Journal of
Health & Medical Informatics

Noblin et al., J Health Med Informat 2012, S7
DOI: 10.4172/2157-7420.S7-001

Review Article Open Access

Utilizing Telemedicine Techniques to Confront Rural Mental Health Care Challenges: The Progression Towards a Technological Health Ecosystem

Alice Noblin[1], Kendall Cortelyou-Ward[1] and John Cantiello[2]*

[1]*Department of Health Management & Informatics, University of Central Florida, USA*
[2]*Department of Health Administration and Policy, George Mason University, USA*

Abstract

Due to the unique population characteristics of Rural America, the diagnosis and treatment of medical conditions is a challenge. This is especially true when specialists are needed, in particular for mental health care including psychiatry. Provision of care often falls to primary care providers, who may fail to recognize symptoms or misdiagnose a condition. In addition, a stigma is often attached to mental health issues and precludes many people from seeking treatment, particularly due to embarrassment and perceived confidentiality issues.

This paper will describe the rural population and mental health issues faced by patients and providers. Challenges will be explored from a systems theory viewpoint, as well as from community development perspectives. Solutions will be offered ranging from the broad theoretical perspective including policy options, and specific solutions for practitioners in various settings.

Of particular focus is telemedicine in the form of telepsychiatry. This option is mentioned throughout this paper in terms of current usage in specific settings as well as provider and patient acceptance of the technology. Telemedicine utilizes computer technology to transmit data, voice, video, and a combination of the three with live video feeds. This implies the technology is available not only in terms of computers and other hardware, but also the infrastructure, or availability of internet connection. In rural areas, this may require satellite based internet connections or other options.

Keywords: Rural Health; Telemedicine; Telepsychiatry; Mobile Health

Introduction

In the United States, mental illness is the leading cause of disability for individuals aged 15 to 44 years [1] and is one of the leading indicators identified by Healthy People 2010 [2]. While mental health issues are prevalent everywhere, research shows that those patients located in rural settings suffer worse outcomes and are more likely to commit suicide than their urban counterparts [3]. Research has demonstrated that a patient suffering from mental illness in a rural setting is more likely to receive generalized medical care, and less likely to receive specialized mental health care than their urban counterparts [4]. This indicates a gap in the quality of care experienced by over half of the counties in the United States that have no mental health professionals [5].

One key factor in the provision of adequate mental health services in rural areas is the availability of specialized health care providers. While the supply of specialists is increasing overall, a geographic maldistribution of all physicians exists and a lack of specialized care exists in rural areas [6]. Several phenomenons influence this lack of specialized care. First, the rural healthcare force is aging, and thereby shrinking [7]. Second, there is evidence that supports the idea that lifestyle preference of young physicians dictate that they do not want to practice in more rural areas [8]. Reasons for this are opportunities to earn a higher income, more professional interaction, better access to contemporary medical facilities and technology, increased cultural diversity, an increased availability of social and recreation activities [6], and an inadequate patient supply to provide financial sustainability for physician practices [9].While several programs, such as loan forgiveness programs available to physicians who practice in underserved areas, the National Health Service Corps, and Migrant and Community Health Center Programs have been implemented, they have typically not addressed mental health professional shortages [6].

In light of the need for mental health services in rural populations, and the apparent lack of traditional medical services, the use of telehealth, and in particular, telepsychiatry has proven to be a viable solution to these issues. The aim of this paper is to investigate the need for telepsychiatry services, explore the current trends in this area, and offer solutions on both a broad policy perspective and an individual practitioner level.

Background

The state of rural America

In the United States, the Mississippi River divides two distinctly different forms of rural America [10]. The eastern side of the country is more densely populated with small towns spread along highways and back roads. West of the Mississippi is a more sparsely populated area, with wide open spaces between the metropolitan areas. The scarcity of populations translates into difficult and expensive travel distances for health and mental health care.

