent, indicate that there is no such demarcation between housing psychiatric and non-psychiatric patients. Again, this lack of specialized care has a negative impact on the already delicate psychiatric patient as they can sometimes sit for hours amidst the hustle of a typical emergency department. This impact is commonly accepted, especially the impact on children, as the emergency department environment is just the opposite of the soothing and therapeutic climate needed to calm the psychiatric patient. Due to the aforementioned lack of specialized psychiatric care, while these patients are boarded in the emergency department, their care is medically minimal and not geared toward psychiatry. This can often lead to sedation, rather than the psychiatric driven care they need. These patients with psychiatric emergencies have few places to seek treatment and the harmful delays experienced in the typical

emergency room environment are affecting them negatively, sometimes irreversibly. These delays also compound the impact on all other patients and staff in the emergency department (Manton, 2010).

2.4. Patient Satisfaction

2.4.1 Telemedicine

It has been shown that patients, physicians and clinicians are generally satisfied with the experience telemedicine provides and feel that telemedicine is as good as face to face (Wootton, 2003; Monnier, 2003). Patients have even cited preferring telemedicine to in-person appointments (Monnier, 2003). Common reasons for this preference are reduced travel time, minimal time off from work and diminished childcare issues (Monnier, 2003). Conversely, an analysis of a grouping of studies has shown deficiencies in the methodologies used, such as limited sample sizes and poor response rates, disparities in selection and depth of criteria used. (Monnier, 2003; Norman, 2006; Wootton 2006). However a subsequent review of more recent study's found that many of the deficiencies of earlier research have been mitigated, mostly due to the technological advances in the telemedicine equipment and the ease of its use (Richardson, 2009). In this same review, a straightforward two-pronged approach to the value of the equipment was used to measure patient satisfaction: 1) does poor quality equipment affect patient satisfaction 2) what is the patients' ability to manage the equipment. In summary,

analyses of studies have found that patients do not feel that a diminished relationship occurs due to telemedicine (Richardson, 2009).

This supports the belief that it is the attitude toward therapy that affect opinions rather than the technology (Simpson, 2005). It seems the next logical step already begun. While yet to be researched and analyzed, recent studies have shown that recommendations for equipment standards are now in play, with the belief that this will better ensure patient satisfaction (Richardson, 2009). Sure to follow are studies that focus on the technological literacy and exposure to technology on behalf of the patients. The hope is to eradicate the mystique and misconception of technology through education and on-call support. (Shore, 2007).

2.4.2. Tele-psychiatry

Patients, physicians and clinicians alike report that they like the convenience of on-line therapy. Groups that realize the greatest benefit are those with limited transportation options, those living in rural and remote areas, those not within reasonable driving distance of a healthcare facility and those who cannot afford to take time off from work (Rochlen, 2004). Tele-psychiatry also provides the benefit of anonymity. This proves especially favorable to psychiatric patients who may feel that having a mental health issue and needing therapy carries a social stigma. Psychiatric patients are more apt to use on-line help, where they do not have to sit face to face with the therapist or not be seen coming or going from a mental health

facility. They also tend to be more forthcoming during their sessions (Mitchell, 1998).

Studies have suggested the effectiveness of tele-psychiatry is difficult to confirm as current studies report satisfaction for those completing treatment but with limited research and evidence those patients who do not join or drop out of using tele-psychiatry. Further investigation and studies are needed for more concrete evidence rate of success or failure (Waller, 2009) especially if the dropout rates are as high as one particular review discovered. This study found that only 56 percent of patients fully completed a course of therapy. The reasons for the 44 percent drop-out rate was examined and it was found that the reasons were due more to personal circumstances than unease with the technology or unorthodox approach. This report also found that the therapists themselves seemed less likely than patients to embrace the technology (Kaltenthaler, 2008).

In a review of 22 random control trials, it was reported that patients were typically satisfied with and stuck with tele-psychiatry, despite the reduced face time with the therapist (Andrews, 2010). These are compelling findings as all 22 of the random control trails measured both adherence and satisfaction. Almost half of the studies reported a patient satisfaction level of 86 percent. The method of recruitment, however, does cast a shadow of uncertainty on these findings. Most patients were recruited using a marketing strategy provided over media. This

method may have skewed results as these patients were expecting an alternative form of therapy (Andrews, 2010). This leaves to question if the satisfaction results would have been that high for a random selection of patients who were steered toward tele-psychiatry after initially expecting traditional face to face therapy.

2.5. Cost

At first glance, it is commonly assumed that tele-psychiatry, telemedicine and other forms of electronic therapy provide a more cost effective means of dispensing therapy, versus the more traditional in-person style (discussed further in section 2.8). One study demonstrated that there had been few studies that intended to measure cost (Wootton, 2003). Yet another earlier review performed in 2002, randomly picked 55 papers from 612 and measured cost benefit data. This report deduced that there was limited evidence that tele-psychiatry and video-conferencing solutions offered a more cost-effective solution to traditional healthcare (Whitten, 2002). A more recent 2010 review of 1593 papers found the same; a limited amount of evidence can be provided surrounding the cost-effectiveness of electronic care solutions (Ekeland, 2010). So despite telemedicine programs having been implemented several decades ago there is still limited evidence of its cost effectiveness. While these reports cite several reasons to explain the difficulty of measuring the cost-effectiveness and the limitation of studies to

date, other reviews deduce that advocacy for tele-psychiatry and video-conferencing is growing. Overall the primary difficulty faced by validating the research of the cost of telemedicine solutions is the speed at which these electronic non-conventional solutions are advancing. As research is ratified and published, the technology advances and the cost changes rendering the finding obsolete almost immediately (Richardson, 2009; Hyler, 2003).

While the studies analyzed above have speculated about cost-effectiveness, there is a scarcity of studies that correlate these cost savings into real economic gains, such as a decline in hospital admissions and reduced length of stay. Until more studies are performed that set out to highlight these economic gains, it is burdensome to ascertain the true economic value of such an investment. (Whitten, 2002). Accordingly, healthcare financial experts generally conclude that they should be involved in the early stage architecture of such a project. Their involvement will ensure that key performance indicators are properly tracked measured and reported thus providing the pertinent data to justify whether this is a viable economic alternative to the current standard (Da´valos, 2009). Despite the lack of documentation and consistency in already performed research of cost effectiveness, it seems reasonable to expect that more and more organizations will begin to warm to the idea of telemedicine solutions. Hopefully with the constant

growth of telemedicine, future studies will produce more precise results as to what can drive up or down costs.

2.6. Barriers to successful implementation of telemedicine solutions

Several study's have reported that a majority of the research into telemedicine is finite and incomplete as the research is often based on pilot sites, which often cease collecting data upon completion of the pilot (Mair, 2000), making it difficult to ascertain common obstacles. There are plentiful examples where telemedicine has failed because it was not integrated into the health and business environment but rather in a controlled environment (Wootton, 2003). Evidence suggests that when key staff and patients are solicited for input, confidence in the technology and process escalates and the new plan in more likely to succeed (Norman 2006).

Several telemedicine technology projects were examined in a study, and the results discovered that the projects were designed to fail (Peppard, 2008). This repeatedly happens due to inadequate project management during the implementation of the new technology. Project management technology application differs from project management in construction. Upon completion of a construction project, a tangible product is produced, such as a structure.

Alternatively, the result of a technology project is an intangible benefit, such as cost or time savings. Also, the implementation of new technology requires change of policies and procedures. These changes need the direction of management and consensus throughout the organization. A precedent of deterioration of results can occur when a large organization implements a new technology enterprise-wide, but based only on the success of a very small trail site or group. While this small site may have experienced great success, not all other sites may operate in the same way nor have the same accessibility and/or quality of service. For example, such a scenario might exist when comparing rural versus metropolitan locations. This scenario can create a perceived misconception that the technology is to blame when in reality it was the implementation (Whitten, 2002).

To improve perception and quality of subsequent studies, focus should shift from equipment cost to connectivity, as infrastructure is the larger investment. No physician wants to deal with a malpractice lawsuit after a disconnected virtual consult leads a patient to follow the wrong treatment regimen. For the use of telemedicine, organizations must invest in the necessary technology that can sustain its virtual requirements, which includes a strong platform and Internet connection. For telemedicine to succeed, the technology should be easily and readily accessible, provide no obstacles to staff or patients and enhance, not replace, current care models. A review of patient satisfaction recommends that prior to an organization's

implementation of an enterprise-wide telemedicine solution it should be evident and apparent what varieties of consultations will benefit, what are the end user's perceptions of using telemedicine solutions and what impediments could prevail, such as shortage of accessibility and lack of end-user knowledge (Mair, 2000). Historically, limited training was provided prior to many telemedicine solution implementations. Training consisted of only the rudimentary basics, with little post implementation support (Yellowlees, 1997). A decade later, it is reported that many technological projects in the healthcare industry fail due to this lack of training and support. This deficit in support creates a climate of dissatisfaction and a gradual cessation in use of the technology (Shore et al 2007).

2.7. Demographic Issues Affecting Telemedicine

2.7.1. Urban/Rural

Sufficient mental health care needs services are often not readily available in rural and remote areas, and accessibility continue to diminish as rural health care providers continue to face economic hardships. Telemedicine interventions represent a mechanism for providing solutions to access issues (Grubaugh, 2008).

Behavioral tele-psychiatry provides a legitimate solution to the mental health care deficiencies that persist in many rural communities. Services are productively delivered using specialized telemedicine technology (SnapMD, USARAD, Vitaphone

e-health solutions, Ergotron, Utila, Doctor on Demand, InstaMD, etc.) to underserved rural populations. The unique barriers to mental health care experienced by rural and underserved locations can be overcome through across distance delivery of services. For this treatment to be a viable, long-term option, the technology must be embraced by both the patient and health care providers (Bischoff, 2004).

Various studies reviewing the use of telemedicine between rural and urban communities have been conducted. These studies have derived that both urban and rural patients are uniformly agreeable to using telemedicine solutions. One such survey of 243 patients reviewed the perceptions and attitudes of urban and rural patients and their level of acceptance of receiving care via telemedicine solutions. No real, discernable statistical differences were found between urban and rural patients in regard to comfort or satisfaction in use (Grubaugh, 2008). The study revealed that in regards to concerns with tele-psychiatry as a medium of care, only a small percentage of the sample believed that the information technology would be too sophisticated, that a tele-psychiatry application would not help their problems, and/or expressed concerns regarding what others would think (Grubaugh, 2008). Of interest, more than half of patients (64.3% of rural and 67.9% of urban) endorsed the expectation that tele-psychiatry would not be as helpful as a face-to-face intervention. However, it is important to remain mindful that tele-psychiatry is

not intended to be superior to traditional care, but rather superior to no or limited care. This argument is supported by the finding that very few participants reported that tele-psychiatry would not be helpful (5.1%–7.1%)(Grubaugh, 2008). Thus, concern that most patients do not expect tele-psychiatry to be as effective as traditional care is mitigated by the fact that most patients would be willing to try tele-psychiatry anyway if it would improve their access to needed mental health services they might otherwise not receive (Grubaugh, 2008).

Most research indicates that rural residents would benefit from increasing access to care in regards to the use of tele-psychiatry. Due to the unique challenges such as remote neighborhoods, people within rural areas are less likely to access mental health services often due to lack of appropriate health care services in the area (see Appendix 2)(Rost, 2002). Studies have also suggested that the utilization of telemedicine in rural areas can benefit both staff and patients as it can be cost effective by reducing travel time and expenses, and for patients decreases the requirement to take time off work (Jones, 2001). Therefore most research allude that telemedicine is the solution to provide services for patients in rural location to improve access, by allowing clinicians in urban areas to distantly deliver care.

Once an organization determines that a particular rural area would benefit from telemedicine, considerations need to be made with respect to the quality of their Internet access which oftentimes is limited and with slow broadband

connections. A recent reports shows that 15% of rural people report slow broadband connections in their homes (DEFRA, 2012) and a second report of small businesses reveal that 57% claim that their business is negatively impacted by slow internet (Hunter, 2012). Both of these reports support the assumption that there is still an urban/rural divide in Internet access. This in turn can affect the usage and satisfaction in a patient's experience using telemedicine.

Access to tele-psychiatry has provided a compelling enhancement to access to psychiatric care in rural (Preston, 1992; Hilty, 1999; Johnston 2001; Doze, 1999), suburban (Hilty, 1999), and metropolitan areas (Straker, 1976). It not only provides enhanced accessibility for patients but also to clinicians and other mental health professionals by connecting those in rural setting with specialists in an academic or regional facility settings. This easy access to information to those in underserved regions is especially helpful and useful (Hilty, 1999; Johnston 2001; Doze, 1999). Further, this model aids primary care providers as they no longer need to include a dedicated psychiatrist on their staff. It also aids the mental health patient, as they do not need to get redirected to a mental health facility, and in turn be re directed to an emergency department (as explained in section 2.3)(Hilty, 1999). This access can also reduce provider isolation by providing a hands-on, face-to-face alternative to learning. Using this technology, primary care providers also have the ability enhance their knowledge of diagnosis and treatment of mental health patients if

they are allowed to participate in the initial psych evaluation (Hawker, 1998). Tele-psychiatry has provided an electronic alternative to traditional in-person consultations and has proven successful, with high initial and long-term satisfaction on the part of participants (Hilty, 1999). In summation all of the research not only displays an increase in the quality of care, but by avoiding travel to rural sites, it also uses specialist time more efficiently.

2.7.2. Age

It is perceived that older adults have had limited experience with technology making them less likely to embrace telemedicine and further reducing their opportunity to benefit from telemedicine solutions. And while overall Internet use among the elderly is less than those younger than 65, studies show that Internet usage among senior citizens is growing at a faster rate than other age groups. In a 2012 study it was shown that for the first time, Internet usage among the elderly was over 50 percent (Zickuhr, 2012).

The proportion of young adults ages 18-29 who use the Internet has always outpaced overall adoption levels among older groups. But while older adults still report lower levels of Internet use today, seniors have the greatest rate of change since 2000 (Perrin, 2015). Overall, Internet usage is a common, everyday occurrence for most Americans. Recent statistics show that 84 percent of American adults use the internet with a breakdown by age as follows:

- Ages 18 – 29 experience an interest usage rate of 96%
- Ages 30 – 49 follow close behind at 93%
- Ages 50 – 64 sees a bit of a decline at 81%
- Ages 65 and older come in at 58%, over 50% for the first time(Perrin, 2015).

2.7.3. Gender

A 2014 analyses of gender technology usage concluded that there continue to be small but significant gender differences. The findings from a series of linear regressions suggest that gender differences vary for different life stages related to occupation and marital status (Helsper, 2014).This proved to particularly be true for males. The study also determined that other factors related to life stage will continue to influence gender differences in technology usage in the future. Generally males are more likely to use technology than females, but not by any significant differences. There is less than a 5% difference in Internet usage in males and females, and similarly statistics (less than 10% difference) in smart phone usage (Helsper, 2014). In regards to telemedicine there are limited studies that observe if there are differentiations between telemedicine and gender. However, the studies that have been done have found that there is no difference in mindsets and eagerness to use telemedicine solutions with mental health (Grubaugh, 2008; Eikelboom, 2005).

2.8. Ethical and Legal Issues

Matters of concern regarding the legal and ethical aspects of telemedicine abound. These include the obligations and possible liabilities of the health professional, the prudence to preserve the confidentiality and privacy of patient records, and the potential jurisdictional complications associated with cross-border consultations. There is also the financial issue of repayment for care provided using a telemedicine service. Today, not all telemedicine costs are reimbursed. Medicare, which has to some extent set the standard, reimburses for telemedicine services when the originating site (where the patient is) is in a Health Professional Shortage Area (HPSA) or in a county that is outside of any Metropolitan Statistical Area (MSA), defined by HRSA and the Census Bureau, respectively. This originating site must be a medical facility and not the patient's home. Medical facilities include practitioners' offices, hospital, and rural health clinics. This reimbursement is not affected by the location from which the telemedicine services are being delivered. Medicare will only pay for "face-to-face", interactive video consultation services wherein the patient is present. That is, Medicare will cover telemedicine services that mimic normal face-to-face interactions between patients and their health care providers. Medicare does cover store-and-forward applications, such as teleradiology and remote EKG applications, as they do not typically involve direct interactions with patients. Medicare does cover store-and-forward applications,

such as teledermatology, in Alaska and Hawaii. There is no single widely-accepted standard for private payers. Some insurance companies value the benefits of telemedicine and will reimburse a wide variety of services. Others have yet to develop comprehensive reimbursement policies, and so payment for telemedicine may require prior approval. Likewise, different states have various standards by which their Medicaid programs will reimburse for telemedicine expenses (Goodrich, 2016).

