SIMILARITIES AND DIFFERENCES BETWEEN RURAL AND URBAN TELEMEDICINE UTILIZATION

Posted on December 7, 2020 by Matthew

Category: Winter 2021

Similarities and Differences Between Rural and Urban Telemedicine Utilization

By Lincoln R. Sheets, MD, PhD; Emmanuelle Wallach, MS; Saif Khairat, PhD, MPH; Rachel Mutrux, BA; Karen Edison, MD; and Mirna Becevic, PhD

Abstract

Telemedicine has traditionally been used in rural areas, but the recent development of mHealth solutions has led to a growth in urban telemedicine services. The aim of this study was to determine whether urban and rural patients in a large academic medical center use telemedicine to access different healthcare specialties at different rates. This retrospective cohort study examined all telemedicine visits dated 2008-2017 at a large academic medical center. Visits were classified by clinical specialty. Teledermatology, child telepsychiatry, and adult telepsychiatry made up 97 percent of telemedicine visits.

Rural patients were more likely to have multiple telehealth visits. A significant difference was observed between rural and urban use of telemedicine, both in terms of specialties and demographics. This suggests that health systems should consider adjusting resources and training to meet the different needs of these two populations. In particular, telemedicine may offer help for the nationwide maldistribution of adolescent psychiatry providers.

Keywords: Telemedicine, rural health, urban health, healthcare disparities

Introduction

For more than 30 years, telemedicine has been used as a platform that supports patient-centered care, bringing the care to the patient's location and supporting local economic development. Telemedicine has traditionally been used in rural areas, because of its obvious advantages in reducing unnecessary travel and improving access to specialty care for patients from underserved regions.[1] In fact, a recent study found family physicians practicing in rural areas were twice as likely to refer their patients to use telemedicine as their urban counterparts.[2] However, telemedicine use is not limited to rural areas; though less widely advertised, a few telemedicine programs focus on underserved urban populations.[3]

At the same time, recent rapid development of eHealth, or "organization and delivery of health services and information using the Internet and related technologies"[4] and mHealth, or "medical and public health practice supported by mobile devices",[5] solutions has supported the growth of urban telemedicine services. The convenience of disruptive technologies, such as easy-to-use video-conferencing applications, will likely reduce the differences between telemedicine utilization in rural and urban areas in the near future.[6] It has been suggested that telemedicine and eHealth can help reduce geographic disparities in the treatment of mental illness[7] and diabetes.[8] However, a better understanding is needed of how specific telemedicine services are used by rural and urban patients, and if certain specialties have higher utilization rates than others. This information can be used for better resource allocation and a more data-driven approach to improving access to care.

The University of Missouri (MU) Missouri Telehealth Network (MTN) has been providing telemedicine services to Missourians since 1994. With more than 100 telemedicine sites across the state, its mission is to improve access to care for all Missourians and provide distant live-interactive continuing medical education for clinicians. The MTN also provides operational, legal, regulatory and research support to telemedicine sites, and conducts program evaluation and research.[9]

Missouri faces a serious healthcare crisis: a recent America's Health Rankings report positioned Missouri 39th out of 50 states in the assessment of the nation's health.[10] Some of the challenges indicated in this report are high prevalence of frequent mental distress, and increased rates of obesity, diabetes, and sexually transmitted diseases.[10] However, Missouri is also ranked 36th in the country on measures of access to care.[11,12] A primarily rural state (over 97 percent of land is considered rural)[13], Missouri's barriers to access to care are hardly limited to geographic isolation. High poverty rates, coupled by strong community norms (such as stigma for mental health and psychiatric care) affect how and where Missourians seek medical care maybe even more so than their physical location or geographic isolation. The aim of this project was to study differences in telemedicine use between rural and urban patients when accessing healthcare specialties. In addition, we wanted to learn more about telemedicine patient demographics, in terms of age and sex.