The demographics of this wide variety of rural Americans offer some similarities. Unemployment and poverty are higher in rural America than in urban areas. More than half of children in rural American homes live in poverty, with single mothers as head of household [10]. Children

***Corresponding author:** John Cantiello, Department of Health Administration and Policy, George Mason University, USA, Tel: 703-993-1731; Fax: 703-993-1953; E-mail: jcantiel@gmu.edu

Received February 25, 2012; **Accepted** March 08, 2012; **Published** March 14, 2012

Citation: Noblin A, Ward CK, Cantiello J (2012) Utilizing Telemedicine Techniques to Confront Rural Mental Health Care Challenges: The Progressions towards a Technological Health Ecosystem. J Health Med Informat S7:001. doi:10.4172/2157-7420.S7-001

are further at risk because of high rates of depression, alcoholism and sexual abuse in rural areas [11]. Although education attainment levels among adults in rural America have recently been on the rise, adults still have lower educational levels than their urban counterparts overall [12].

Fifteen percent of African Americans live in rural areas, and of those, approximately 30% live in poverty; similarly, 9% of Hispanics live in rural areas and 25% of those live in poverty [10]. These demographic characteristics represent some of the unique features of the rural population, including the vulnerabilities of the children, and represent some of the challenges facing medical and mental health care providers.

Physicians in rural America face their own challenges. They are in shorter supply than in urban areas, with 5.4 specialists per 10,000 population in rural areas compared to 13.4 in urban areas [9]. Referral patterns differ, resulting in rural areas being unable to support the specialty practices. However, when services are needed rural physicians find fewer qualified providers available for referrals [9]. This is not surprising given that 55% of the rural counties in the U.S. have no practicing psychologists, psychiatrists, or social workers [10].

These characteristics result in fewer providers, longer wait times for both appointment scheduling and in the provider's office, and longer distances to travel for appointments. Rural physicians are able to charge more because they are in short supply and these factors result in more costly care in a population already in poverty and increased strain on social services.

Challenges to Rural Mental Health Care Delivery of Services

Rural America as a community

Rural residents will often turn to friends, relatives and religious organizations for mental health care needs and depend on a social network instead of a health care provider in times of mental anguish [13]. Some possible reasons for this reliance on friends and family are the stigma attached to mental illness, inability to pay for services, and lack of education on treatment options [14]. People living in rural areas are involved socially and psychologically with ties to each other and to the area in which they live [15]. These psychological ties that link residents to one another can be considered as horizontal ties within the community. These ties are strengthened over time as relationships among the community members are maintained and used for the benefit of the members. These strong bonds, while important for the social infrastructure of rural communities, can be a barrier to new practitioners offering services.

Providers as outsiders

Practitioners who enter the rural community system are often considered to be outsiders and are not readily accepted by the residents. The process to gain acceptance is often slow and can be unsuccessful if the residents feel that urban values are being impressed upon their rural community [16]. It is not until a mental health provider is appropriately inculcated to the society that they can be a valuable member of the healthcare team.

In addition to the professional acceptance difficulties that caregivers face as "outsiders," some caregivers who relocate to rural areas from urban areas face personal challenges as well. They often feel isolated and must have the ability to work independently to be successful in rural locations [16]. Rural providers must also have a unique set of personality traits such as creativity and flexibility in order to deal with scarce resources. This wider view allows the caregivers to take advantage of resources available in the environment (including their community and perhaps surrounding areas) for the benefit of the rural residents.

Geographic proximity and infrastructure

The unique geography of the various rural areas in the U.S. is one challenge to provision of medical and mental health care. The creation of territorial communities has often resulted in geographic isolation and increased travel distance to receive health and mental health care services. Thus, patients are less inclined to return for follow-up outpatient visits, and consequently may be hospitalized for acute care treatment more frequently than urban patients [17].