By it's essence, telemedicine concedes to the transmission of health information across the borders of states. These cross-border consultations are becoming particularly common in areas of specialty with mental health among them. Questions of jurisdiction and registration have yet to be answered definitively. While this may be true, many legal and ethical facets of the use of telemedicine can be mitigated by the responsible, honest and prudent use of telemedicine (Stanberry, 2006).

Electronic Medical Records may be subject to abuses that can be carried out on a large scale and cause great damage. A wide range of data protection and information security measures will need to be taken to ensure the quality and integrity of such records. The responsible teleconsultant or clinician, as the data controller, must make sure these measures are enforced. As different elements of the records are spread throughout the different departments of a hospital or across

different geographical locations, it may become difficult to ascertain who is responsible for protecting and controlling what. Therefore, the designation of liability by contractual means, between the hospitals and remote users of a telemedicine network, would be the clearest and most straightforward way of achieving uniformity and predictability in terms of the distribution of responsibility for data protection and security (Stanberry, 1998).

The primary legal and ethical concerns surrounding telemedicine are security and privacy. Telemedicine risk potentials pose questions such as:

1. It is thought that confidentiality could be breached as it is possible for someone else to watch the consultation but not be visible on the video screen (Norman, 2006).

2. Patients should be educated about their choice of provider, ensuring them to access services by accredited organizations. This will reduce the risk of personal, confidential information being inadvertently given to fraudsters (Proudfoot, 2004).

Any technology has the potential to put patient information at risk if information is transmitted via unsecured network (Hyler, 2004). With electronic patient records and networks used for remote patient monitoring at the current leading edge of new technologies, the face of the existing infrastructure within healthcare is changing rapidly. Old, paper-based patient records are being converted to electronic format enabling patients to more easily access their records

via the Internet. Remote patient monitoring is becoming more feasible as specialized sensors can be placed inside homes and other ambulatory settings. This combination of technologies will advance the quality of health care by reducing the potential for errors and liberating physicians' and clinicians' schedules, allowing more patient time. While there are benefits to technologies, associated privacy and security issues need to be analyzed to make these systems publicly acceptable (Meingast, 2006).

2.9. Conclusion

Ample research exists about tele-psychiatry in general and a significant number of studies have examined the impact of tele-psychiatry implementations. The majority of those studies have examined practitioner acceptance or utilization and efficacy rather than costs and benefits or increasing access to effective care. Tele-psychiatry has reached populations such as veterans, the elderly, students, and rural residents. This greatly increases access to appropriate mental health care, with significantly decreased costs. While tele-psychiatry has been primarily proven to be advantageous, this technology does have some constraints. Apprehensions about reimbursement, licensure, privacy, security, patient safety, and interoperability have been identified and present current challenges that providers using this technology must overcome to provide the most effective patient care. Finally, despite the

surprisingly long history of tele-psychiatry, its potential and impact are still in the relatively early stages of understanding. With the decreasing costs of available systems and the wider availability of increasingly secure technologies, psychiatrists and patients may find this mode of service more suitable. The dependable high performing networks that are beginning to become the norm as the technological backbone of tele-psychiatry are still limited in their reach, being clustered mostly around urban and suburban areas and less prevalent in the rural areas that tele-psychiatry could benefit the most.

Telemedicine is a growing alternative to traditional psychiatric services that increases patient access to providers (Doarn, 2013). Tele-psychiatry is at the forefront of technological advances in the mental health field and has the potential to greatly benefit patients and providers. This study investigates quality improvement in tele-psychiatry, but further research will be instrumental in continuing to measure benefits and constraints in this area.

CHAPTER 3: METHODOLOGY

3.1. Research Design/Method

The methods section will describe the hardware and infrastructure used, the application development (Tele-psychiatric Consultation Process), the former process prior to the 1/1/2015 implementation, the current process (post implementation of the Tele-psychiatric Consultation application), the method in which the data were collected and analyzed, and the qualifications of the team tasked with analyzing the data.

The data utilized in this study include all patients seen in participating CHS ED's (CMC Anson, CMC Lincoln, CMC Northeast, CMC Pineville, CMC Steele Creek Health Pavilion, CMC Union, CMC University, CMC – Main, CMC Mercy) who had the Telepsych icon fired within FirstNet ("Telepsych Ordered"). Patient demographics were not limited and thus included;

- All races
- All ages (including adolescence)
- Any gender
- All diagnosis
- Any marital status

The data reports retrieved by Dickson Advanced Analytics analyst Dr. Nino Dzebisashvili utilizing the Power Insight Report from Cerner includes the fields Encounter ID, Facility, Tele-psych Services (Yes/No), Patient, Arrival date and time, Departure date and time, Notes started date and time, Consult time start, Consult time depart, and LOS hours. The data reports were for the time periods of October 2014 and October 2015. Patient encounters were excluded based on the following rare events:

- If time between "Arrive" and "TelePsych Ordered" is >24 hours within FirstNet
- If "TelePsych Ordered" appears after admission
- If Telepsych Consult was ordered and canceled (7 patients)
- Patients from 7 facilities excluded because there were no patients seen for which the Telepsych icon was fired

3.1.1. New FirstNet Application Development

Psychiatric consultations can occur on any given day across CHS Emergency Departments, as well as inpatient facilities. To perform these consultations CHS:

- Use state of the art, two-way, secure telemedicine equipment to connect the provider with the patient.

- Behavioral Health Clinicians contact the EDs, gather and chart vital information to be reviewed by the psychiatrists
- Psychiatrists call into a mobile cart or wall mounted device at the remote facility where the patient is located.
- From there, the provider will talk with the patient just as though they were talking face to face.
- The Provider then documents their recommendations and treatment regimens
- The ED staff responds accordingly (admit, discharge, etc.)

The technologies utilized by CHS are telemedicine software/hardware, FirstNet (Cerner), and a reliable network/infrastructure. All of these technologies, or a variation of them, are growing in healthcare and tele-psychiatry services.

CHS specifically utilizes HP technologies for hardware. The current CHS telemedicine hardware standard is the HP ZBook 17" mobile workstation. Its specs include a 17.3 inch display, i5 core processor, Win 7 Pro OS, webcam, 4GB RAM, wireless and Bluetooth capability and fingerprint reader security. In 2016 CHS will be migrating to the HP ProOne 600 GI All-In-One. Although it does not look like a traditional laptop, the device is essentially just that using many internal laptop components such as RAM and hard drives. The benefit for this enhancement comes

mainly from the much larger display (21.5”) which will enhance the tele-psychiatric experience for patients, clinicians and physicians. While CHS upgrades these mobile devices, they will also replace the mobile cart on which they are affixed. The Rubbermaid Carelink M48 Medication Cart has been selected as the standard medication and documentation cart. Features of the new systems include:

- Powered cart with accurate battery display – battery life of at least 10 hours
- The monitor is adjustable independent of the cart and can be turned to the side for clear sight lines when moving
- Electronic lift with height adjustment memory settings
- Adjustable keyboard tray to allow for proper placement of hands when typing
- Easier to Move because of N-Stride steering control that directionally locks one caster straight at the touch of a button making it easier to navigate through hallways and around corners.
- N-Sight fleet management for remote asset management

CHS Network utilizes Cisco technologies to operate and maintain it’s Wide Area Network (WAN). (See appendix 1) A WAN is a data communications network that covers a relatively broad geographic area and that often uses transmission facilities provided by common carriers, such as telephone companies, to transmit data. CHS

then uses Cerner for their EMR needs. Cerner enables physicians, nurses and other authorized users to share data and streamline processes across the entire CHS organization. An online "digital chart" displays up-to-date patient information in real time, complete with decision-support tools for physicians and nurses. Simple prompts allow swift and accurate ordering, documentation, and billing.

Finally, to manage the ER workflow, CHS further engages Cerner by using their FirstNet product. FirstNet allows for the following:

- *Triage and Tracking*

The Triage and Tracking feature within FirstNet serves as the hub of all patient activity in the emergency department and is a key to improving patient throughput. This feature enables quick patient registration, which, in turn, alleviates treatment delays. Additionally, customizable tracking lists are used to check patient status, monitor resources and view test results quickly and easily. Further, this feature is used to view test results from the tracking board keeping actionable, accurate data nearby for those who have the most impact on the patient experience.

- *Goal of increased time for patient care*

Nursing documentation within FirstNet is a key component to managing an efficient ED. Because Cerner designed nursing documentation for rapid input of data, nurses have more time to care for patients. The solution:

- Automatically enters data captured from bedside medical devices into the system via Cerner's high-acuity flow sheet
- Automates orders, which reduces redundancy and helps ensure accuracy
- Improves patient outcomes with the incorporation of evidence-based nursing documentation

- *Physician documentation*

FirstNet includes a complete set of documentation tools that help physicians create fast and complete documentation. The solution automatically generates the appropriate template based on patient and clinical data.

In addition, it prompts physicians to return to areas requiring additional information and automatically incorporates information such as allergies and prior medical history from documentation created by nurses and ancillary areas.

- *Professional Coding*

The FirstNet offering includes comprehensive professional coding functionality to help your ED accurately capture all charges associated with physician services delivered during a patient's stay. To this end, FirstNet:

- Utilizes '95 CMS guidelines to ensure proper reimbursement
- Streamlines professional coding through a customizable interface that gives clinicians access to the data necessary to complete coding
- Provides all information in one location so clinicians don't have to search in multiple areas for documentation

- *Capturing facility related charges*

Facility charging functionality is designed to ensure ED's are accurately capturing all facility-related charges for a patient's stay and therefore capturing maximum revenue.

- Utilizes a presenting-problem based methodology as opposed to an intervention-based methodology that many organizations use which results in a more accurate, consistent and compliant visit level calculation
- Generates an average of $30 additional net revenue per patient
- Delivers proven ROI

- *Patient education*

The solution has patient education materials from ExitCare, HealthSheets and Exit-Writer. These materials cover all venues of care, including inpatient, emergency department, ambulatory outpatient clinics and ambulatory surgery centers. In addition, they cover multiple heal-related topics, including:

- Illnesses
- Injuries
- Treatments
- Diagnoses
- Discharge guidelines
- Release forms
- Diet directives
- Special instructions

Patient education content is also saved in the patient's electronic medical record for future access and review.

3.1.2. Former CHS tele-psychiatry process

The former process (prior to 1/1/2015) used by CHS Tele-psychiatry Department and ED's to process a Tele-psychiatry consult included the following features:

1. ED calls for a Consult (yellow phone) - PCL
2. Appointment is set up for the patient (Patient information is verbally given and written down)
3. Consult time is given to the Emergency Department (Sets expectation)
4. Patient is Pre-Arrived to "Green Board" at the Behavioral Health location
5. The Clinician performs prescreening process. (Copies information from the "Green Board" and searches for the patient and patient encounter). Five PowerForms are completed with multiple calls to the ED for collateral information.
6. The Provider performs the Psychiatric consultation. (Copies information from the "Green Board" and searches for the patient and patient encounter)
7. The BH Provider then would document disposition recommendations along with medication recommendations within the customized PowerNote for review by the ED Provider
8. ED Provider continually checks for PowerNote in system to see if consultation has been completed.

3.1.3. The new CHS Tele-psychiatry process

The new process (beginning 1/1/2015) that was used by CHS Tele-psychiatry Department and ED's to process a Tele-psychiatry consult was as follows:

1. Patients are placed in Virtual Psych Units at the Emergency Department location (one of fourteen Emergency Department locations)
2. The tab is sorted via LOS
3. Patients are seen based on priority and time.
4. Direct access to the Patients chart (The Psychiatrist/Clinician only has to hover on specific column views to gain instant patient information).
5. Clinicians start the documentation process by accessing PowerNote – document the prescreening and collateral information
6. BH Providers access Existing PowerNote (The Psychiatrist can then open the patient's chart and document any findings on a custom Psychiatric Consultation PowerNote).
7. Signing of this PowerNote Completes the Process (The signing of this PowerNote changes event icons from Red status to Green Completed status).
8. Placement Communicated (Placement comments communicated here can be viewed by the specific Emergency Department where the patient is physically located).

Tele-psychiatry Consult Process developed within FirstNet by CHS application description:

The tele-psychiatry portal was a unique and innovative build that stretched the limits of CHS imagination and required a total CHS IS team (IS Lab, IS Radiology, IS Pharmacy, IS EMR teams, and IS FirstNet team) effort for successful completion. An eTracking queue was developed to bridge the gap by integrating separate processes to better coordinate the flow of patient care as a result of these efforts with custom designed column views with quick access to patient information directly from the board available to Behavioral Health staff from CHS ED's.

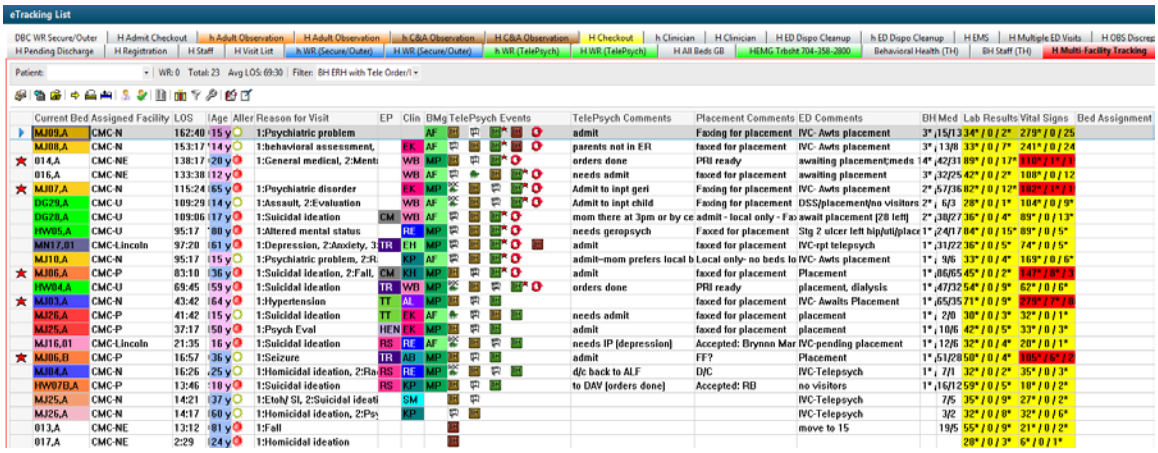


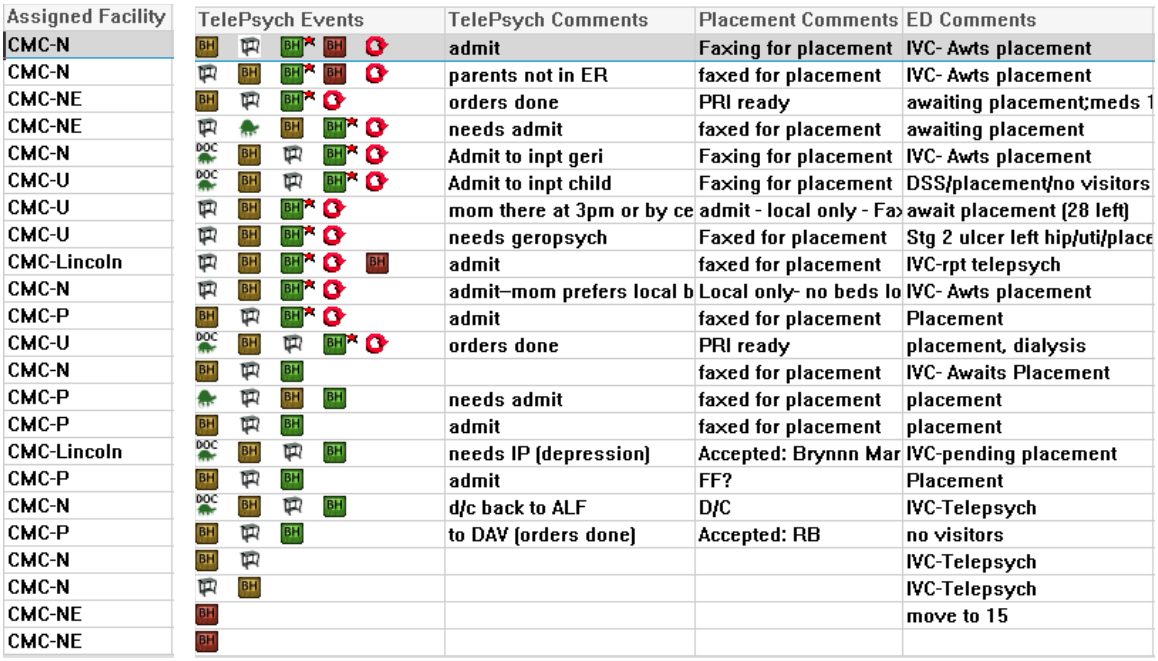
Figure 3.1 *Test data view of the eTracking queue developed (no real patients)