Methods

Data collection

University of Missouri Health Care (UMHC) has been a leader in providing telemedicine services to patients from all over Missouri for more than 20 years. Centrally located, the UMHC's team approach to comprehensive medical care supports its mission to save and improve lives, and serve as Missouri's premier academic health center.[14] With only three metropolitan areas with large medical centers in the state, Missouri has no counties classified as 100 percent urban, and over 97 percent of the land area is classified as rural.[13] UMHC conducted a retrospective cohort study to help highlight the differences between rural and urban patient usage of telemedicine services by UMHC over the past ten years. IBM Cognos/Analyzer (https://www.ibm.com/products/cognos-analytics[15]) was used to access de-identified telemedicine claims data from January 1, 2008, through December 31, 2017. These were provider-submitted claims that did not discriminate by insurance type or ability to pay, and included every telemedicine visit through an UMHC location during the ten-year study period.

The following data points were collected:

- Provider location and date of visit
- Provider name and specialty
- Patient ZIP code (to classify subjects as rural or urban)
- Patient age and gender
- Primary diagnostic code (to identify the purpose of the visit)

The Federal Office of Rural Health Policy (FOHRP)'s definition of rural locations was used to classify patients by their ZIP code.[16] The visits were categorized according to provider specialty:

- Teledermatology (including dermatopathology)
- Child telepsychiatry visits that involved patients up to age 21, and general telepsychiatry visits that involved patients younger than 18 years of age
- Adult telepsychiatry visits that involved patients 18 years of age or older
- Other: other specialties that provided telemedicine services (anesthesiology, child development, endocrinology, family practice, neurology, orthopedic oncology, pediatric hematology/oncology, vascular surgery), which comprised less than 5 percent of all visits

Data Analysis

The following were computed for each classification: the mean age of patients at the time of visit, the proportion of male patients, the proportion of patients in a pediatric (0-17 years old), adult (18-64 years old), and elderly (65 years old and older) cohort, as well as the mean number of visits and mean number of diagnoses for each patient. The numbers for rural and urban were then compared via two-sample hypothesis tests using the Z-test for means and proportions and the F-test for variances. Variances were compared before means to ensure that the correct test statistic was used; the sample sizes were all large enough for the Z-test. We report both the confidence intervals (CI) and *p*-values. This analysis was conducted in Excel (https://products.office.com/en-us/excel).

In addition, the analysis included a multinomial logistic regression, with the specialty as the outcome, and three predictor variables: gender (male or female), location (rural or urban), and age at time of visit (a continuous variable). This was supplemented with logistic regressions looking at binary outcomes: teledermatology or not, child telepsychiatry or not, adult telepsychiatry or not, and telepsychiatry or not telepsychiatry (without age restrictions). A regression analysis looked at the effect of gender, location, and age at time of visit on the number of visits and diagnoses per patient. STATA (www.stata.com) was used for these analyses.

Ethics Approval

Institutional Review Board approval was obtained from the University of Missouri Institutional Review Board.

Results

A total of 2,198 unique patients used telemedicine services during the study period. Of those, 1,420 (65%) were from rural areas, and 778 (35%) were from urban areas. The total number of visits was 5,411, with 3,582 (66%) from rural areas and 1,829 (34%) from urban areas (**Figure 1** and **Figure 2**). Interestingly, rural inhabitants make almost 37 percent of the total Missouri population, which implies that rural patients were almost four times as likely to utilize telemedicine services as their urban counterparts. Only 18 patients came from outside Missouri: six from rural areas in neighboring Kansas, Iowa, and Oklahoma; and 12 came from urban areas.

Telepsychiatry had the highest number of total (3,365, or 63.5%) and unique visits (1,061, or 48.3%), **Table 1** and **Table 2**. The second-most-used specialty was teledermatology, with 1,824 (33.7%) visits and 1,062 (48.3%) unique patients. Child telepsychiatry, adult telepsychiatry, and teledermatology combined to make up 97 percent of all visits. Another 1 percent of visits were for telemedicine visits for "opioid dependence in remission." The remaining 2 percent of visits were telemedicine visits for surgical follow-up, chronic pain, autism, and other conditions. **Figure 3** shows the distribution of unique patients by age, gender, and specialty.