Geographic isolation results in an insufficient patient population to support providers, particularly specialists. Providers are further disadvantaged by instability of the population. Primary care providers may actually purposely misdiagnose a mental health condition because of problems with reimbursement for a diagnosis of depression [13]. This results in lower referral rates for mental health services.

Isolation is a contributing factor to lack of infrastructure as well. The lack of capital resources coupled with the availability of technical assistance precludes rural communities from fully realizing the benefits of an electronic health system [18]. The American Recovery and Reinvestment Act of 2009 established several broadband initiatives with approximately $7.2 billion dollars in funding to the Broadband Technology Opportunities Program to provide access in underserved areas. While this is a step in the right direction, the goals of this project are yet to come to fruition.

Policy barriers

State laws regarding provision of care to rural communities differ. It is possible that a provider located close to a state border will be unable to provide services to members of a neighboring community in another state. An example is the state of Maine, which relies on Massachusetts, New Hampshire and Vermont for some psychiatric services. Certain licenses and certificates are only valid in the state in which they are issued and there are no reciprocal agreements in place. Indeed, the funding of health services is different in each state and providers must navigate these differences in order to bill for services [19].

Medicare has previously instituted strict restrictions on reimbursement for telehealth services. In 2001, stipulations included that the patient had to be physically located in a physician's office, hospital or clinic [20]. There were additional stipulations on the size of the service area and on the type of equipment used, such as full-motion video teleconferencing. It has been argued, however, that telehealth programs can help to reduce overall healthcare spending, and therefore deserve further evaluation and ongoing attention from Medicare [21].

Over time, Medicaid has warmed up to the idea of providing reimbursement for telehealth services. Beginning in 1998, Medicaid began providing reimbursement for such services. Since 1998, the number of states allowing reimbursements for telehealth type services has been increasing, and 34 states have added coverage since then [22]. Data on private payers is more limited. However, the opinions that private payers have regarding telehealth services have been shifting. Results from a survey produced by the American Telehealth Association showed that 43% of third party payers saw telehealth as a barrier to long term sustainability, that number decreased to 22% in 2004 [22]. Overall, more insurers are paying for telemedicine and reimbursement rates are increasing [23].

Theory

The Rural community as a system

Rural communities are closed systems, with minimal interaction with the environment (the surrounding geographical areas). Rural residents often feel autonomous and that they can take care of themselves (including self-diagnosing and self-treating of mental disorders). This is evident in their reluctance to seek help outside their family or close friend networks. Consequently, rural residents are not always amenable to strangers and may not seek their help when it is available.

The closed nature of rural communities can negatively affect these communities as a whole, and especially adolescents. There are fewer and smaller peer groups for rural adolescents to interact with. Rural adolescents have poor coping skills and when angry will use avoidance coping rather than seeking counseling or guidance [24]. Since adolescent patterns of coping behaviors are precursors to adult patterns, proper recognition and referral by public health or school officials is important [24].

Current trends

Telemedicine and specifically, telepsychiatry, as well as telephone calls are emerging as viable solutions for addressing the disparities in mental health treatment in rural America and are showing promise. A 2004 study found that patients receiving mental health services through a two way videoconferencing function and those receiving traditional care, had similar outcomes with respect to the measurement of depression [25]. Although currently an expensive type of technology, smartphones have the capability to aid in the provision of mental health services.

Telemedicine: Telemedicine in the form of telepsychiatry to remote areas allows the patient to maintain family support while receiving care. Privacy can also be maintained and perhaps even enhanced through the use of this technology. Treatment can be augmented with sensors, which are worn to alert caregivers to changes in the patient's temperature, blood pressure or biochemical changes [20]. To be successful, the targeted population must accept the technology which can be challenging in rural settings; it has been observed that rural Iowans felt telepsychiatry was impersonal [26]. Further, older residents were unwilling to use telepsychiatry. Several factors were attributed to their reluctance: hearing ability, discomfort with the technology, and reluctance to seek mental health services [26].