Figure 3.1 displays the view from the CHS Behavioral Health Location. As patients are placed in Virtual Psych Units at one of fourteen Emergency Department locations they automatically appear on this unique filtered eTracking tab. The tab is sorted via LOS and patients are seen based on priority and time (LOS). The

Psychiatrist viewing this portal would hover over a specific column to gain instant patient information. The Psychiatrist can then open the patient's chart and document any findings on a custom Psychiatric Consultation PowerNote. The signing of this PowerNote changes event icons from Red status to Green Completed status. This eTracking column build is custom to meet the needs of the Psychiatrists performing care. Placement of comments communicated here can be viewed by the specific Emergency Department where the patient is physically located. Patient information is face up and visible including:

- Medications
- Lab Results
- Vital Signs

The queue gives CHS Behavioral Health direct access into the patient's chart.



Assigned Facility	TelePsych Events	TelePsych Comments	Placement Comments	ED Comments
CMC-N		admit	Faxing for placement	IVC- Awts placement
CMC-N		parents not in ER	faxed for placement	IVC- Awts placement
CMC-NE		orders done	PRI ready	awaiting placement;meds 1
CMC-NE		needs admit	faxed for placement	awaiting placement
CMC-N		Admit to inpt geri	Faxing for placement	IVC- Awts placement
CMC-U		Admit to inpt child	Faxing for placement	DSS/placement/no visitors
CMC-U		mom there at 3pm or by ce	admit - local only - Fax	await placement (28 left)
CMC-U		needs geropsych	Faxed for placement	Stg 2 ulcer left hip/uti/place
CMC-Lincoln		admit	faxed for placement	IVC-rpt telepsych
CMC-N		admit–mom prefers local b	Local only- no beds lo	IVC- Awts placement
CMC-P		admit	faxed for placement	Placement
CMC-U		orders done	PRI ready	placement, dialysis
CMC-N			faxed for placement	IVC- Awaits Placement
CMC-P		needs admit	faxed for placement	placement
CMC-P		admit	faxed for placement	placement
CMC-Lincoln		needs IP (depression)	Accepted: Brynnn Mar	IVC-pending placement
CMC-P		admit	FF?	Placement
CMC-N		d/c back to ALF	D/C	IVC-Telepsych
CMC-P		to DAV (orders done)	Accepted: RB	no visitors
CMC-N				IVC-Telepsych
CMC-N				IVC-Telepsych
CMC-NE				move to 15
CMC-NE				

Figure 3.2

Figure 3.2 displays an example of a typical day with multiple facilities pulling into the one tab view. This is the use of 14 new unique virtual nurse locations from different facility locations (physical locations) pulling to one specific location and one specific tab.

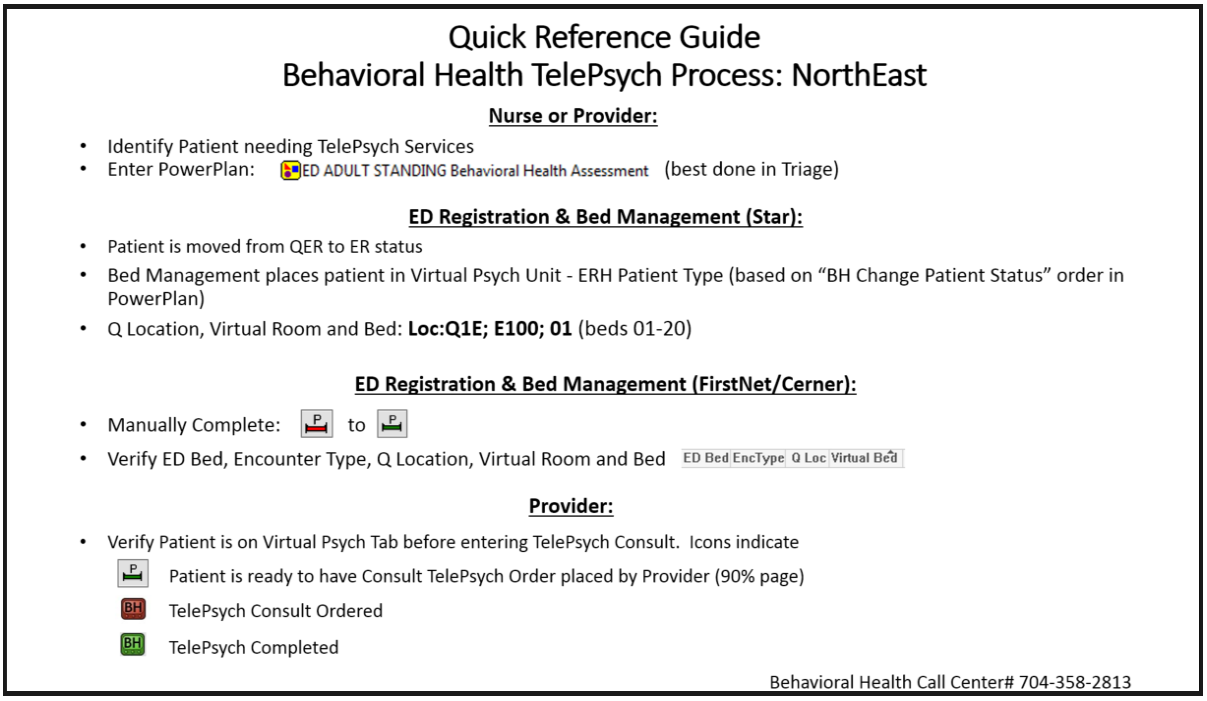
The patient names are hidden from view.

Some notable details are:

- Tele-psychiatry events communicate between behavioral health staff status and any delays that may occur.
- Tele-psychiatry comments – for Behavioral Health only

- Placement comments – used by BH and read only by the ED
- ED Comments - used by the ED and read only for BH

The process from the facility perspective (CMC NorthEast used in this example) is as follows in figures 3.3 and 3.4:



Quick Reference Guide
Behavioral Health TelePsych Process: NorthEast

Nurse or Provider:

- Identify Patient needing TelePsych Services
- Enter PowerPlan: ED ADULT STANDING Behavioral Health Assessment (best done in Triage)

ED Registration & Bed Management (Star):

- Patient is moved from QER to ER status
- Bed Management places patient in Virtual Psych Unit - ERH Patient Type (based on "BH Change Patient Status" order in PowerPlan)
- Q Location, Virtual Room and Bed: **Loc:Q1E; E100; 01** (beds 01-20)

ED Registration & Bed Management (FirstNet/Cerner):

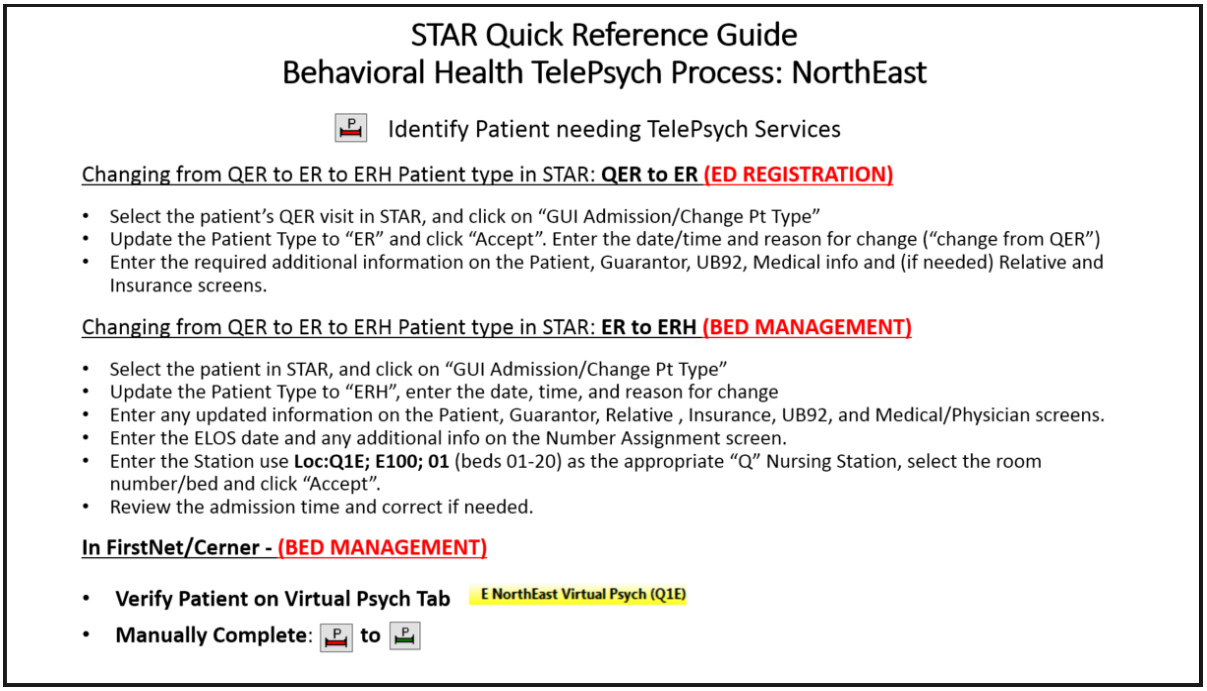
- Manually Complete: to
- Verify ED Bed, Encounter Type, Q Location, Virtual Room and Bed ED Bed EncType Q Loc Virtual Bed

Provider:

- Verify Patient is on Virtual Psych Tab before entering TelePsych Consult. Icons indicate
  - Patient is ready to have Consult TelePsych Order placed by Provider (90% page)
  - TelePsych Consult Ordered
  - TelePsych Completed

Behavioral Health Call Center# 704-358-2813

Figure 3.3



STAR Quick Reference Guide
Behavioral Health TelePsych Process: NorthEast

Identify Patient needing TelePsych Services

Changing from QER to ER to ERH Patient type in STAR: **QER to ER (ED REGISTRATION)**

- Select the patient's QER visit in STAR, and click on "GUI Admission/Change Pt Type"
- Update the Patient Type to "ER" and click "Accept". Enter the date/time and reason for change ("change from QER")
- Enter the required additional information on the Patient, Guarantor, UB92, Medical info and (if needed) Relative and Insurance screens.

Changing from QER to ER to ERH Patient type in STAR: **ER to ERH (BED MANAGEMENT)**

- Select the patient in STAR, and click on "GUI Admission/Change Pt Type"
- Update the Patient Type to "ERH", enter the date, time, and reason for change
- Enter any updated information on the Patient, Guarantor, Relative , Insurance, UB92, and Medical/Physician screens.
- Enter the ELOS date and any additional info on the Number Assignment screen.
- Enter the Station use **Loc:Q1E; E100; 01** (beds 01-20) as the appropriate "Q" Nursing Station, select the room number/bed and click "Accept".
- Review the admission time and correct if needed.

In FirstNet/Cerner - (BED MANAGEMENT)

- **Verify Patient on Virtual Psych Tab** E NorthEast Virtual Psych (Q1E)
- **Manually Complete**: to

Figure 3.4

The process is the same throughout all facilities, however the person who performs the steps may change.

CHS Behavioral Health custom events for the developed process (figure 3.5):

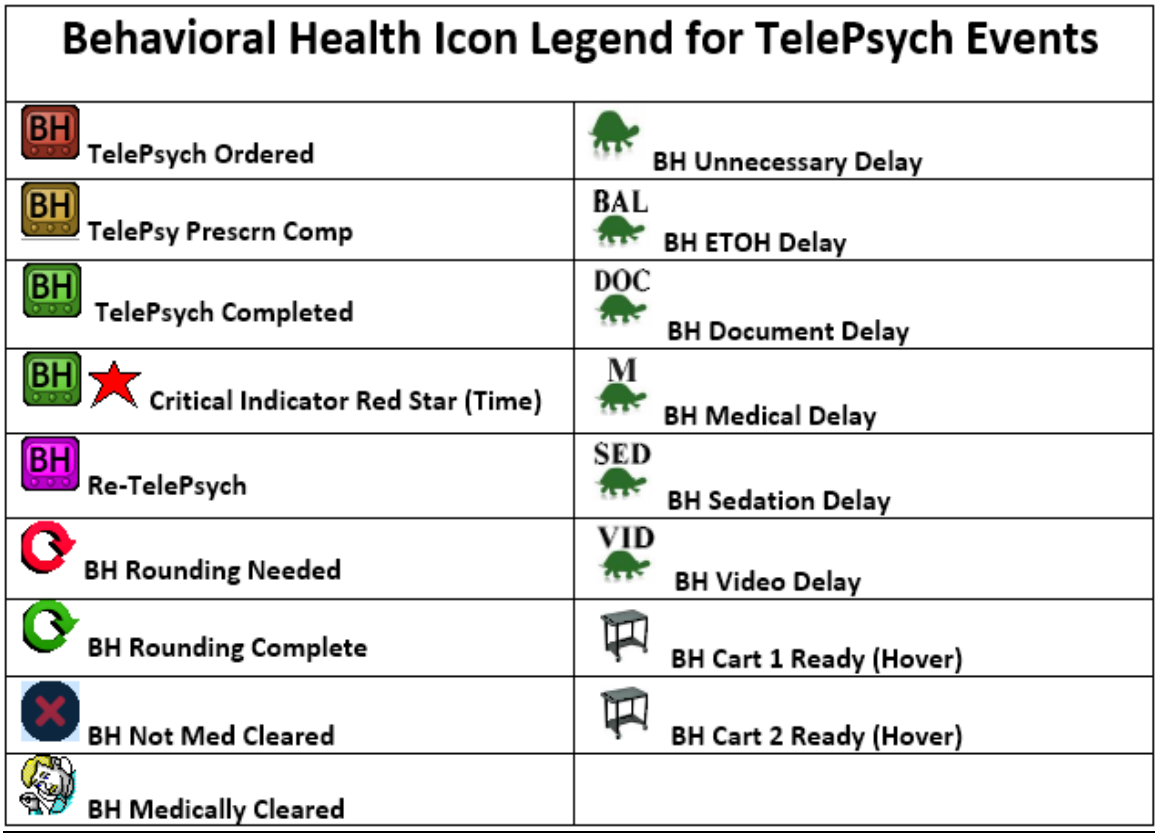


Figure 3.5

- Several types of delays were added to gather information and identify where the process needs streamlining
- These events also serve as data points for analyzing the process and identifying issues

In summary, the Tele-psychiatry Consult Process developed by taking the existing tele-psychiatry process and directly connecting it to CHS's EMR (Cerner) by utilizing Firstnet (ED specific Cerner application). As a result CHS mental health

professionals can directly update patients medical records and direct staff at remote ER's on the diagnosis and next step for the patient.