Rural vs. urban populations

Overall, the rural patient population was older than the urban population (average age of 31, and 95% confidence interval , in rural areas, and average age of 21, and 95% CI , in urban areas; $p < 0.001$) and had a larger proportion of females than the urban population (45% female, and 95% CI , in rural areas, and 35%, and 95% CI , in urban areas; $p < 0.001$). The difference between rural and urban areas in the proportions of pediatric, adult, and elderly patients was significant (respectively, 39% (95% CI), 48% (95% CI), and 13% (95% CI) in rural areas, and 66% (95% CI), 30% (95% CI), and 4% (95% CI) in urban areas, with $p < 0.001$ for all three proportions). A significant difference was also observed in the proportion of unique patients using teledermatology, child telepsychiatry, and other specialties (respectively, 64%, 95% CI , 21%, 95% CI , and 3%, 95% CI , in rural areas, and 20%, 95% CI , 58%, 95% CI , and 5%, 95% CI , in urban areas, with $p < 0.001$ for teledermatology and child telepsychiatry and $p = 0.002$ for other specialties). **Figure 4**.

Analysis showed a significant difference between rural and urban areas in the proportion of total visits in teledermatology (44% of rural visits, 95% CI , and 13% of urban visits, 95% CI , with $p < 0.001$), child telepsychiatry (35% of rural visits, 95% CI , and 72% of urban visits, 95% CI , with $p < 0.001$), adult telepsychiatry (19% of rural visits, 95% CI , and 11% of urban visits, CI , with $p < 0.001$), and other specialties (2% of rural visits, 95% CI , and 4% of urban visits, 95% CI , with $p < 0.001$). Regressions of the number of visits or diagnoses per patient show a significant effect ($p < 0.001$) for specialty and location, but not for age or gender.

Predictors of Telemedicine use

The results of the multinomial logistic regression (**Table 3**) indicate that location, rural or urban area, is a significant predictor of the patient's use of a telemedicine specialty ($p < 0.001$). More specifically, the results of the binary logistic regressions, summarized in **Table 4**, and specifically the odds ratios, suggest that, all else being equal, i.e., for a patient of the same gender and age, the odds of an urban patient using teledermatology, as opposed to another specialty, are 84 percent lower than those of a rural patient (the 95% CI of the odds being , which does not include 1, with $p < 0.001$); the odds of an urban patient using child telepsychiatry, as opposed to another specialty, are 451 percent, or 5.5 times greater than for a rural patient (the 95% CI of the odds being , with $p < 0.001$); the odds of an urban patient using adult telepsychiatry, as opposed to another specialty, are 106 percent greater than for a rural patient (the 95% CI of the odds being , with $p < 0.001$); and the odds of an urban patient using telepsychiatry, child or adult, as opposed to another specialty, are 415 percent greater than for a rural patient (the 95% CI of the odds being , with $p < 0.001$). In summary, controlling for age and gender does not remove the effect of residency in an urban or rural area.

Although the proportion of males differed significantly between rural (55%) and urban (65%) patient populations, with $p < 0.001$, this was not reflected in the proportion of males for any individual specialty. (**Figure 5**) Throughout both urban and rural Missouri, males tend to outnumber females in the younger age groups, and females tend to outnumber males in the older age groups.[17] However, even as the observed rural patient population skews older and contains a higher proportion of females overall, the binary logistics regression indicated a significant (odds ratios of 0.448 for dermatology, with 95% CI , and 3.968 for child psychiatry, with 95% CI , and $p < 0.001$) effect of being male on the choice of specialty, even when controlling for age and location. This was not true in the case of adult psychiatry (odds ratio of 0.955, with 95% CI , which does contain 1, and $p = 0.743$).

The mean age of rural patients was 31 (95% CI); the mean age of urban patients was only 21 (95% CI), a statistically significant difference ($p < 0.001$). (**Figure 6**)

Rural patients are also less likely to be younger than 18 (39%, 95% CI , in rural and 66 percent, , in urban areas, with $p < 0.001$), more likely to be between 18 and 64 (48%, 95% CI , in rural, and 30 percent, 95 percent CI , in urban areas, with $p < 0.001$), and much more likely to be at least 65 (13%, 95% CI , in rural, and 4%, 95% CI , in urban areas, with $p < 0.001$).