In contrast, children tend to warm up to the technology quickly [27]. Telehealth equipment can be used to zoom in on facial expressions on both the clinician and the child. Some clinicians who work with children may employ techniques such as growling and angry expressions to gauge reactions from the child. While this may seem more difficult using telehealth, it is simply a matter of using the zoom feature effectively. In addition, cards used to evoke responses work well with telemedicine [27].

In recent years, the use of video conferencing has become much more common, not only in the United States, but around the world [28]. While some providers may have questions about the provision of physical health services (i.e. diagnosis of physical ailments), it seems using telemedicine to diagnose and treat mental ailments is becoming more routine. It has been noted that psychiatry is an ideal specialty for the application of telemedicine because information is generally obtained using audiovisual communication [29]. It has been observed that primary care providers (PCPs) were "very satisfied" with the use of telepsychiatry in their practices [30]. The model for care in their study was for the PCP to remain the main caregiver, with videoconferencing systems used to connect the patient with a psychiatrist for consultations and ongoing treatment planning. Prior to the use of this system, it was noted that patients were often given inadequate trials of antidepressants and it was felt that the PCPs would benefit from the assistance of the psychiatrists in managing these patients.

Not only is telemedicine becoming more routine, but many argue that it is also cost effective. While the initial purchase of this type of technology and connectivity costs can be expensive, an increased patient volume can offset costs and help the facility implementing this technology realize positive financial returns [25]. Financial modeling has the capability to allow practices to determine the number of virtual office visits required to offset the technology costs associated with telemedicine [23]. Some studies have shown an impressive decrease in costs (up to $12,000) associated with telemental health two years after implementation [31]. While issues related to the high number of uninsured individuals living in rural areas may arise, it has been observed that relatively similar claims statistics on payments were found when claims between telemedicine and face to face encounters were compared in an area containing a high number of uninsured individuals [32].

Furthermore, the Health Resources and Services Administration works to increase the use of telemedicine in healthcare through The Office for the Advancement of Telehealth (OAT), which is part of the office of The Office of Rural Health Policy (ORHP). OAT provides millions of dollars in the form of competitive grants as an incentive for clinics to adopt telemedicine technology [33]. The very existence of the OAT, and the mention of telemedicine in the Affordable Care Act (ACA), illustrate the benefits that are associated with this type of technology and the recognition of its importance.

Use of telephone calls: The telepsychiatry methodology referred to above emphasizes the use of medications in conjunction with psychiatric counselors. While this is an effective mechanism for some, many do not require medication and simply need an effective and efficient means of counseling. A user friendly option offered a "call-in service" for rural parents whose children experience behavioral issues [34]. This was considered a bridge service between the primary care provider and a specialist in childhood psychology. Unfortunately, this type of solution is not in use widespread probably due to financial issues, because brief services given over the telephone cannot be directly reimbursed [34]. As such, we argue that the use of telepsychiatry is an improved alternative.

Mobile health and smartphone apps: With the increased usage of smartphones and smartphone applications or "apps" in the United States, it is no surprise that the introduction of mobile health into the healthcare industry has occurred. "Mobile health" or "mhealth" can be defined broadly as technologies related to mobile computing, medical sensor, and communication [35]. The difference between conventional telemedicine and mobile health is that mobile health involves portable devices. This type of technology could conceivably be another way for healthcare providers to evaluate and treat patients suffering from mental health ailments in rural areas. There are obstacles though. People who live in rural areas are more likely to have lower incomes and therefore less likely to have access to mobile technology in the form of a smartphone [36].