3.1.4. Quantitative Analysis

Method of analysis by Dickson Advanced Analytics (DA^2)

A complete retrospective cross sectional analysis was performed by the DA^2 team comparing patients seen during the same random month (October) in two consecutive years, 2014 and 2015. Measurement comparisons included:

- LOS_HRS (length of stay in hours)
- LOS distribution
- Median, mean, and Standard deviation comparisons of LOS by year and facility
- Independent group T-test - a parametric statistical test that made assumptions about the parameters (defining properties) of the population distribution from which the data were drawn. The variables were(including adolescence) Length Of Stay hours classified by year. This test will be utilized to determine the result if there is a normal distribution.
- Non-parametric Kruskal-Wallis Test - Makes no such assumptions about the properties of the source population. The Kruskal-Wallis test is a non-parametric test, which means that it does not assume that the data come from a distribution that can be completely described by two parameters,

mean and standard deviation (the way a normal distribution can). The variables were Length Of Stay hours classified by year. This test will be utilized to determine the result if there is not a normal distribution.

- Patient Population Analysis: To control for patient characteristics (diagnosis, gender, race, age, and marital status), this study will include a multivariable linear regression model on a logged LOS variable while controlling for all the covariates that are tested in the comparison analysis, comparing the average LOS difference between Oct 2014 and Oct 2015.

3.1.5. Quantitative Analysis: Dickson Advanced Analytics (DA^2) credentials

The requested data analysis for this study was performed by Dickson Advanced Analytics (DA^2) department of Carolinas Healthcare System. CHS is enhancing the quality and value of care for patients through the work of DA^2. DA^2 uses innovative tools and technologies to help medical providers deliver the best possible care to patients and families. It integrates and analyzes clinical data to manage the health of individual patients and of communities, and to develop analytics models that can be used to predict population health trends. By harnessing data across a variety of healthcare settings, DA^2 drives solutions that help advance performance metrics and business intelligence and that improve the wellbeing and experience of all patients.

DA^2 integrates healthcare analytics for evidenced-based population health management, individualized patient care and predictive modeling. DA^2's mission is

to adopt advanced technologies and build collaborative relationships in hopes to offer better patient care and outcomes through centralization and standardization of analytics across CHS. DA^2 was launched in 2013 when CHS joined other healthcare systems and IT experts. It is the first healthcare department of its kind that was created with a specific goal of improving population health through data analytics and business intelligence. The creation of DA^2 combined data and resources from four geographically distinct healthcare systems, operating 100 hospitals and more than 1,600 non-acute sites, caring for more than 28 million people. DA^2 is a major resource in helping CHS achieve its goal of being a national leader in advanced healthcare.

DA^2 department provides predictive analytics to positively impact patient and community health. This helps CHS to proactively deliver preventive healthcare services and interventions in the areas of readmission, patient compliance with evidence-based guidelines, and enhanced care delivery models. With Readmission Risk Analytics, CHS hospitals now are able to predict, with nearly 80 percent accuracy, a patient's risk for being readmitted within 30 days after being discharged by pulling electronic medical records data for 40 different patient variables. In regards to Payer Claims Analytics, CHS offers employer groups claims data analysis that helps determine the optimal programs and medical practices for improving the health of employees and patients. CHS is one of the first provider organizations to

integrate claims and clinical data to demonstrate quality and value to various stakeholders. DA^2's Enterprise Data Warehouse integrates CHS patient information within minutes from a wide range of sources, including clinical, billing and claims data. This intensive effort brings information from more than 5 million patients into one repository that includes 1.5 petabytes of data across the CHS. This is the data equivalent to storing the entire print collection of the Library of Congress.

CHS have been contacted by noteworthy organizations such as HIMSS, the Health IT Summit, the UK's National Health Services Trust, and many other organizations looking to learn more about CHS's DA^2 team. Leadership highlights that DA^2 is providing in healthcare analytics include:

- DA^2 research has developed partnerships with the University of Pittsburg, Evolent Health, and Duke University
- Clinical & Experimental Immunology accepted DA^2 research on drug-induced liver injury (DILI) leukocyte.
- National recognition in Growth Analytics research.
- National recognition for extensive research and in readmissions.
- Development of a patient profile for the Advanced Illness Management (AIM) program that will help identify AIM eligible patients admitted into acute care before they are discharged.

- Ebola Travel Power Form in creation in Cerner for better readiness and increased quality of care.
- Completion of a LCI Palliative Care scorecard (which allows the measurement and reporting of chemotherapy use, ICU admissions, acute care readmissions, and inpatient length of stay within the last 14-30 days of life) to support the growth of the oncology palliative care delivery model through a single unified approach.
- Segmenting and classifying CHS's current patient population, which enabled DA^2 to forecast and aid in the valuation and possible purchase of medical practices.
- DA^2's analytics is responsible for identifying and developing major avoidable care, strategic growth, quality and patient safety initiatives for CHS.
- Harvard Business School sent a request to CHS to do a case study about how CHS developed DA^2 and the strategic use of DA^2.

3.1.6. Operational definitions within the new FirstNet Tele-Psychiatric Consultation Process

Using the FirstNet application to pull the patient's current EMR encounter from multiple ED locations to the CHS Behavioral Health facility location for consultation is the primary purpose of the Tele-psychiatry Consultation Process.

From the physician view, the CHS Behavioral Health Tele-psychiatry Consultation eTracking board appears as followed in figure 3.6:

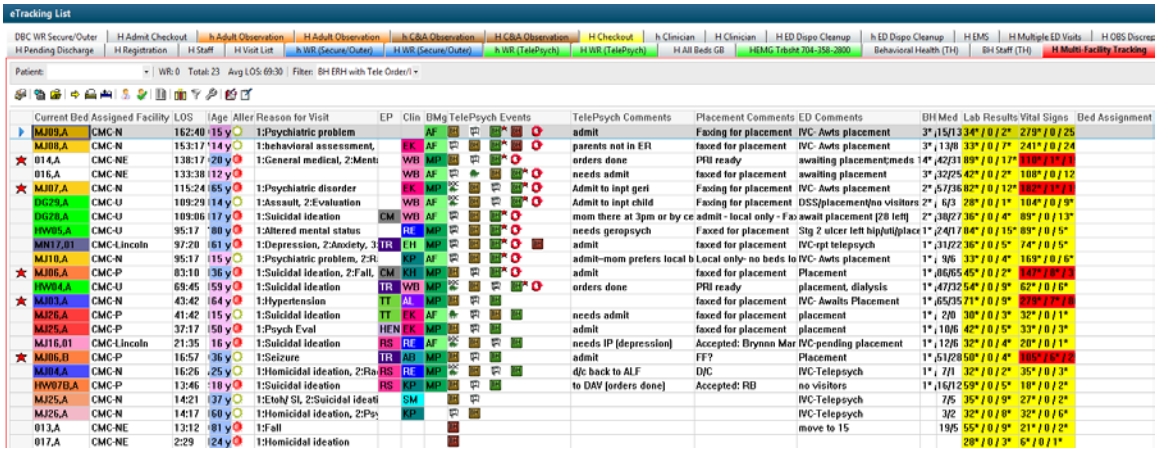


Figure 3.6

Each column within the eTracking board (Figure x) allows the physician to have a general view of all psychiatric patients at various ED locations.

Column 1:

Current bed assignment

Column 2:

Facility the patient is physically located

Column 3:

Length of Stay (LOS in hours and minutes displayed in figure 3.7)

LOS
88:33
52:56
38:23
39:18
34:48
34:32
27:28
23:48
19:56
8:50
13:41
11:08
11:11
12:56
10:21
10:37
10:13
5:38
3:08

Figure 3.7

Column 4:

Patients age

Column 5:

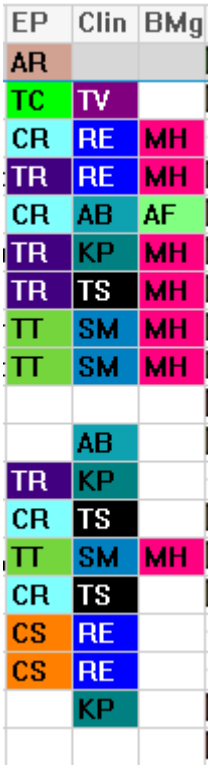
Patients allergies

Column 6:

Reason for patient visit

Column 7, 8, and 9:

Initials of person assigned to patient care at the patient's facility and at CHS Behavioral Health (displayed in figure 3.8).



EP	Clin	BMg
AR		
TC	TV	
CR	RE	MH
TR	RE	MH
CR	AB	AF
TR	KP	MH
TR	TS	MH
TT	SM	MH
TT	SM	MH
	AB	
TR	KP	
CR	TS	
TT	SM	MH
CR	TS	
CS	RE	
CS	RE	
	KP	

Figure 3.8

*Provider role example above

EP = Provider Role (ED Provider)

Clin = Provider Role (BH Clinician)

BMgmt = Provider Role (Bed Management)

Column 10:

Telephych events

 **TelePsych Ordered** (Order is placed by ED and fires this Icon – Automated)

 **TelePsy Prescrn Comp** (TelePsych Prescreen Completed- The manual completion of the Red BH fires this Yellow BH)

 **TelePsych Completed** (Signing of the Psychiatric Consultation

 **TelePsych Completed over 23 hours** (The red star indicates the time of 23 hours or greater as a critical indicator)

 **Re-TelePsych** (Patient needs a Re-TelePsych – Manual firing of Icon)

 **Rounding Needed** (This patient has had a TelePsych and needs to be rounded on – Manual firing of Icon)

 **Rounding Complete** (This Icon appears when the Red Icon like this is manually completed indicating Rounding is completed)

 **Not Med Cleared** (Not Medically Cleared - this indicated the patient is not medically cleared for the TelePsych – Manual firing of Icon)

 **Medically Cleared BH** (Indicates Patient is Medically Cleared for TelePsych – When the "Not Med Cleared Icon" is completed this fires the Medically Cleared BH Icon – Automated) (This Icon can also be manually fired)

 **Unnecessary Delay** (Manually fire this Icon to indicate a delay in the TelePsych process)

BH ETOH Delay (Manually fire this Icon to indicate a ETOH/BLOOD ALCOHOL delay in the TelePsych process)

BH Document Delay (Manually fire this Icon to indicate a DOCUMENTATION delay in the TelePsych process)

BH Medical Delay (Manually fire this Icon to indicate a MEDICAL delay in the TelePsych process)

BH Sedation Delay (Manually fire this Icon to indicate a SEDATION delay in the TelePsych process)

BH Video Delay (Manually fire this Icon to indicate **a** VIDEO delay in the TelePsych process)

BH Cart 1 Ready (Manually fire this Icon to indicate the Cart 1 is ready. Hover over Icon to display Cart Number #)

BH Cart 2 Ready (Manually fire this Icon to indicate the Cart 2 is ready. Hover over Icon to display Cart Number #

Emergency Department Events for Behavioral Health (ED Only)

 **TelePsych Ordered** (Order is placed by ED and fires this Icon – Automated)

 **TelePsych Completed** (Signing of the Psychiatric Consultation Note fires this Icon – Automated)

Note- the events may appear similar but are completely different events.

Column 11:

Tele-psychiatry comments

Column 10:

Placement comments

Column 11:

ED comments

Column 12:

Behavioral Health Medication

Column 13:

Lab results

Column 14:

Vital signs

Selection screen example below in figure 3.9:

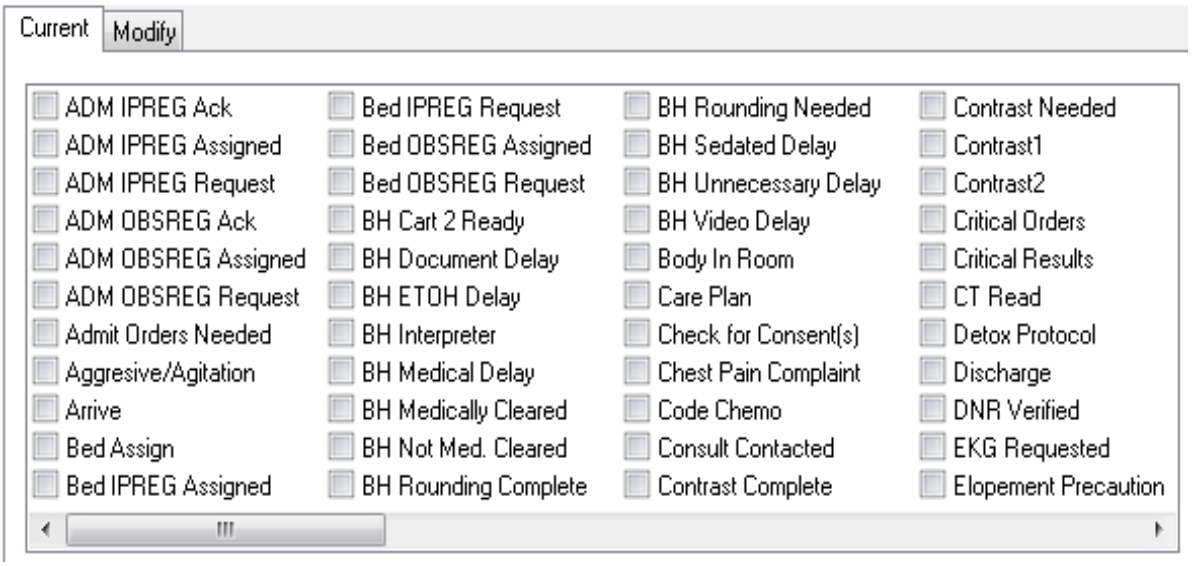
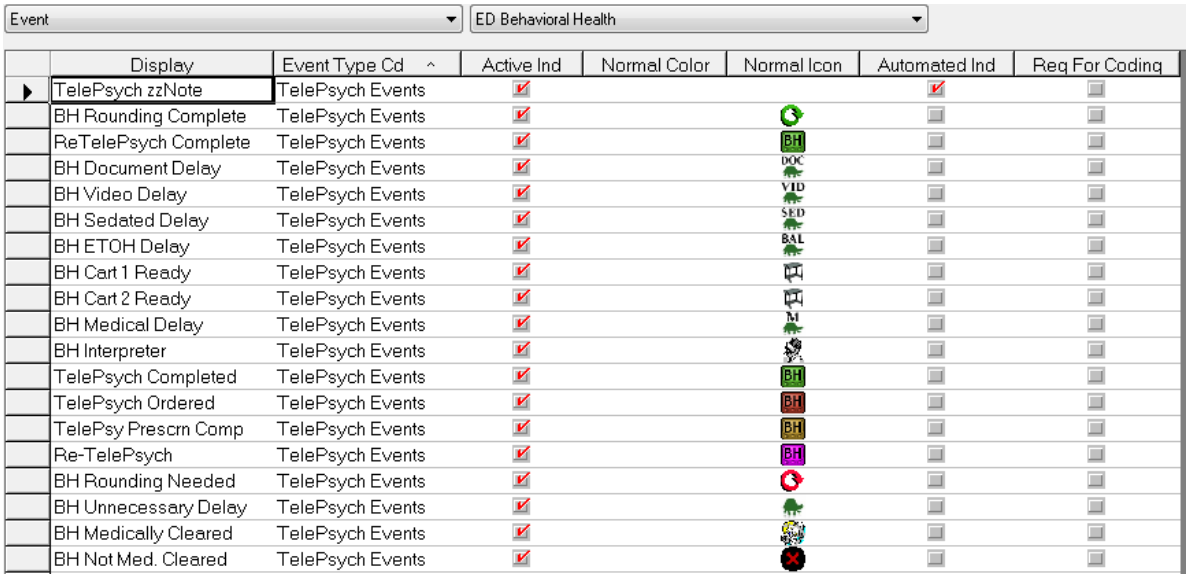