In teledermatology, the difference in the proportions of rural and urban patients was significant only for pediatric (respectively 29% and 95% CI for rural patients, and 43% and 95% CI for urban patients, with $p < 0.001$) and elderly patients (respectively 19%, 95% CI , and 7%, 95% CI , with $p <0.001$), but not for the proportion of adult patients (respectively 52%, 95% CI , and 50%, 95% CI , with $p = 0.38$). The mean age of patients also differed significantly for rural and urban teledermatology patients ($p < 0.001$), with a mean age of 40 (95% CI) for rural teledermatology patients and 25 (95% CI) for urban ones.

For child and adult telepsychiatry and other visits, there was no significant difference between the proportions of rural and urban patients in each age group, although the mean age of patients differed significantly between rural and urban areas for child telepsychiatry (respectively mean 13.0, 95% CI and mean 15.6, 95% CI , with $p < 0.001$).

The mean and maximum number of visits (**Figure 7**) and diagnoses were computed for each patient. While the number of visits ranged from a single one to 28, only a few patients, mostly rural, had a large number of visits, and the average number of visits ranged from 1.72 for teledermatology to 3.38 for child telepsychiatry. The mean number of visits per patient differed significantly between rural and urban populations only for adult telepsychiatry (3.87 rural mean visits, with 95% CI , and 1.56 urban mean visits, with 95% CI ; $p < 0.001$). Similarly, the number of diagnoses per patient ranged from a single diagnosis to twelve diagnoses, but is comparable for rural and urban patients, with the exception of adult psychiatry, where the maximum number of diagnoses was twelve for rural patients versus only four for urban. The average number of diagnoses ranged from 1.27 for specialties other than teledermatology or telepsychiatry to 1.97 for child telepsychiatry. The number of diagnoses per patient differed significantly between rural and urban populations only for adult telepsychiatry (1.94 rural mean diagnoses, with 95% CI , and 1.26 urban mean diagnoses, with 95% CI ; $p < 0.001$).

Discussion

This study investigated the differences in telemedicine use between rural and urban settings. More than 30 percent of the Missouri population, or about 1.8 million people out of nearly 6 million, live in rural areas.[18] This study found that a rural resident of Missouri is 4.2 times as likely to use telemedicine as an urban Missourian, which is consistent with the literature.[2]

Rural and urban populations were found to use telemedicine differently: at different rates (more than four times as much for rural populations) and for different specialties (for teledermatology and child telepsychiatry, the difference between rural and urban areas was significant in both unique patients and total visits; for adult psychiatry, the difference between rural and urban areas was significant in total visits but not in unique patients; in the "other" category, we observed no significant difference in either total number of visits or in number of unique patients). Overall, rural use involved older patients (13% of rural patients were older than 65, compared to 4% of urban patients) and was concentrated in teledermatology (64% of patients and 44% of visits), while urban use involved younger patients (66% of urban patients were younger than 18, compared to 39% of rural patients) and was concentrated in child telepsychiatry (58% of unique patients and 72% of visits). These findings concur with a recent study of telemedicine utilization by rural and urban veterans, which also found that rural veterans are more likely to access mental health care via telemedicine than their urban counterparts.[19]

Missouri's population is like most states: a sustained growth shows a 21 percent increase over the population in 2000.[20] In addition, older adults (45-64 age group) and the elderly (65 and older) populations have increased more significantly than other groups due to increasing longevity, which is transforming population demographics of the state.[21] Our findings, however, are consistent with the trends in population, with emphasis on older rural and younger urban telemedicine users.