Although there are obstacles to their implementation, these devices are being used in our healthcare delivery system. As of 2009, two thirds of all physicians used some type of mobile technology in their

practice of medicine, and there are over 1,500 healthcare related apps offered in Apple's Appstore for the iPhone [36]. Healthcare apps can assist healthcare professionals with access to patient electronic medical records, access to reference systems, access to decision support systems, and to provide a way for providers to interact with patients [37]. Patients can use these apps to communicate with their provider of care (through video conferencing, text service, or basic voice communication) and to monitor and track their own health maintenance activities. Similar to the use of telephone calls, the structure for reimbursement of these services is not fully in place. Mobile technology is being utilized in medical systems; the key to realizing the full potential of this technology is getting this technology into the hands of patients living in rural areas and providing a mechanism for its use.

Solutions

For successful provision of rural medical and mental health services, an integrated systems approach may prove to be advantageous to all involved. This type of arrangement is usually financially driven and is viewed from a resource dependence theoretical perspective [38]. Organizations must be responsive to the environment in resource dependence. This thinking tends to be contrary to the closed rural approach. In addition to an emphasis on open systems, power is an important facet of resource dependency [39]. While a particular provider may have little power over the entities he/she refers patients to, the provider does have power over the patient. However, the balance of power may be difficult to maintain in a rural environment where patients lack trust in outsiders and indeed are reluctant to seek treatment at all.

The network of providers in the integrated system can be formal or informal but, either way, their functions and patient services are coordinated through collaborative relationships. The resource dependency theory suggests that since organizations "cannot produce or control all essential resources internally," they will enter into agreements with other organizations to obtain the needed resources [38].

The Internet is the common bond that exists between telemedicine and mobile health technologies. The World Wide Web can be used to augment rural mental health services through the following: videoconferencing, e-mailing, chat rooms and discussion boards [40]. Internet resources can also be used for continuing education and training purposes for primary care providers, nurse practitioners, physician assistants, and social workers. It should be noted, however, that not everyone has access to the Internet, and people living in poverty are not likely to have a home computer. This "digital divide" represents the difference between those who have access to telephones, computers and the Internet, and those who do not [40]. Alternate sources, such as libraries and churches may be able to provide these resources. The potential of the technology for reducing treatment gaps will be realized as the disparities in rural care are lessened.

Conclusion

The resource dependence perspective illustrates that an open system is needed to facilitate the improvement of and access to mental health services in the United States. Herein lies the problem with many rural areas and their corresponding medical and mental healthcare systems. The rural residents are often not willing to seek or accept help. Although policies can help by providing reimbursement for services, availability and willingness to pursue care is still necessary for success. Although challenges remain due to the shortage of many services, new technology is offering some options to help alleviate the need. Combinations of technology and human contact can provide very satisfactory substitutes for human only services which are often unavailable or at best inconvenient.

The literature clearly reveals telemedicine, and to an extent mobile health technologies, have proven to be successful in evaluating and treating certain physical and mental ailments. This type of technology, and the infrastructure needed to support such technology, exists. However, adoption of these technologies, as with many other types of technologies is not always rapid. We assert that the closed rural system even further hinders the adoption of these types of technologies. In order for rural communities to realize the benefits associated with using telemedicine and certain mobile health technologies, we believe a fundamental change must occur. Healthcare organizations and systems must be willing to operate in an open system that relies on telemedicine and mobile health technologies, not just a system that utilizes them as adjuncts.

A mobile ecosystem is defined as "a system characterized by a large and complex network of companies interacting with each other, directly and indirectly, to provide a broad array of mobile products and services to end-customers" [41]. We contend that health systems must work together to form a technological ecosystem, which includes telemedicine and mobile health technologies, and that provide a wide variety of technological products to patients. In turn, currently, we believe that telemedicine in the form of telepsychiatry is a more realistic approach than relying heavily on mobile technologies, due to costs associated with portable devices. However, the passage of the Affordable Care Act and increased incentives for the formation of Accountable Care Organizations is changing the landscape of the healthcare industry. There is now an increased focus on coordination of care and the elimination of waste. An increased investment in telemedicine in the form of telepsychiatry and venturing into the mobile health landscape appear to be viable ways to offer coordinated care to individuals living in rural areas. The use of this type of technology also appears to be a way for smaller rural clinics and larger healthcare systems to forge a mutually beneficial relationship, in turn fostering an integrated systems approach to improving access to care for individuals living in rural areas.