Figure 3.9

Tele-Psychiatric Consultation Process event board and event list displayed in figure 3.10:



Event: ED Behavioral Health

Display	Event Type Cd	Active Ind	Normal Color	Normal Icon	Automated Ind	Req For Coding
TelePsych zzNote	TelePsych Events	☑			☑	☐
BH Rounding Complete	TelePsych Events	☑			☐	☐
ReTelePsych Complete	TelePsych Events	☑			☐	☐
BH Document Delay	TelePsych Events	☑			☐	☐
BH Video Delay	TelePsych Events	☑			☐	☐
BH Sedated Delay	TelePsych Events	☑			☐	☐
BH ETOH Delay	TelePsych Events	☑			☐	☐
BH Cart 1 Ready	TelePsych Events	☑			☐	☐
BH Cart 2 Ready	TelePsych Events	☑			☐	☐
BH Medical Delay	TelePsych Events	☑			☐	☐
BH Interpreter	TelePsych Events	☑			☐	☐
TelePsych Completed	TelePsych Events	☑			☐	☐
TelePsych Ordered	TelePsych Events	☑			☐	☐
TelePsy Prescrn Comp	TelePsych Events	☑			☐	☐
Re-TelePsych	TelePsych Events	☑			☐	☐
BH Rounding Needed	TelePsych Events	☑			☐	☐
BH Unnecessary Delay	TelePsych Events	☑			☐	☐
BH Medically Cleared	TelePsych Events	☑			☐	☐
BH Not Med. Cleared	TelePsych Events	☑			☐	☐

Figure 3.10

Total list events from the ED/patient facility location displayed in figure 3.11:

Arrive
Psych Placement
TelePsych Ordered
TelePsy Prescrn Comp
TelePsych Completed
Re-TelePsych
ReTelePsych Complete
BH Rounding Needed
BH Rounding Complete

BH Not Med Cleared
BH Medically Cleared
BH Unnecessary Delay
BH Video Delay
BH Sedated Delay
BH Medical Delay
BH Document Delay
BH ETOH Delay
BH Cart 1 Ready
BH Cart 2 Ready
Admit
BH Interpreter
Discharge

Figure 3.11

3.2. Sample selection

Sample size:

All data from CHS Psychiatric ED patients were examined from the facilities listed below during the months of October2014 (532 patients), prior to new system implementation, and October 2015 (769 patients), after new system implementation. The selected patients included everyone in participating EDs who had the Tele-psych icon "Telepsych Ordered" chosen in FirstNet (Cerner). All patients consented to treatment. It is unknown if any patients refused treatment. Psychiatric diagnoses used for selection of included patients were:

- Mental disorders due to known physiological conditions
- Mental and behavioral disorders due to psychoactive substance use
- Schizophrenia, schizotypal, delusional, and other non-mood psychotic disorders
- Mood [affective] disorders
- Anxiety, dissociative, stress-related, somatoform and other nonpsychotic mental disorders
- Behavioral syndromes associated with physiological disturbances and physical factors
- Disorders of adult personality and behavior
- Intellectual disabilities
- Pervasive and specific developmental disorders

- Behavioral and emotional disorders with onset usually occurring in childhood and adolescence
- Unspecified mental disorder

Study Population:

The data includes psychiatric ED patients from the following Western North Carolina facilities during October 2014 and October 2015:

- CMC Anson
- CMC Lincoln
- CMC Northeast
- CMC Pineville
- CMC Steele Creek Health Pavilion
- CMC Union
- CMC University
- CMC - Main
- CMC Mercy

These are currently the only CHS ED facilities participating in Tele-psychiatric services with at least one Tele-psychiatric consultation during these two time periods. They are located within a 100 mile radius around the metro Charlotte NC area (Illustrated below in figure 3.12).

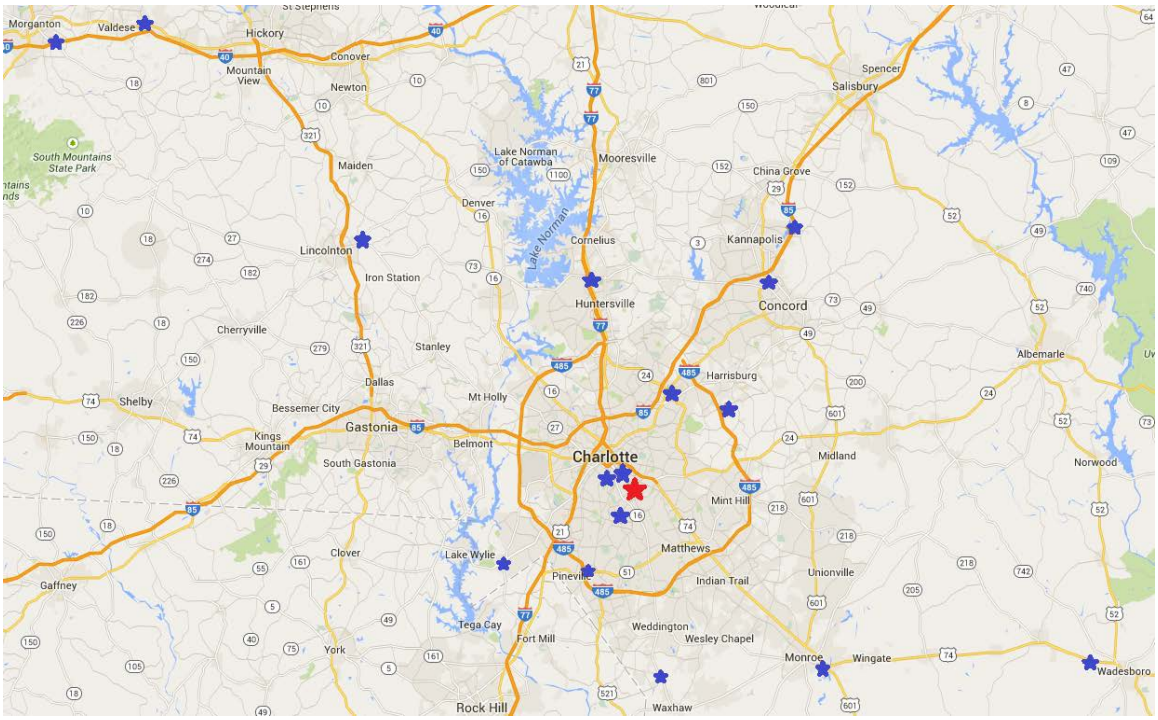


Figure 3.12

3.3. Instrumentation / Data Collection-Procedure / Data Set Description / Data Analysis

Data Selection/Patient selection criteria for this study in regards to the new Tele-Psychiatric Consultation Process built within the FirstNet application included:

- Everyone in participating CHS EDs who had Telepsych icon fired (“Telepsych Ordered”) within FirstNet
- Removed outlier facilities (No patients with Telepsych Ordered selected in FirstNet)

- Exclude if Telepsych Consult was ordered and canceled
- Encounter-level summaries (patients with > 1 visit are counted twice)
- Removing duplicate events with different time stamp
- Keep the EARLIEST timestamp for:
  - Arrive
  - Psych Placement
  - TelePsych Completed
  - TelePsych Ordered
  - TelePsy Prescrn Comp
  - BH Medically Cleared
  - BH Not Med. Cleared
  - Re-TelePsych
  - BH Rounding Complete
  - BH Rounding Needed
  - BH Delay (ALL)
  - BH Cart 1(2) Ready
  - BH interpreter
- Keep the LATEST timestamp:
  - Admit
  - Discharge

Data sources

- PowerChart (Cerner) / Power Insight via DA^2 reporting services

3.4. Limitations/delimitations

Limitations include:

- Data comparison is for October 2014 and October 2015. Analysis for other time periods could potentially result in a different trend.
- Other unknown process changes in the admittance and discharge process may confound the outcome.
- Looking only at one health care system in a limited geographic area limits generalizability.
- Cross sectional design does not allow for causation to be shown.

3.5. Protection of Human Subjects

Study data were delivered as de-identified aggregated results in output formats. Analytic data was aggregated and de-identified by DA^2 at the facility level prior to study analysis. There is no patient level information included in the study and thus this study was non-human research where Institutional Review Board

(IRB) approval was not required, but was submitted and approved nevertheless by both CHS and MUSC IRB's.

CHAPTER IV: RESULTS

4.1. Results/Findings

Project: Measure ED LOS for CHS Psych visits

Work group: Nino Dzebisashvili PhD (DA^2 Analyst), Howard Beatty

Comparing October 2014 with October 2015

This study only included the facilities which did not fall into the outlier category. Qualifiers were facilities that participated in the Tele-psychiatry Consult Process (tracking board program) and had more than 10 patients per month. There were a total of 7 facilities excluded from the study due to an insufficient data/tele-psychiatry patients. The facilities with sufficient data and tele-psychiatry patient load included:

- CMC Anson
- CMC Lincoln
- CMC Northeast
- CMC Pineville
- CMC Steele Creek Health Pavilion
- CMC Union
- CMC University

- CMC - Main
- CMC Mercy

The distribution of psych patients admitted to ER during the study by facility is summarized in Figure 4.4. Clearly the larger facilities (Carolinas Medical Center, CMC Union, and CMC North East) had the majority of the ED psych visits during the study (as seen in figure 4.6). The LOS results from 532 ED psych patients in October of 2014 were compared to 769 ED psych patients in October of 2015 (Figure 4.5). The increase in number of patients can most likely be attributed to the increase of over .5 million patient encounters per year on average since 2007 according to CHS Annual Reports. The current (2015 report) annual patient encounter is over 11 million, which includes a diverse commercial, Medicaid (16% of gross revenue) and Medicare (37% of gross revenue) payer group. There was a median reduction in LOS hours from 19 in 2014 to 12.6 in 2015. The mean also displayed a reduction in LOS hours from 23.6 in 2014 to 20.7 in 2015. The standard deviation remained almost constant from 2014 (25.5) to 2015 (25.9).

Both a Pooled (p=.0429) and Satterthwaite (p=.0424) T-Test method was performed on the data (figure 4.7) and proved to be a significant reduction, but as earlier stated there was not a normal distribution therefore this test was not considered.

For verification of LOS results, a non-parametric Kruskal-Wallis test (figure 4.8) was performed on the data because the distribution was not normal. The results from the non-parametric Kruskal-Wallis test displayed a reduction as well. The Wilcoxon Scores for Variable measuring LOS hours revealed a decrease in mean score from 702.117481 in 2014 to 615.636541 in 2015, which ***resulted in a statistically significant reduction*** **(p = .0001). This result is unadjusted, and therefore will only stand if the adjusted patient population (Chapter/Section 4.2) proves to be statistically significant for test periods October 2014 and October 2015.**

The study had limitations. First of all, only one month from each year was selected to study. This could possibly produce a systematic sampling error (coverage error). In other words, by restricting the sampling frame to a subset of the population of interest, the sample being studied (October) could vary systematically from the population for which this study intended to generalize the results. Also, factors outside of the study could affect the LOS results of the study. Changes in budget/staffing, policy and organizational changes, other technological changes, changes in management, increase/decrease in patient population, and changes in competitive resources in the same region are a few factors that could affect the study results.

Some characteristics from the study sample group (n=1301) are displayed in figures 4.1, 4.2, and 4.3 below. The majority (over 90%) of the population was either classified as Caucasian (60%) or African American (30.7). The gender for the test months was almost evenly split, and the age for adults was approximately 40 (with a standard deviation of 15), and 14 for adolescence (with a standard deviation of 2).

Race/Ethnicity distribution for October 2014 and October 2015 (figure 4.1):

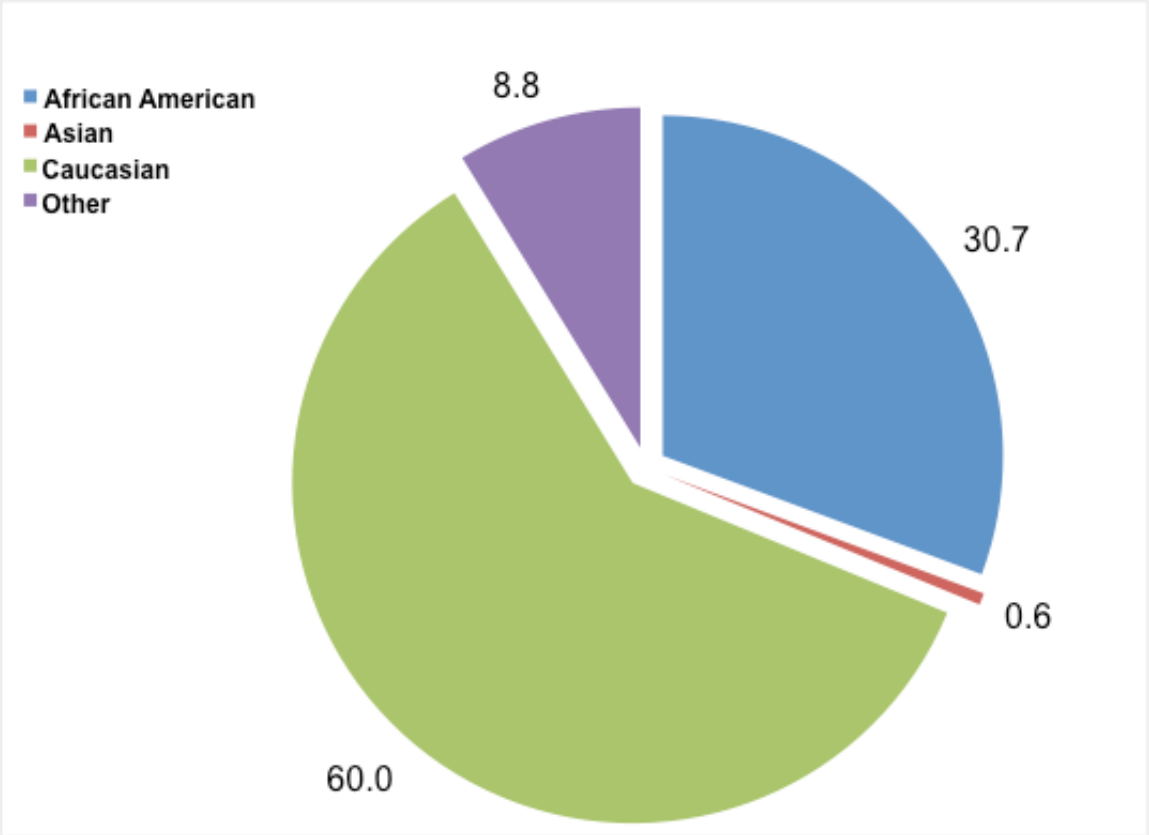


Figure 4.1

Gender for October 2014 and October 2015 (figure 4.2):

Gender:	%
Male	49%
Female	51%

Figure 4.2

Age for October 2014 and October 2015 (Figure 4.3):

Mean age for adults (± standard deviation) = 40.4 (±15.3)
Mean age for adolescence (± standard deviation) = 14.4 (± 2.3)

Figure 4.4: LOS Distribution:

- Patients by facility
- LOS_HRS = Length of stay in hours

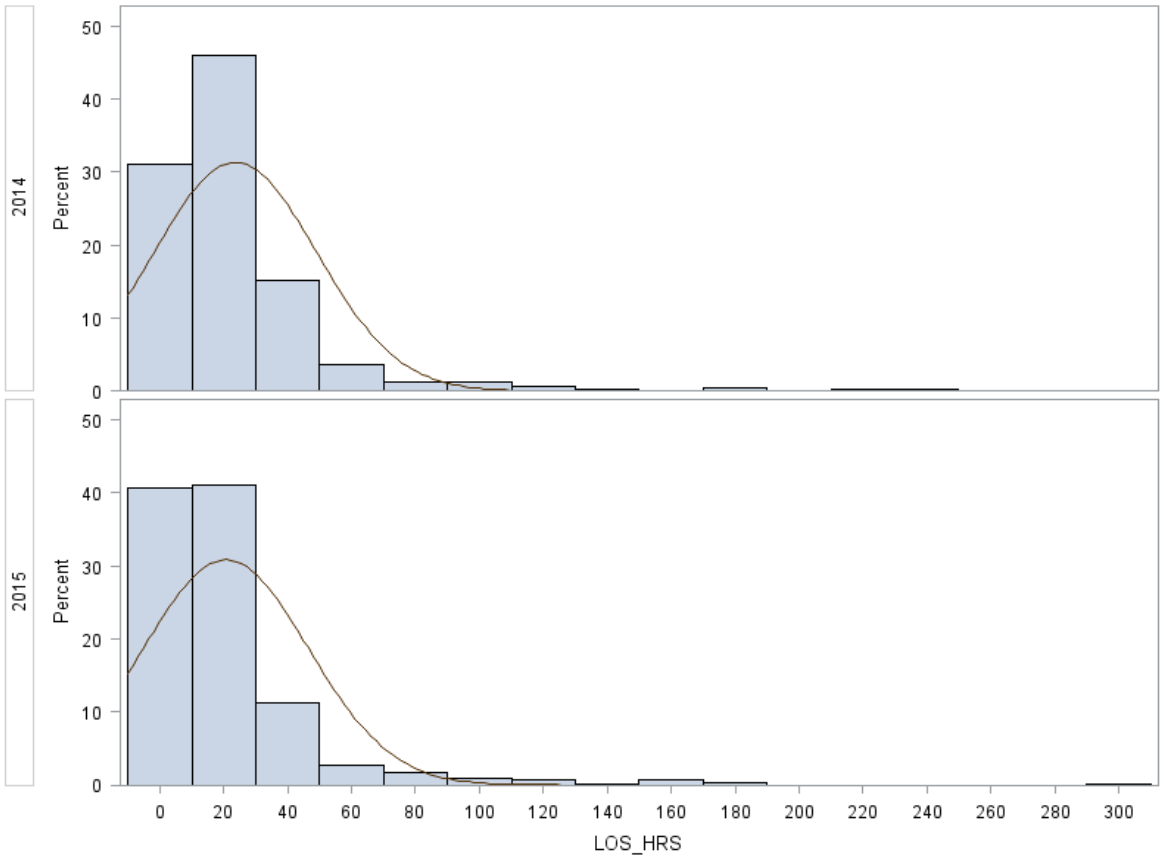


Figure 4.4 *Clearly not a normal distribution

Figure 4.5: Comparison of LOS (hours) median, mean standard deviation. LOS (hours) Minimum and LOS (hours) maximum by year:

year	#	Median	Mean	Std Dev	Minimum	Maximum
OCT_2014	532	19	23.6	25.5	1	241.5
OCT_2015	769	12.6	20.7	25.9	0.3	290.8

Figure 4.5

Figure 4.6: Comparison by year and by facility:

Analysis Variable : LOS_HRS							
CHS_SITE_DESC	year	#	Median	Mean	Std Dev	Minimum	Maximum
CMC Anson	2014	18	22.4	34.4	51.2	3	212.8
	2015	15	33.3	33.7	23.9	3.5	111.5
CMC Lincoln	2014	24	22.2	26.2	15.8	2.9	66.2
	2015	41	15.7	23	23	2	113.4
CMC Northeast	2014	130	26.9	36.7	37	1.3	241.5
	2015	160	19.6	30.5	37.5	0.9	290.8
CMC Pineville	2014	68	20.7	21.5	15.7	1	91.6
	2015	82	21.2	27.7	26.4	2	185.1
CMC Steele Creek	2014	12	22.4	20.8	7.7	5.4	30.7
	2015	15	11.8	19.3	16.2	2.6	54.6
CMC Union	2014	63	24.7	28.8	14.7	2.1	81.6
	2015	116	19.9	24.6	23.3	0.8	169.7
CMC University	2014	66	22.6	25.7	18	2.4	80.5

	2015	67	17.9	26.2	29.4	0.4	163.9
CMC Mercy	2014	14	15.1	15	5	3.9	22.4
	2015	14	9.8	10.3	5.8	2.6	23.6
CMC Main	2014	137	6.7	8.1	6.4	1.7	66.5
	2015	259	7.3	8.7	8.1	0.3	88.3

Figure 4.6

Figure 4.7: Statistics Independent Group T-Test:

year	N	Mean	Std Dev	Std Err	Minimum	Maximum
OCT_2014	532	23.6253	25.4873	1.105	0.9806	241.5
OCT_2015	769	20.6864	25.8789	0.9332	0.2522	290.8
Diff (1-2)		2.9389	25.7195	1.4504		

year	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
OCT_2014		23.6253	21.4546	25.796	25.4873	24.0424	27.1185
OCT_2015		20.6864	18.8544	22.5184	25.8789	24.647	27.2414
Diff (1-2)	Pooled	2.9389	0.0935	5.7842	25.7195	24.7675	26.7482
Diff (1-2)	Satterthwaite	2.9389	0.1011	5.7767			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	1299	2.03	0.0429*
Satterthwaite	Unequal	1153	2.03	0.0424*

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	768	531	1.03	0.7064

Figure 4.7

Figure 4.8 : Non-parametric Kruskal-Wallis Test:

Wilcoxon Scores (Rank Sums) for Variable LOS_HRS Classified by Variable year					
Year	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
2015	769	473424.5	500619	6662.44759	615.636541
2014	532	373526.5	346332	6662.44759	702.117481
Average scores were used for ties.					

Wilcoxon Two-Sample Test	
Statistic	373526.5
Normal Approximation	
Z	4.0817
One-Sided Pr > Z	<.0001
Two-Sided Pr > |Z|	<.0001
t Approximation	
One-Sided Pr > Z	<.0001
Two-Sided Pr > |Z|	<.0001
Z includes a continuity correction of 0.5.	

Kruskal-Wallis Test	
Chi-Square	16.6607
DF	1
Pr > Chi-Square	<.0001*

Figure 4.8 *P value <.05 indicated statistically significant difference

4.2. Patient population

To determine if the patient population displays a significant difference in 2014 and 2015 a data analysis was performed on *patient diagnosis* data (figure 4.9) and *patient demographics* data (figure 4.12) from all of the participating EDs in this study. These facilities include CMC Anson, CMC Lincoln, CMC Northeast, CMC Pineville, CMC Steele Creek Health Pavilion, CMC Union, CMC University, CMC – Main, and CMC Mercy.

The *patient diagnosis* analysis included:

- Chi-Square test for all diagnosis against year (Figure 4.10)
- Z-test for each diagnosis against year. (Figure 4.11)

The Chi-Square result (figure 4.11) indicates that the number of cases from each year do not differ significantly at 5% level.

Diagnosis Analysis

Principal Diagnosis - 3 Digit (ICD-9)		Month Metrics	OCT 2014 Total Cases	OCT 2015 Total Cases
Total			**532**	**769**
290	SENILE/PRESENILE PSYCHOS		1	5
291	ALCOHOLIC PSYCHOSES*		9	16
292	DRUG PSYCHOSES*		17	27
293	TRANSIENT ORG MENTAL DIS		1	1
294	OTHER ORGANIC PSYCH COND		11	6
295	SCHIZOPHRENIC DISORDERS*		12	25

296	AFFECTIVE PSYCHOSES*	30	40
297	PARANOID STATES*	2	5
298	OTH NONORGANIC PSYCHOSES	24	34
299	PSYCHOSES OF CHILDHOOD*		4
300	NEUROTIC DISORDERS*	134	171
301	PERSONALITY DISORDERS*	4	6
302	SEXUAL DISORDERS*		
303	ALCOHOL DEPENDENCE SYNDR	42	42
304	DRUG DEPENDENCE*	3	5
305	NONDEPENDENT DRUG ABUSE*	131	222
306	PSYCHOPHYSIOLOGIC DIS*	2	1
307	SPECIAL SYMPTOM NEC*	19	22
308	ACUTE REACTION TO STRESS	4	9
309	ADJUSTMENT REACTION*	13	19
310	NONPSYCHOTIC BRAIN SYND*	10	17
311	DISORDER, DEPRESSIVE NEC	55	71
312	CONDUCT DISTURBANCE NEC*	4	11
313	EMOTIONAL DIS CHILD/ADOL	3	7
314	HYPERKINETIC SYNDROME*	1	1
315	SPECIFIC DEVELOP DELAYS*		2
316	PSYGNC FACTORS W/OTHER DISEASES		
318	OTHER MENTAL RETARDATION		
319	UNSPEC INTELLECTUAL DISABILITIES		

Figure 4.9: Diagnosis data

Diagnosis * Year Crosstabulation

		Year		Total
		Oct 2014	Oct 2015	
SENILE/PRESENILE PSYCHOS ALCOHOLIC PSYCHOSES*	Count	1_a	5_a	6
	% within Diagnosis	16.7%	83.3%	100.0%
DRUG PSYCHOSES* TRANSIENT ORG MENTAL DIS	Count	9_a	16_a	25
	% within Diagnosis	36.0%	64.0%	100.0%
OTHER ORGANIC PSYCH COND SCHIZOPHRENIC DISORDERS*	Count	17_a	27_a	44
	% within Diagnosis	38.6%	61.4%	100.0%
AFFECTIVE PSYCHOSES* PARANOID STATES*	Count	1_a	1_a	2
	% within Diagnosis	50.0%	50.0%	100.0%

OTH NONORGANIC PSYCHOSES PSYCHOSES OF CHILDHOOD*	Count	11_a	6_b	17
	% within Diagnosis	64.7%	35.3%	100.0%
NEUROTIC DISORDERS* PERSONALITY DISORDERS*	Count	12_a	25_a	37
	% within Diagnosis	32.4%	67.6%	100.0%
SEXUAL DISORDERS* ALCOHOL DEPENDENCE SYNDR	Count	30_a	40_a	70
	% within Diagnosis	42.9%	57.1%	100.0%
DRUG DEPENDENCE* NONDEPENDENT DRUG ABUSE*	Count	2_a	5_a	7
	% within Diagnosis	28.6%	71.4%	100.0%
PSYCHOPHYSIOLOGIC DIS*	Count	24_a	34_a	58
	% within Diagnosis	41.4%	58.6%	100.0%
SENILE/PRESENILE PSYCHOS ALCOHOLIC PSYCHOSES*	Count	0_a	4_a	4
	% within Diagnosis	0.0%	100.0%	100.0%
DRUG PSYCHOSES* TRANSIENT ORG MENTAL DIS	Count	134_a	171_a	305
	% within Diagnosis	43.9%	56.1%	100.0%
OTHER ORGANIC PSYCH COND SCHIZOPHRENIC DISORDERS*	Count	4_a	6_a	10
	% within Diagnosis	40.0%	60.0%	100.0%
AFFECTIVE PSYCHOSES* PARANOID STATES*	Count	42_a	42_a	84
	% within Diagnosis	50.0%	50.0%	100.0%
OTH NONORGANIC PSYCHOSES PSYCHOSES OF CHILDHOOD*	Count	3_a	5_a	8
	% within Diagnosis	37.5%	62.5%	100.0%
NEUROTIC DISORDERS* PERSONALITY DISORDERS*	Count	131_a	222_a	353
	% within Diagnosis	37.1%	62.9%	100.0%
SEXUAL DISORDERS* ALCOHOL DEPENDENCE SYNDR	Count	2_a	1_a	3
	% within Diagnosis	66.7%	33.3%	100.0%
DRUG DEPENDENCE*	Count	19_a	22_a	41
	% within Diagnosis	46.3%	53.7%	100.0%
ACUTE REACTION TO STRESS ADJUSTMENT REACTION*	Count	4_a	9_a	13
	% within Diagnosis	30.8%	69.2%	100.0%
NONPSYCHOTIC BRAIN SYND* DISORDER, DEPRESSIVE NEC	Count	13_a	19_a	32
	% within Diagnosis	40.6%	59.4%	100.0%
	Count	10_a	17_a	27

CONDUCT DISTURBANCE NEC* EMOTIONAL DIS CHILD/ADOL	% within Diagnosis	37.0%	63.0%	100.0%
HYPERKINETIC SYNDROME* SPECIFIC DEVELOP DELAYS*	Count	55_a	71_a	126
	% within Diagnosis	43.7%	56.3%	100.0%
PSYGNC FACTORS W/OTHER DISEASES OTHER MENTAL RETARDATION	Count	4_a	11_a	15
	% within Diagnosis	26.7%	73.3%	100.0%
UNSPEC INTELLECTUAL DISABILITIES ACUTE REACTION TO STRESS	Count	3_a	7_a	10
	% within Diagnosis	30.0%	70.0%	100.0%
ADJUSTMENT REACTION* NONPSYCHOTIC BRAIN SYND*	Count	1_a	1_a	2
	% within Diagnosis	50.0%	50.0%	100.0%
DISORDER, DEPRESSIVE NEC	Count	0_a	2_a	2
	% within Diagnosis	0.0%	100.0%	100.0%
Total	Count	532	769	1301
	% within Diagnosis	40.9%	59.1%	100.0%

Each subscript letter denotes a subset of Year categories whose column proportions do not differ significantly from each other at the .05 level.

Figure 4.10 Diagnosis analysis

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.097[a]	24	.573
N of Valid Cases	1301		

Figure 4.11 Diagnosis Chi-Square result

The Chi-Square result (figure 4.11) indicates that the number of cases from each year do not differ significantly at 5% level.

Demographic Analysis

Figure 4.15: Demographic data (age ,race, gender, marital status)

20-Year Age Grouping	Race	Gender	Marital Status	Month Metrics	OCT 2014 Total Cases	OCT 2015 Total Cases
Total					**532**	**769**
0-17 years	WHITE	Male	Married			
			Single		22	15
			Divorced			
			Other			
		Female	Single		9	20
			Other		2	1
	BLACK	Male	Single		5	15
			Other		1	
		Female	Married			
			Single		8	9
			Other			
	AMERICAN INDIAN	Male	Single			1
		Female	Single			
	ASIAN	Male	Single			
		Female	Single			
	PACIFIC ISLANDER	Male	Single			
		Female	Single			
	OTHER	Male	Single		5	5
			Other			1
		Female	Single		8	8
			Other		1	
	UNABLE TO DETERMINE	Male	Single			
			Other		1	
		Female	Single			
18-39 years	WHITE	Male	Married		10	15
			Single		45	74
			Legally Separated		7	3
			Divorced		5	9
			Widowed			
			Other		6	7
		Female	Married		9	15
			Single		50	75
			Legally Separated		7	8
			Divorced		7	12

			Widowed	1	
			Other	5	3
	BLACK	Male	Married	2	5
			Single	11	40
			Legally Separated	4	
			Divorced		
			Widowed		1
			Other	4	1
		Female	Married	4	2
			Single	11	30
			Legally Separated		1
			Divorced	8	1
			Other	1	
	AMERICAN INDIAN	Male	Single		1
		Female	Married		
			Single		
	ASIAN	Male	Married	1	
			Single	1	2
			Other		
		Female	Married		
			Single	3	1
			Other		
	PACIFIC ISLANDER	Male	Married		
			Single		
		Female	Single	2	
			Divorced		
	OTHER	Male	Married	2	4
			Single	8	20
			Legally Separated		
			Divorced	1	
			Other	4	5
		Female	Married	6	9
			Single	7	15
			Legally Separated	1	1
			Divorced	1	
			Other		3
	UNABLE TO DETERMINE	Male	Married		
			Single	2	3
			Other		
		Female	Married		
			Single	2	4
			Divorced		
			Other	1	