Missouri is also sparsely populated state, with only three large cities with specialty medical centers.[20] Most of the specialists practice in major metropolitan areas, and a recent report indicates that only 10 percent of physicians practice in rural areas.[22] With this in mind, some of the observed trends in this report are expected, but the extent of child telepsychiatry use, especially in urban areas, was surprising. Anecdotal evidence suggests that parents rely on telepsychiatry to spare their children the stigma of being seen at a psychiatrist's office. There is no evidence in the literature on cultural norms and stigma around in-person versus child telepsychiatry services, and we suggest more studies focus on this challenging issue. The reason for rural telemedicine use, however, seems more directly linked to a dearth of specialty providers within a reasonable distance.

Our main finding was that an overwhelming majority (97%) of all telemedicine visits were for teledermatology and telepsychiatry. These specialties do lend themselves to telemedicine, since they rely on visual observation (dermatology) or conversation (psychiatry), with a reduced need for physical examination of the patient. This may also be due to the drive and dedication of the dermatology and psychiatry departments at UMHC, and enthusiasm for telemedicine by their respective professional associations.[23,24] In any case, telemedicine may offer help for the critical nationwide shortage of adolescent psychiatry providers in rural and urban areas.[25]

While the researchers were able to have access to the entirety of telemedicine visits with UMHC providers over ten years, this still amounted to only 5,411 visits; the system sees this many in-person ambulatory visits in two days. Note that Missouri has three urban areas with major hospitals: UMHC in Columbia, in the center of the state; and large hospital systems in Kansas City to the west, St. Louis to the east. The map in **Figure 2** shows telemedicine utilization from the Columbia academic hub.

We recommend that future studies compare these results with outreach efforts undertaken by the specialist clinics, to test whether different specialties targeted different originating sites. Other hypotheses that remain to be tested are whether different specialties' telemedicine use has waxed and waned over time, or whether there are other temporal trends in telemedicine use.

Conclusions

Urban patients access telemedicine significantly differently, with a much greater demand for child telepsychiatry. Telemedicine may offer help for the critical nationwide shortage of dermatologists and adolescent psychiatry providers in rural and urban areas. Health systems should consider adjusting resources to meet the different needs of these two populations. These specific findings may or may not generalize to other telemedicine programs, but it is clear that all telemedicine programs would be well advised to monitor the telemedicine usage of different populations in order to tailor resources.

Telemedicine helps robust health systems extend their reach to hard-to-reach populations. It helps to shift the paradigm for the "right care, at the right time, and at the right place." The Institute of Medicine (IOM) report on Crossing the Quality Chasm recommended redesigning care delivery and encouraging implementation of information technologies in order to improve workforce capabilities and quality of care.[26] This is the promise of telemedicine; it may save the lives of patients experiencing access issues. Rural farmers at high-risk for melanoma now have timely access to specialty dermatologic care via telemedicine right in their own communities. Similarly, child psychiatry telemedicine may help meet the needs of diverse populations at the community level, both rural and urban.

Authors

Lincoln R. Sheets, MD, PhD, (sheetslr@health.missouri.edu) is assistant research professor, Department of Health Management and Informatics, University of Missouri.

Emmanuelle Wallach, MS, (wallache@health.missouri.edu) is evaluation coordinator, Department of Health Management and Informatics, University of Missouri.

Saif Khairat, PhD, MPH, (saif@unc.edu) is assistant professor, School of Nursing, University of North Carolina at Chapel Hill.

Rachel Mutrux, BA, (mutruxe@health.missouri.edu) is senior program director, Department of Health Management and Informatics, University of Missouri.

Karen Edison, MD, (edisonk@health.missouri.edu) is professor emerita of dermatology, senior medical director, Missouri Telehealth Network.

Mirna Becevic, PhD, FAMIA, (becevicm@health.missouri.edu) is assistant professor, department of dermatology, Missouri Telehealth Network.

Bibliography

Vidal-Alaball J, Pena JM, Valmana GS. Rural-urban differences in the pattern of referrals to an asyncronous teledermatology service. *Int Archiv Med,* vol. 11, no. 30, 2018.

Jetty A, Moore MA, Coffman M, Petterson S, Bazemore A. Rural family physicians are twice as likely to use telehealth as urban family physicians. *Telemed J E Health,* vol. 24, no. 4, 2018.