References

1. National Institute of Mental Health. NIMH: The numbers count-mental disorders in America.
2. Gamm LG, Stone S,Pittman S (2003) Mental Health and Mental Disorders—A Rural Challenge: A Literature Review. Rural Healthy People 2010: A companion document to Healthy People 2010. Volume 2. College Station, TX: The Texas A&M University System Health Science Center, School of Rural Public Health, Southwest Rural Health Research Center.
3. Institute of Medicine (2002) Reducing Suicide: A National Imperative. Washington DC, National Academic Press.
1. Western Interstate Commission for Higher Education (2008) Assessment of the Mental Health Funding Market place in Rural vs Urban Settings.
4. Gustafson DT, Preston K, Hudson J (2009) Mental health: Overlooked and Disregarded in Rural America. Center for Rural Affairs 23: 57.
5. Shi L, Singh D (2008) Delivering Health Care in America: A Systems Approach. Sudbury, Massachusetts: Jones and Bartlett Publishers.
6. Chen FM, Fordyce MA, Andes S, Hart G (2008) Rural Physician Workforce: Analysis of Medical School Graduates from 1988-1997.
7. Rabinowitz HK, Diamond JJ, Markham FW, Wortman JR (2008) Medical School Programs to Increase the Rural Physician Supply: A Systematic Review and Projected Impact of Widespread Replication. Acad Med 83: 235-243.

8. Reschovsky JD, Staiti AB (2005) Access and quality: Does rural America lag behind? Health Aff 24: 1128-1139.

9. Mohatt DF, Adams SJ, Bradley MM, Morris CA (2005) Mental Health and Rural America: 1994-2005. U. S. Department of Health and Human Services, Health Resources and Services Administration, Office of Rural Health Policy.

10. Petti TA, Leviton LC (1986) Re-thinking rural mental health services for children and adolescents. J Public Health Policy 7: 58-77.

11. United States Department of Agriculture Economic Research Services (2003) Rural development research report (Report No. 98).

12. Jameson, JP, Blank MB (2007) The role of clinical psychology in rural mental health services: Defining problems and developing solutions. Clinical Psychology: Science and Practice 14: 283-298.

13. Cuellar N, Cochran S, Ladner C, Mercier B, Townsend A, Harbaugh B, et al. (2003) Depression and the use of conventional and nonconventional interventions by rural patients. J Am Psychiatr Nurses Assoc 9: 151-153.

14. Lyons L (1999) The community in urban society. Long Grove, Illinois: Waveland Press, Inc.

15. Weigel DJ, Baker BG (2002) Unique issues in rural couple and family counseling. The Family Journal: Counseling and Therapy for Couples and Families 10: 61-69.

16. Rost K, Adams S, Xu S, Dong F (2007) Rural-urban differences in hospitalization rates of primary care patients with depression. Psychiatr Serv 58: 503-508.

17. Noblin A, Cortelyou-Ward K, Liu D (2011) The use of governance tools in promotion of health care information technology adoption by physicians. Health Care Manag 30: 250-260.

18. Mack D, Brantley KM, Bell KG (2007) Mitigating the health effects of disasters for medically underserved populations: Electronic health records, telemedicine, research, screening, and surveillance. J Health Care Poor Underserved 18: 432-442.

19. Schopp LH, Demiris G, Glueckauf RL (2006) Rural backwaters or front-runners? Rural telehealth in the vanguard of psychology practice. Professional Psychology: Research and Practice 37: 165-173.

20. Baker LC, Johnson SJ, Macaulay D, Birnbaum H (2011) Integrated teleheatlh and care management programs for Medicare Beneficiaries with chronic disease linked to savings. Health Aff (Millwood) 30: 1689-1697.