40-59 years	WHITE	Male	Married	7	15
			Single	19	29
			Legally Separated	4	3
			Divorced	12	15
			Widowed	2	2
			Other	2	2
		Female	Married	13	18
			Single	6	20
			Legally Separated	7	4
			Divorced	13	18
			Widowed	4	5
			Other	4	4
	BLACK	Male	Married	6	7
			Single	15	20
			Legally Separated	4	2
			Divorced	2	5
			Widowed		
			Other	2	2
		Female	Married	6	11
			Single	9	15
			Legally Separated	2	2
			Divorced	5	3
			Widowed	3	4
			Other		2
	AMERICAN INDIAN	Male	Married		1
		Female	Married		
	ASIAN	Male	Married	1	
			Single		
			Other		
		Female	Married		1
			Single	1	
	PACIFIC ISLANDER	Male	Single		
		Female	Single		
	OTHER	Male	Married	6	1
			Single	2	4
			Legally Separated		1
			Divorced		
			Widowed		
			Other		
		Female	Married	7	1
			Single	4	1
			Legally Separated		1
			Divorced	1	

			Widowed		
			Other		
	UNABLE TO DETERMINE	Male	Married		
			Single		
			Divorced		
			Other	1	
		Female	Married		
			Single		
			Legally Separated		
			Divorced		1
			Other		2
60-79 years	WHITE	Male	Married	3	8
			Single	3	8
			Legally Separated	1	2
			Divorced	4	5
			Widowed	2	2
			Other		
		Female	Married	3	10
			Single	5	4
			Legally Separated		
			Divorced	2	6
			Widowed	2	5
			Other		1
	BLACK	Male	Married	1	2
			Single	2	7
			Legally Separated	1	1
			Divorced	1	2
			Widowed	2	1
			Other		1
		Female	Married	2	
			Single	2	5
			Legally Separated		1
			Divorced	2	1
			Widowed	2	3
			Other		1
	AMERICAN INDIAN	Female	Married		
			Widowed		
	ASIAN	Male	Married		
		Female	Single		
			Divorced		
			Widowed	1	
	PACIFIC ISLANDER	Female	Single		

	OTHER	Male	Married		1
			Single		1
			Divorced		
			Widowed		
			Other		
		Female	Married		
			Single	1	
			Legally Separated		
			Divorced		
			Widowed		
			Other		
	UNABLE TO DETERMINE	Male	Married		
			Single		
		Female	Married		
			Single		
			Widowed		
			Other		
80+ years	WHITE	Male	Married	2	3
			Single		1
			Legally Separated		
			Divorced	1	1
			Widowed	2	4
			Other	1	
		Female	Married	2	2
			Single	1	
			Divorced		1
			Widowed	4	7
			Other		1
	BLACK	Male	Married		
			Single	1	1
			Legally Separated		
			Divorced		
			Widowed		
		Female	Married		
			Single		
			Divorced	1	
			Widowed	2	2
	ASIAN	Male	Single		1
		Female	Widowed		
	OTHER	Male	Married	1	
			Single	1	
			Divorced		
			Widowed		

		Female	Married		
			Widowed		
			Other		
	UNABLE TO DETERMINE	Female	Widowed		

Figure 4.12: Demographics data

Oct2014 Oct2015 * Age			
Age		Oct2014	Oct2015
0 -17 years	N	10	9
	Mean	6.2000	8.3333
	Std. Error of Mean	2.01550	2.35112
	Minimum	1.00	1.00
	Median	5.0000	8.0000
	Maximum	22.00	20.00
18 -39 years	N	34	30
	Mean	7.0294	12.3333
	Std. Error of Mean	1.84395	3.50118
	Minimum	1.00	1.00
	Median	4.0000	4.5000
	Maximum	50.00	75.00
40 -59 years	N	30	33
	Mean	5.6667	6.7273
	Std. Error of Mean	.84327	1.30868
	Minimum	1.00	1.00
	Median	4.0000	3.0000
	Maximum	19.00	29.00
60 -79 years	N	20	23
	Mean	2.1000	3.3913
	Std. Error of Mean	.23952	.58553
	Minimum	1.00	1.00
	Median	2.0000	2.0000
	Maximum	5.00	10.00
80 + years	N	12	11

	Mean	1.5833	2.1818
	Std. Error of Mean	.25990	.56918
	Minimum	1.00	1.00
	Median	1.0000	1.0000
	Maximum	4.00	7.00
Total	N	106	106
	Mean	5.0189	7.2547
	Std. Error of Mean	.69045	1.14140
	Minimum	1.00	1.00
	Median	2.5000	3.0000
	Maximum	50.00	75.00

Figure 4.13: Age analysis

Oct2014 Oct2015 * Race			
Race		Oct2014	Oct2015
WHITE	N	42	43
	Mean	7.5238	10.7674
	Std. Error of Mean	1.57589	2.39759
	Minimum	1.00	1.00
	Median	4.0000	5.0000
	Maximum	50.00	75.00
BLACK	N	33	34
	Mean	4.0000	6.0588
	Std. Error of Mean	.61082	1.50870
	Minimum	1.00	1.00
	Median	2.0000	2.0000
	Maximum	15.00	40.00
AMERICAN INDIAN	N		3
	Mean		1.0000
	Std. Error of Mean		.00000
	Minimum		1.00
	Median		1.0000

	Maximum		1.00
ASIAN	N	6	4
	Mean	1.3333	1.2500
	Std. Error of Mean	.33333	.25000
	Minimum	1.00	1.00
	Median	1.0000	1.0000
	Maximum	3.00	2.00
PACIFIC ISLANDER	N	1	
	Mean	2.0000	
	Std. Error of Mean	.00	
	Minimum	2.00	
	Median	2.0000	
	Maximum	2.00	
OTHER	N	19	18
	Mean	3.5263	4.5556
	Std. Error of Mean	.62767	1.27372
	Minimum	1.00	1.00
	Median	2.0000	2.0000
	Maximum	8.00	20.00
UNDETERMINED	N	5	4
	Mean	1.4000	2.5000
	Std. Error of Mean	.24495	.64550
	Minimum	1.00	1.00
	Median	1.0000	2.5000
	Maximum	2.00	4.00
Total	N	106	106
	Mean	5.0189	7.2547
	Std. Error of Mean	.69045	1.14140
	Minimum	1.00	1.00
	Median	2.5000	3.0000
	Maximum	50.00	75.00

Figure 4.14: Race analysis

Oct2014 Oct2015 * Gender			
Gender		Oct2014	Oct2015
Male	N	53	54
	Mean	4.9245	7.1852
	Std. Error of Mean	.99010	1.63728
	Minimum	1.00	1.00
	Median	2.0000	3.0000
	Maximum	45.00	74.00
Female	N	53	52
	Mean	5.1132	7.3269
	Std. Error of Mean	.97191	1.60451
	Minimum	1.00	1.00
	Median	3.0000	3.5000
	Maximum	50.00	75.00
Total	N	106	106
	Mean	5.0189	7.2547
	Std. Error of Mean	.69045	1.14140
	Minimum	1.00	1.00
	Median	2.5000	3.0000
	Maximum	50.00	75.00

Figure 4.15: Gender analysis

Oct2014 Oct2015 * Marital_Status			
Marital_Status		Oct2014	Oct2015
Married	N	21	20
	Mean	4.4762	6.5500
	Std. Error of Mean	.73879	1.28037
	Minimum	1.00	1.00
	Median	3.0000	4.5000
	Maximum	13.00	18.00

Single	N	32	32
	Mean	8.4688	14.2188
	Std. Error of Mean	2.03794	3.30711
	Minimum	1.00	1.00
	Median	5.0000	7.5000
	Maximum	50.00	75.00
Legally Separated	N	10	13
	Mean	3.8000	2.3077
	Std. Error of Mean	.80000	.54754
	Minimum	1.00	1.00
	Median	4.0000	2.0000
	Maximum	7.00	8.00
Divorced	N	16	14
	Mean	4.1250	5.7143
	Std. Error of Mean	.99530	1.52066
	Minimum	1.00	1.00
	Median	2.0000	4.0000
	Maximum	13.00	18.00
Widowed	N	12	11
	Mean	2.2500	3.2727
	Std. Error of Mean	.27866	.57352
	Minimum	1.00	1.00
	Median	2.0000	3.0000
	Maximum	4.00	7.00
Other	N	15	16
	Mean	2.4000	2.3125
	Std. Error of Mean	.44508	.43511
	Minimum	1.00	1.00
	Median	2.0000	2.0000
	Maximum	6.00	7.00
Total	N	106	106
	Mean	5.0189	7.2547
	Std. Error of Mean	.69045	1.14140
	Minimum	1.00	1.00

	Median	2.5000	3.0000
	Maximum	50.00	75.00

Figure 4.16: Age analysis

Multiple regression of log of length of stay on Age, Race, Gender, Marital Status and diagnosis are displayed in figure 4.17. The multiple regression equation utilized was:

$$Log(LOS) = c + B_1 Year + B_2 Age + B_3 Race + B_4 Gender + B_5 Marital\ Status + B_6 Diagnosis + e$$

Figures 4.17 present the results for the equation.

Since the covariates are category, all the first level are used as reference category.

Variable	Covariates	Coefficients results			
		Estimate	Std. Error	t value	Pr(>|t|)
Constant	c	1.458533	0.14581	10.00297	4.95E-21***
Year	Oct2015	0.066181	0.064379	1.028002	0.304613
Age	18 – 39 years	0.632752	0.117871	5.36819	1.40E-07***
	40 – 59 years	0.527479	0.119264	4.42278	1.28E-05***
	60 – 79 years	-0.02756	0.122062	-0.2258	0.821484
	80+ years	-0.46138	0.134209	-3.43776	0.000653***
Race	BLACK	-0.58213	0.092006	-6.3271	7.14E-10***
	AMERICAN INDIAN	-1.97097	0.178053	-11.0696	7.94E-25***
	ASIAN	-1.73196	0.126487	-13.6928	7.09E-35***
	PACIFIC ISLANDER	-2.27286	0.180356	-12.6021	1.36E-30***
	OTHER	-1.00549	0.095301	-10.5506	5.91E-23***
	UNDETERMINED	-1.61914	0.11246	-14.3974	1.05E-37***
Gender	FEMALE	0.141874	0.064671	2.193762	0.028867***

Marital Status	Single	0.542715	0.099051	5.479131	7.87E-08***
	Legally Separated	-0.58043	0.129902	-4.46826	1.05E-05***
	Divorced	-0.32606	0.114398	-2.8502	0.004611***
	Widowed	-0.30701	0.116814	-2.62817	0.008938***
	Other	-0.55984	0.107297	-5.21761	3.01E-07***
Diagnosis	Severe	-0.01468	0.086684	-0.16939	0.865584
	More Severe	-0.03206	0.074911	-0.428	0.668898

*** indicates significance at 5% level.
Figure 4.17:

Explanation of the results presented in figure 4.17: The reference category for the variable include Oct2014 (Year), 0 – 17 (Age), White (Race), Male (Gender), Married (Marital Status) and Less severe for (Diagnosis). The most important parameter is $B_1 \approx 0.066$. The value indicates that the log of LOS in Oct 2015 is about 0.066 times higher than Oct 2014 counterpart. But the value is not significant at 5% level, which implies that the increase in log of LOS in Oct 2015 is by chance and therefore not significant.

In summary, after controlling for patient characteristics (diagnosis, gender, race, age, and marital status) in the multivariable linear regression model, the average LOS difference between Oct 2014 and Oct 2015 is 1.1 hours, but is not statistically significant (p-value=0.30). **Although the unadjusted analysis displays a significant LOS, the adjusted analysis was not significant, therefore the hypothesis (The use of EMR reduced LOS for tele-psychiatry patients post January 1, 2015) was not proven to be true.**

CHAPTER V: DISCUSSION

5.1. Discussion of Results

Over the past 40 years, services for psychiatric patients have become increasingly deinstitutionalized, shifting away from inpatient facilities (Stowell, 2012). As a result, inpatient beds have dwindled to less than 50,000 nationwide, forcing patients to seek other avenues for treatment, including outpatient facilities, outpatient medical management groups, and community resources. Unfortunately, those resources have also become increasingly constrained by widespread budget cuts, leaving patients with the health care system's last remaining safety net, which is the emergency department (Stowell, 2012). This results in an increasing demand from mental health consumers for crisis assessment and intervention in public Emergency Departments, which has placed considerable strain on the resources of the ED and long delays awaiting admission are also experienced (Kalucy, 2004).

Tele-psychiatry delivered in the emergency department through a centralized coordinated program has great promise for improving linkage with outpatient mental health services while reducing inpatient utilization and hospital costs. Psychiatric assessments are able to occur within a shorter time after patient arrival. Since psychiatric patients typically spend over 3 times longer in the ED than medical patients, tele-psychiatry's arrival means that psychiatric patients are able to

move on to the next level of care much more quickly. This improvement results in shortened wait times for all patients within the ED, and ultimately an increase in revenue for the hospital system. By implementing tele-psychiatry and improving the rate of bed throughput, a hospital is ultimately able to increase income.

Another way tele-psychiatry programs are adding value to hospital systems is by reducing costly inappropriate commitments. Tele-psychiatry enables organizations to make sure that the ED psychiatric patients move on to the most appropriate level of treatment, whether that is hospitalization or community-based care, quickly. ED staff does not always have the expertise and training to best manage psychiatric episodes, but telemedicine with EHRs can connect these patients and providers to specialists to ensure that they receive optimal care. Access to timely care also means that hospitals are more likely to be able to meet standards for patient care set by regulating bodies like The Joint Commission who advocate that patient boarding times not exceed 4 hours. Since our results show that ED psychiatric care can be more efficient with telemedicine and an EHR, making the investment in such a system shows that it can impact the timeliness and quality of care.

Because tele-psychiatrists are able to work from remote or home offices and don't have to be in-person at the emergency department, it is much easier to staff difficult hours like weekends, nights and holidays. Ultimately, establishing an ED

tele-psychiatry program can set up a health system to more effectively manage the psychiatric needs of an entire community or population. In addition to using tele-psychiatrists within EDs, many systems are also expanding programs into other settings within the hospital and beyond. Given the increased demand for psychiatric services in the ED and beyond, such a strategy can assist hospitals in attaining the resources they need.

According to the Agency for Healthcare Research and Quality, mental disorders and/ or substance abuse are related to one of every eight emergency department cases in the U.S. This translates into nearly 12 million visits to hospital emergency departments in a year (Emergency, 2010). It is important therefore that best practices in the care of psychiatric patients in the emergency department be identified, documented and disseminated to both improve care of psychiatric patients in the emergency setting and also to provide for increased staff safety. It is also important that gaps in the research literature related to the care of psychiatric patients in the emergency care setting be identified.

The goal of the addition of the FirstNet Tele-Psychiatry Consultation Process was to identify waste within the consult process for CHS ED psych patients. The process goal was to remove 18 non-value added steps to reduce the time from the ordering of the consult to the consult being completed by 365 minutes per patient. For example at CMC Pineville if you multiply that by the 620 patients (a year) it

would potentially result in a reduction in 3771 hours. This would be a significant quality improvement effort for that facility. For this study, the 769 CHS tele-psych patients in the month of October 2015 potentially produced 4678 hours saved, in comparison to the tele-psychology consultation method used prior to 2015.

The FirstNet Tele-psychiatry Consultation process allows you to better dissect the entire consultation process. In the example below (figure 5.1) of 426 patients with key events triggered in the process. Not only did it decrease LOS, but it allowed the organization to pinpoint each stage LOS was affected.