Spaulding R, Cain S, Sonnenschein K. Urban Telepsychiatry: Uncommon Service for a Common

Need. *Child and Adolescent Psychiatric Clinics of North America,* vol. 20, pp. 29-39, 2011.

Boogerd E, Arts T, Engelen L, van de Belt T. What is eHealth": Time for an update? *JMIR Res Protoc,* vol. 4, no. 1, 2015.

"mHealth: new horizons for health through mobile technologies," in *mHealth: new horizons for health through mobile technologies*, World Health Organization, 2011.

Clayton C. The innovator's dilemma, Cambridge, Mass: Harvard Business School Press, 1997.

Evans TS, Berkman N, Brown C, Gaynes B, Weber RP. Disparities within Serious Mental Illness. Agency for Healthcare Research and Quality, Rockville (MD), 2016.

Shea S, Kothani D, Teresi JA, Kong J, Eimicke JP, Lantigua RA, Palmas W, Weinstock RS. Social impact analysis of the effects of a telemedicine intervention to improve diabetes outcomes in an ethnically diverse, medically under-served population: findings from the IDEATel Study. *Am J Public Health,* vol. 103, no. 10, pp. 1888-1894, 2013.

Becevic M, Boren S, Mutrux R, Shah Z, Banerjee A. User satisfaction with telehealth: study of patients, providers, and coordinators. *Health Care Manag (Frederick),* vol. 34, no. 4, pp. 337-349, 2015.

"America's Health Rankings," United Health Foundation, Minneapolis, MN, 2020.

"Issues in Missouri Health Care," Missouri Foundation for Health, St. Louis, MO, 2013.

"2018 Scorecard on State Health System Performance," The Commonwealth Fund, New York, NY, 2018.

University of Missouri Office of Social and Economic Data Analysis, "Ten things to know about urban vs. rural," Missouri Census Data Center.

"Why choose MU Health Care," MU Health Care, 2020. . Available: https://www.muhealth.org/about-us. .

"IBM Cognos Analytics," IBM, . Available: https://www.ibm.com/products/cognos-analytics?cm_mmc=Search_Google-_-Hybrid+Cloud_Business+Analytics-_-WW_NA-_-+cognos_Broad_&cm_mmca2=10000844&cm_mmca7=1020268&cm_mmca8=aud-646793424653:kwd-26807681031&cm_mmca9=_k_CjwKCAjwr8zoBRA0EiwANmvpYKFXBKU8W4Ah-Zcx. .

US Department of Health and Human Services, "Federal Office of Rural Health Policy (FORHP) Data Files," December 2018. . Available: https://www.hrsa.gov/rural-health/about-us/definition/datafiles.html. .

Office of Primary Care and rural Health, Missouri Department of Health and Senior Services, "Health in Rural Missouri - Biennal report 2014-2015," 2015. . Available:

https://health.mo.gov/living/families/ruralhealth/pdf/biennial2015.pdf. .

U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau, "Missouri: 2010 - Population and Housing Unit Counts," 2012.

Adams S, Mader M, Bollinger M, Wong E, Hudson T, Littman A. Utilization of Interactive Clinical Video Telemedicine by Rural and Urban Veterans in the Veterans Health Administration Health Care System. *The Journal of Rural Health,* vol. 35, no. 3, pp. 308-3018, 2019.

"Missouri population," worldpopulationreview.com, 5 June 2019. . Available: http://worldpopulationreview.com/states/missouri-population/. .

"Population trends," Office of Administration Division of Budget and PLanning, . Available: https://oa.mo.gov/budget-planning/demographic-information/population-projections/population-trends. .

"About Rural Health Care," National Rural Health Association, . Available: https://www.ruralhealthweb.org/about-nrha/about-rural-health-care. .

American Academy of Dermatology, "Teledermatology toolkit," 2 May 2019. . Available: https://www.aad.org/practicecenter/managing-a-practice/teledermatology. .

American Psychiatric Association & American Telemedicine Association, "Best Practices in Videoconferencing-Based Telemental Health," April 2018. . Available: https://www.psychiatry.org/psychiatrists/practice/telepsychiatry/blog/apa-and-ata-release-new-telemental-health-guide. .