21. Brown NA (2006) State Medicaid and private payer reimbursement for telemedicine: an overview. J Telemed Telecare 12: S32-39.

22. Glueck DA (2011) Telepsychiatry in private practice. Child Adolesc Psychiatr Clin N Am 20: 1-11.

23. Sung KM, Puskar KR, Sereika S (2006) Psychosocial factors and coping strategies of adolescents in a rural Pennsylvania high school. Public Health Nurs 23: 523-530.

24. Ruskin PE, Silver-Aylaian M, Kling MA, Reed SA, Bradham DD, et al. (2004) Treatment outcomes in depression: Comparison of remote treatment through telepsychiatry to in-person treatment. Am J Psychiatry 161: 1471–1476.

25. Rohland BM, Saleh SS, Rohrer JE, Romitti PA (2000) Acceptability of telepsychiatry to a rural population. Psychiatr Serv 51: 672-674.

26. Miller, Thomas W (2006) Telehealth issues in consulting psychology practice. Consulting Psychology Journal: Practice and Research 58: 82-90.

27. Richardson LK, Frueh BC, Grubaugh AL, Egede L, Elhai JD (2009) Current Directions in Videoconferencing tele-Mental Health Research. Clin Psychol (New York) 16: 323–338.

28. Baer L, Elford DR, Cukor P (1997) Telepsychiatry at forty: What have we learned? Harv Rev Psychiatry 5: 7-17.

29. Hilty DM, Yellowlees PM, Nesbitt TS (2006) Evolution of telepsychiatry to rural sites: Changes over time in types of referral and in primary care providers' knowledge, skills and satisfaction. Gen Hosp Psychiatry 28: 367-373.

30. Shore JH, Brooks E, Savin DM, Manson SM, Libby AM (2007) An economic evaluation of telehealth data collection with rural populations. Psychiatr Serv 58: 830-835.

31. Hilty DM, Cobb HC, Neufeld JD, Bourgeois JA, Yellowless PM (2008) Telepsychiatry reduces geographic physician disparity in rural settings, but is it financially feasible because of reimbursement? Psychiatr Clin North Am 31: 85–94.

32. Health Resources and Services Administration. (n.d.). Telehealth. Health Resources and Services Administration: Rural Health.

33. Polaha J, Volkmer A, Valleley R (2007) A call-in service to address parent concerns about child behavior in rural primary care. Families, Systems, & Health 25: 333-343.

34. Istepanian R, Jovanov E, Zhang YT (2004) Introduction to the special section on m-health: beyond seamless mobility and global wireless health-care connectivity. IEEE Trans Inf Technol Biomed 8: 405-414.

35. Sarasohn-Kahn J (2011) How Smartphones Are Changing Health Care for Consumers and Providers. California HealthCare Foundation. http://www.chcf.org Accessed 03/30/11

36. Hamou A, Guy S, Lewden B, Bilyea A, Gwadry-Sridhar F, et al. (2010) Data collection with iPhone Web apps efficiently collecting patient data using mobile devices Proceedings of the. e-Health Networking Applications and Services (Healthc om), 12th IEEE International Conference.

37. Moscivice I, Wellever A, Christianson J, Casey M, Yawn B, et al. (1997) Understanding integrated rural health networks. Milbank Q 75: 563-588.

38. Scott WR, Davis GF (2007) Organizations and organizing: Rational, natural, and open system perspectives. Upper Saddle River, New Jersey: Pearson Prentice Hall.

39. Farrell SP, McKinnon CR (2003) Technology and rural mental health. Archives of Psychiatric Nursing 17: 20-26.

40. Basole R (2009) Visualization of interfirm relationships in a converging mobile ecosystem. Journal of Information Technology 24: 144-159.

This article was originally published in a special issue, **Virtualized Medical Systems** handled by Editor(s). Dr. Mark E. Deaton , Morehead State University, USA