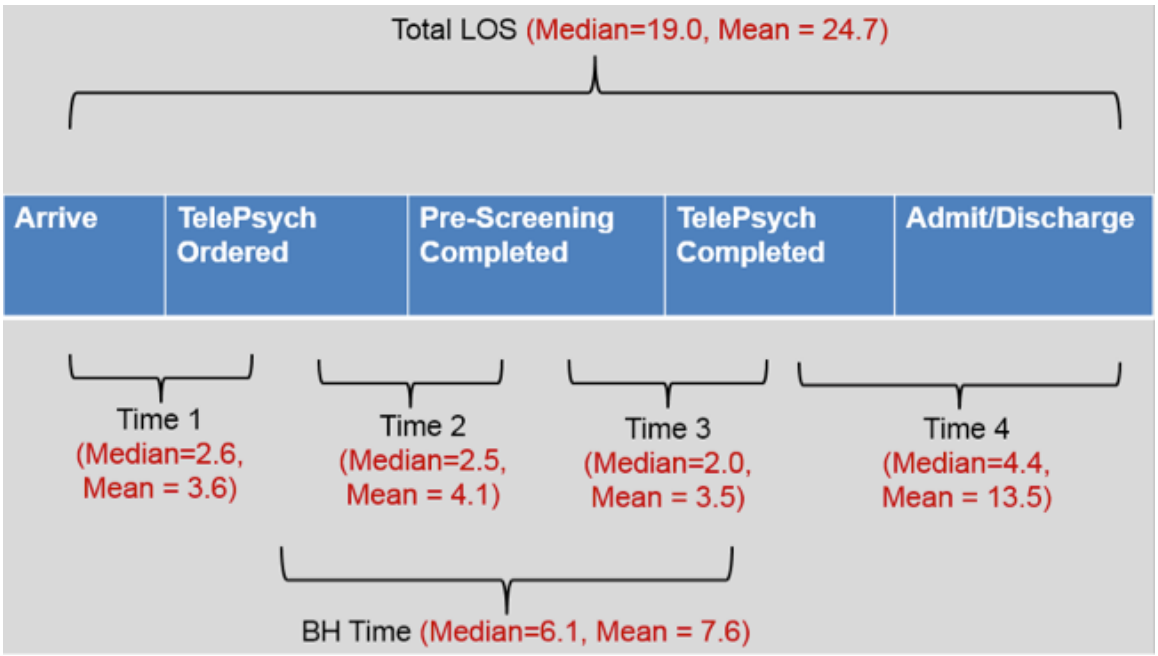


Figure 5.1

The implementation of the FirstNet Tele-Psychiatry Consult Process successfully pulled the patient's current EMR encounter from multiple facility

locations to a different physical facility location for consultation, and provided increase in quality by decreasing in total unadjusted LOS. Therefore, the FirstNet eTracking queue (Tele-psychiatry Consult Process) did successfully bridge the gap by integrating the separate dual processes utilized by CHS emergency departments and CHS Behavioral Health to better coordinate the flow of patient care. Although the adjusted results negated the significance, this study's analysis clearly exhibited the seamless transaction of data and information by the enhancement of system processes which decreased patient length of stay for possible future improvements in quality of care.

5.2. Conclusions/Implications

The results displayed an unadjusted decreased LOS for the selected population, providing some evidence of possible value of ED tele-psychiatry with EHR. The development and implementation of the FirstNet Tele-psychiatry Consultation Process improved the coordination of care with consultations from specialty providers (CMC Behavioral Health) and revealed a possible trend leading towards the improvement in quality (LOS) by not only enhancing communication and processes, but also allowing documentation of medications and treatment regimens that may be unfamiliar to the direct care provider to be placed electronically by the Psychiatrist. Cerner, who initially informed CHS that this

modification to FirstNet was not possible, has contacted CHS regarding implementation of this process at other healthcare organizations across the nation.

5.3. Recommendations/Areas for further study

Implementing tele-psychiatry solutions and/or enhancements is not a simple solution, there are several variables (cost, technical knowledge, clinical knowledge, organizational tele-psychiatry need, etc.) that can affect the successful implementation. As telemedicine is continuing to change emergency psychological services from a predominately face to face service, to a service that also utilizes various technologies in providing care, those within the services will need to embrace telemedicine and make it an important part of their service delivery. It is hoped that the recommendations in this research will assist in make this happen. Based on the literature and study, the researcher would like to make the following recommendations:

1) Further qualitative study to get a better understanding of staff and patients perceptions and concerns. For instance understanding why in some areas they would not be willing to use a solution such as the Firstnet Tele-psychiatry Consult Process and link their tele-psychology solution to their EMR technology manually. This may be due to a lack of knowledge of what is

available/possible, perceived or actual cost, or there may be a better alternative to this solution.

2) Understanding the target population: This study has demonstrated an increase in quality as a result of this implementation. Further work would need to be done to understand if the data is supported throughout other months of the year. Also, future years should be analyzed to identify trends in LOS. Is it continuing to improve? Have the improvements plateaued?
3) There have been several successful and sometimes failed telemedicine implementations. Future research is needed to see if linking telemedicine to EMR is beneficial to smaller organizations as well. Smaller organizations may not have the technical knowledge or financial means to develop an application such as this. Research to determine if the investment is worth the quality improvement effort would be needed.
4) This study did not consider cost because it was developed "in house." Before implementing a telemedicine solution or enhancement organizations should perform a cost benefit analysis which should include/consider development, equipment, training, implementation, operational and on-going support costs, travel costs, potential staff time and administration savings, and HIPPA/patient data security enhancements.

Tele-psychiatry enhancements, such as the FirstNet Tele-psychiatry Consult Process, have the potential to meet the unmet needs within mental health organizations but further work would need to be done to fully understand patient and staff perceptions about using telemedicine and additional measures of quality improvement other than LOS. It would be beneficial to continue to compare pre and post telemedicine implementation and/or enhancements to telemedicine such as linkage to EMR.

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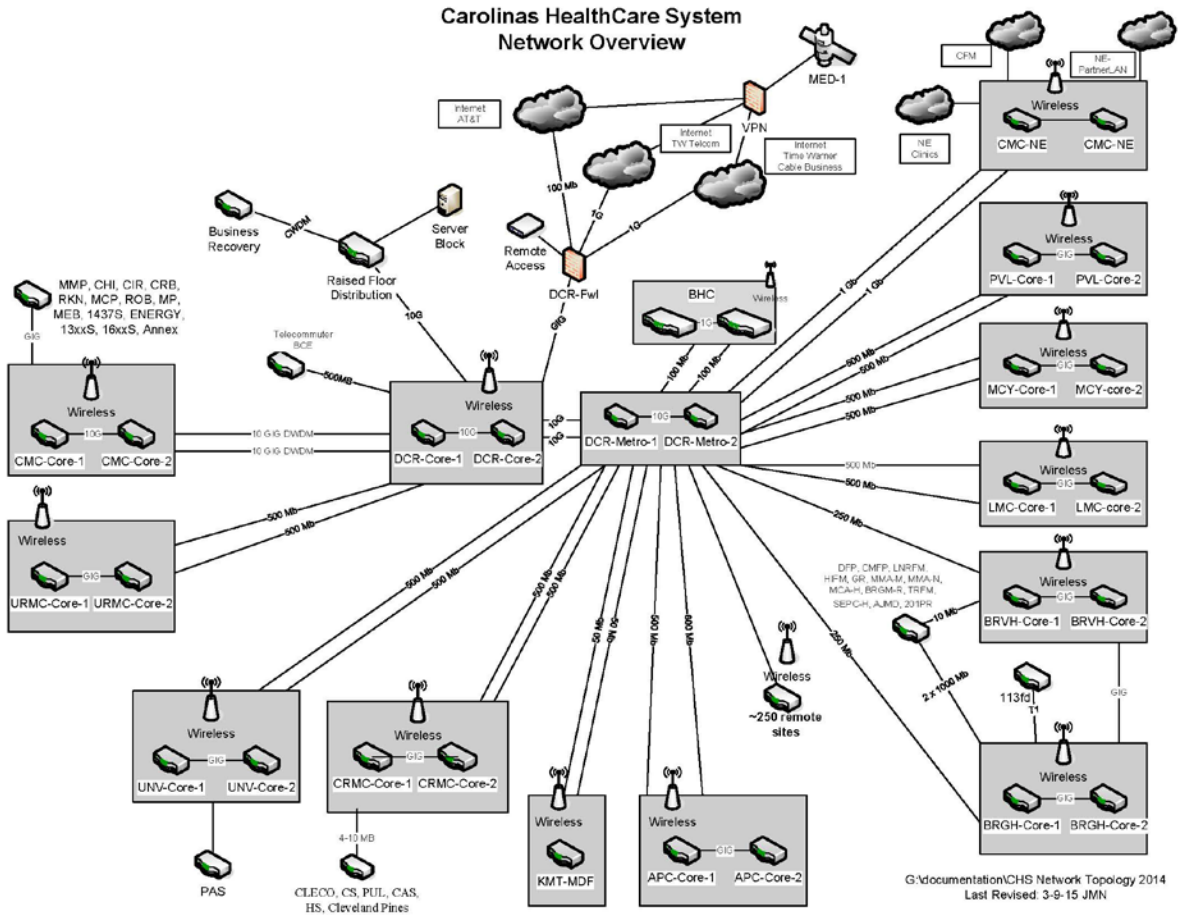
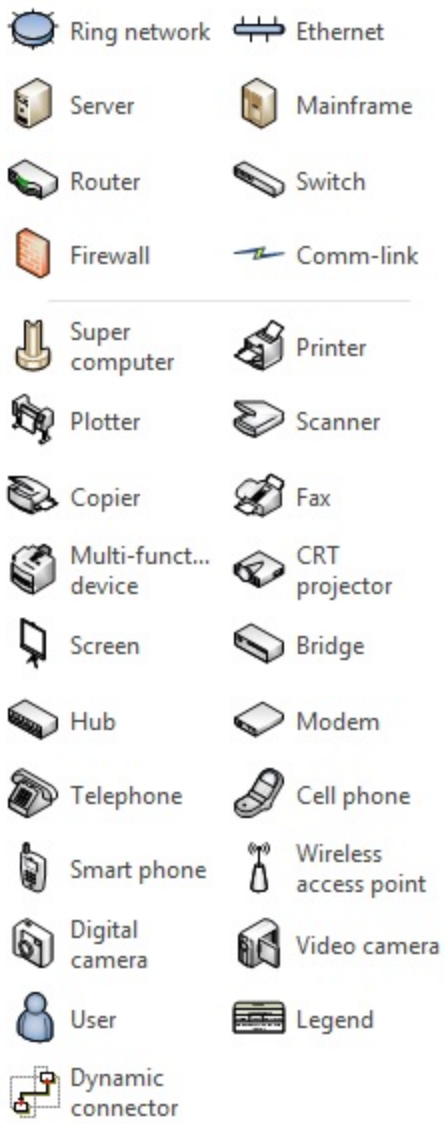
Appendices

Appendix 1




Ring network
Ethernet
Server
Mainframe
Router
Switch
Firewall
Comm-link
Super computer
Printer
Plotter
Scanner
Copier
Fax
Multi-funct... device
CRT projector
Screen
Bridge
Hub
Modem
Telephone
Cell phone
Smart phone
Wireless access point
Digital camera
Video camera
User
Legend
Dynamic connector

Appendix 2

Summary of Studies Examining Rural-Urban Differences in Use, Quality, and Outcomes of Care

Authors	*Population*	*Study Period*	*Major Dependent Variable*	*Major Findings (Rural Compared to Urban)*	*Comments*
ENTRY					
Rost, Kirchner, Fortney, and Booth (2000)	733 problem drinkers, community residents	1994-1995	Any primary care for mental health	Better	Retrospective self-report over past 6 months
			Any specialty care	Same	
Hartley (2001)	26,800 state employees	1992-1996	Any use for depression	Worse	Claims report during 4 years
			Any primary care for depression	Worse	
			Any specialty care for depression	Worse	
Rost, Zhang, Fortney, Smith, and Smith (1998a)	435 depressed community residents	1993-1995	Any use for mental health	Same	Prospective self-report and/or claims data during 1 year
			Any primary care for mental health	Same	
			Any specialty care	Same	
Fischer, Owen, and Cuffel (1996)	139 schizophrenia hospital discharges	1992-1993	Any specialty care use	Same	Prospective medical record data during 6 months
Bussing, Zima, and Belin (1998)	143 special education elementary students with attention deficit hyperactivity disorder	1995	Any use for mental health	Same	Retrospective parent report during past year
			Any primary care for mental health	Worse	
			Any specialty care	Same	

Authors	*Population*	*Study Period*	*Major Dependent Variable*	*Major Findings (Rural Compared to Urban)*	*Comments*
Rost, Owen, Smith, and Smith(1998)	53 bipolar community residents	1993-1995	Any use for mental health Any primary care for mental health	Same Better	Prospective self-report during 1 year
Lambert, Agger, and Hartley (1999)	78,949 adult AFDC and SSI beneficiaries	1994	Any use for mental health	Worse	Medicaid claims report during 1 year
Lambert and Agger (1995)	81,069 child and adult AFDC beneficiaries	1991	Any use for mental health Any specialty care Any primary care for mental health	Worse Worse Better	Medicaid claims report during 1 year
Vega et al. (1999)	508 Hispanic community residents with mental health disorders	1996	Any use for mental health Any primary care for mental health Any specialty care	Same Better Worse	Cross-sectional self-report during past year
Burns et al. (1995)	1,015 school children	1992-1993	Any use for mental health Any specialty care	Same Worse	Retrospective self-report by child or parent during past 3 months, controlling for need
Sullivan, Jackson, and Spritzer (1996)	210 SMI hospital discharges	NS	Any specialty care	Same	Retrospective medical record data during past 6 months
Fortney et al. (2002)	317 cognitively impaired elderly community residents	1997	Any specialty care use	Same	Cross-sectional self-/caregiver report of use during past 2 months
Fortney, Rost, and Zhang (1998)	435 depressed community residents	1993-1995	Any use for mental health Any primary care for mental health Any specialty care	Lower perceived availability and affordability was associated with less service use	Prospective self-report and/or claims data during 6 months
Holzer and Ciarlo (1999)	920 community residents with self-reported disorder	1989	Any specialty care use	Service use varies between farming and nonfarming residents in nonmetropolitan areas	
QUALITY					
Rost, Zhang, Fortney, Smith, and Smith (1998a)	435 depressed community residents	1993-1995	Guideline-concordant antidepressant medication and/or psychotherapy	Same	Prospective self-report, pharmacy data, and/or claims data during 1 year

Authors	Population	Study Period	Major Dependent Variable	Major Findings (Rural Compared to Urban)	Comments
Rost, Zhang, Fortney, Smith, Coyne, and Smith (1998)	98 primary care patients with major depression	1993-1995	Guideline-concordant antidepressant medication	Same	Prospective self-report, pharmacy data, and/or claims data during 1 year
Fischer and Owen (1999)	139 schizophrenia hospital discharges	1992-1994	Frequency of outpatient care following hospitalization	Same	Medical record abstraction during 18 months
Farrell, Koch, and Blank (1996)	5,069 SMI hospital discharges	1992	Continuity of care following hospitalization	Better	Provider report, time frame NS
Rost, Owen, Smith, and Smith (1998)	53 bipolar community residents	1993-1995	Any antidepressant medication	Same	Prospective self-report during 1 year
			Any antimanic medication	Same	
Fortney et al. (1999)	106 depressed patients	1993-1995	Guideline-concordant antidepressant medication and/or psychotherapy	Greater travel time to care predicts lower quality	Prospective self-report, pharmacy, and/or claims data during 6 months
OUTCOMES					
Hoyt, Conger, Valde, and Weihs (1997)	1,487 community residents	1992-1993	Depressive symptoms	Same	Prospective self-report at 1 year
Rost, Zhang, Fortney, Smith, Coyne, and Smith (1998)	98 primary care patients with major depression	1993-1995	Depressive symptoms	Same	Prospective self-report at 1 year
Rost, Owen, Smith, and Smith (1998)	53 bipolar community residents	1993-1995	Manic episodes	Worse	Prospective self-report at 1 year
Fischer, Owen, and Cuffel (1996)	139 schizophrenia hospital discharges	1992-1993	Schizophrenia symptoms	Worse	Prospective self-report at 6 months
Rost, Zhang, Fortney, Smith, and Smith (1998a)	435 depressed community residents	1993-1995	Suicide attempts	Worse	Prospective self-report at 1 year unadjusted for sociodemographic and clinical characteristics
Hartley, Bird, and Dempsey (1999)	All U.S. children and adolescents	1995	Suicide completion	Worse	Death certificates unadjusted for sociodemographic and clinical characteristics

NOTE: AFDC = Aid to Families with Dependent Children; SMI = seriously mentally ill; SSI = supplemental security income; NS = not specified.