American Academy of Child & Adolescent Psychiatry, "Workforce issues," April 2019. . Available: https://www.aacap.org/aacap/resources_for_primary_care/workforce_issues.aspx. .

National Academies of Sciences, Engineering, and Medicine, "Crossing the quality chasm: The IOM Health Care Quality Inititative," 2018.

Tables

Table 1 - Results of the multinomial logistics regression for which specialty a patient used (base is assumed to be teledermatology) with predictor variables the patient's age, gender, and location.

Predictor variables	**Coefficient**	**Standard error of the coefficient**	**Z**	**P-value**	**Relative risk ratios**		
					Mean	**95% confidence Interval**	
						Lower bound	**Upper bound**
Child telepsychiatry							
Urban	2.165	0.136	15.89	< 0.001	8.714	6.672	11.381
Male	1.435	0.134	10.68	< 0.001	4.199	3.227	5.463

Age	-0.100	0.006	-16.04	< 0.001	0.905	0.894	0.916
Constant	0.120	0.153	0.79	0.431	1.128	0.836	1.521
Teledermatology: base outcome							
Adult telepsychiatry							
Urban	1.549	0.149	10.39	< 0.001	4.707	3.514	6.305
Male	0.334	0.136	2.47	0.014	1.397	1.071	1.822
Age	0.015	0.003	4.83	< 0.001	1.015	1.009	1.021
Constant	-2.419	0.178	-13.59	< 0.001	0.089	0.063	0.126
Other telemedicine specialty							
Urban	1.974	0.254	7.77	< 0.001	7.198	4.375	11.841
Male	-0.285	0.252	-1.13	0.259	0.752	0.459	1.233
Age	0.020	0.006	3.54	< 0.001	1.020	1.009	1.031
Constant	-3.948	0.335	-11.78	< 0.001	0.0198	0.010	0.037

Overall likelihood ratio $\chi^2 = 1313.28$ with $p < 0.001$

Table 2 - Number of unique female UMHC telemedicine by specialty, location, and age group, 2008-2017.

FEMALE PATIENTS

Specialty	**Pediatric Rural % (n)**	**Pediatric Urban % (n)**	**Adult Rural % (n)**	**Adult Urban % (n)**	**Elderly Rural % (n)**	**Elderly Urban % (n)**	***Total % (n)***
Child telepsychiatry	34.0% (69)	69.5% (89)	0.3% (1)	2.4% (3)	0	0	*17.7% (162)*
Adult telepsychiatry	0	0	24.1% (79)	42.5% (54)	4.4% (5)	27.8% (5)	*15.6% (143)*
Teledermatology	66.0% (134)	29.7% (38)	69.8% (229)	40.9% (52)	92.9% (105)	38.9% (7)	*61.6% (565)*
Other	0	0.8% (1)	5.8% (19)	14.2% (18)	2.7% (3)	33.3% (6)	*5.1% (47)*
Total	*100% (203)*	*100% (128)*	*100% (328)*	*100% (127)*	*100% (113)*	*100% (18)*	*100% (917)*

Table 3 - Results of the multinomial logistics regression for which specialty a patient used (base is assumed to be teledermatology) with predictor variables the patient's age, gender, and location.

Predictor variables	**Coefficient**	**Standard error of the coefficient**	**Z**	**P-value**	**Relative risk ratios**		
					Mean	**95% confidence Interval**	
						Lower bound	**Upper bound**
Child telepsychiatry							
Urban	2.165	0.136	15.89	< 0.001	8.714	6.672	11.381
Male	1.435	0.134	10.68	< 0.001	4.199	3.227	5.463

Age	-0.100	0.006	-16.04	< 0.001	0.905	0.894	0.916
Constant	0.120	0.153	0.79	0.431	1.128	0.836	1.521
Teledermatology: base outcome							
Adult telepsychiatry							
Urban	1.549	0.149	10.39	< 0.001	4.707	3.514	6.305
Male	0.334	0.136	2.47	0.014	1.397	1.071	1.822
Age	0.015	0.003	4.83	< 0.001	1.015	1.009	1.021
Constant	-2.419	0.178	-13.59	< 0.001	0.089	0.063	0.126
Other telemedicine specialty							
Urban	1.974	0.254	7.77	< 0.001	7.198	4.375	11.841
Male	-0.285	0.252	-1.13	0.259	0.752	0.459	1.233
Age	0.020	0.006	3.54	< 0.001	1.020	1.009	1.031
Constant	-3.948	0.335	-11.78	< 0.001	0.0198	0.010	0.037

Overall likelihood ratio $\chi^2 = 1313.28$ with $p < 0.001$

Table 4 – Results of the logistics regressions for whether a patient used a specific specialty with predictor variables the patient's age, gender, and location.

Predictor variables	**Coefficient**	**Standard error of the coefficient**	**Z**	**P-value**	**Odds ratio**		
					Mean	**95% confidence Interval**	
						Lower bound	**Upper bound**
Binary outcome *"Did the patient use teledermatology?"*							
Likelihood ratio $\chi^2 = 583.87$ with $p < 0.001$							
Urban	-1.824	0.110	-16.65	< 0.001	0.161	0.1310	0.200
Male	-0.801	0.100	-7.98	< 0.001	0.449	0.369	0.547
Age	0.021	0.002	9.11	< 0.001	1.022	1.017	1.026
Constant	0.351	0.113	3.10	0.002	1.420	1.137	1.772
Binary outcome *"Did the patient use child telepsychiatry?"*							
Likelihood ratio $\chi^2 = 1145.21$ with $p < 0.001$							
Urban	1.706	0.125	13.67	< 0.001	5.505	4.311	7.030
Male	1.378	0.129	10.66	< 0.001	3.968	3.080	5.112
Age	-0.105	0.006	-16.95	< 0.001	0.901	0.890	0.912
Constant	0.074	0.148	0.50	0.616	1.077	0.805	1.441
Binary outcome *"Did the patient use adult telepsychiatry?"*							
Likelihood ratio $\chi^2 = 123.01$ with $p < 0.001$							
Urban	0.722	0.138	5.24	< 0.001	2.059	1.572	2.697
Male	-0.046	0.131	-0.35	0.725	0.955	0.739	1.234
Age	0.030	0.003	10.43	< 0.001	1.030	1.025	1.036

Constant	-3.125	0.178	-17.53	< 0.001	0.044	0.031	0.062
Binary outcome *"Did the patient use telepsychiatry (child or adult)?"*							
Likelihood ratio $\chi^2 = 617.19$ with $p < 0.001$							
Urban	1.640	0.107	15.39	< 0.001	5.153	4.182	6.350
Male	0.933	0.102	9.18	< 0.001	2.543	2.084	3.104
Age	-0.028	0.002	-11.31	< 0.001	0.972	0.968	0.977
Constant	-0.367	0.114	-3.21	0.001	0.693	0.554	0.867

Figures

Figure 1: Number of total 2008-2017 UMHC telemedicine visits and unique patients by specialty.

Figure 2: Map of unique 2008-2017 UMHC telemedicine patients by zip code.

Figure 3: Distribution of unique 2008-2017 UMHC telemedicine unique patients by age, specialty, and gender, where pediatric = 0-17 years, adult = 18-64 years, and elderly = 65 years and over.

(* indicates a significant difference (p < 0.001) between rural and urban populations)

Figure 4: Distribution of unique 2008-2017 UMHC telemedicine total visits by gender, and specialty, where pediatric = 0-17 years, adult = 18-64 years, and elderly = 65 years and over.

(* indicates a significant difference (p < 0.001) between rural and urban populations)

Figure 5: 2008-2017 UMHC telemedicine gender distribution by specialty.

Figure 6: 2008-2017 UMHC telemedicine age distribution by specialty.

Figure 7: Maximum and mean number of 2008-2017 UMHC telemedicine visits per patient by specialty and location.

There are no comments yet.