



BRIEF REPORT

Telehealth Availability in US Hospitals in the Face of the COVID-19 Pandemic

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Disclosures: The authors report no conflicts of interest.

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doi: 10.1111/jrh.12482

Abstract

Background: Telehealth is likely to play a crucial role in treating COVID-19 patients. However, not all US hospitals possess telehealth capabilities. This brief report was designed to explore US hospitals' readiness with respect to telehealth availability. We hope to gain deeper insight into the factors affecting possession of these valuable capabilities, and how this varies between rural and urban areas.

Methods: Based on 2017 data from the American Hospital Association survey, Area Health Resource Files and Medicare cost reports, we used logistic regression models to identify predictors of telehealth and eICU capabilities in US hospitals.

Results: We found that larger hospitals (OR(telehealth) = 1.013; $P < .01$) and system members (OR(telehealth) = 1.55; $P < .01$) (OR(eICU) = 1.65; $P < .01$) had higher odds of possessing telehealth and eICU capabilities. We also found evidence suggesting that telehealth and eICU capabilities are concentrated in particular regions; the West North Central region was the most likely to possess capabilities, given that these hospitals had higher odds of possessing telehealth (OR = 1.49; $P < .10$) and eICU capabilities (OR = 2.15; $P < .05$). Rural hospitals had higher odds of possessing telehealth capabilities as compared to their urban counterparts, although this relationship was marginally significant (OR = 1.34, $P < .10$).

Conclusions: US hospitals vary in their preparation to use telehealth to aid in the COVID-19 battle, among other issues. Hospitals' odds of possessing the capability to provide such services vary largely by region; overall, rural hospitals have more widespread telehealth capabilities than urban hospitals. There is still great potential to expand these capabilities further, especially in areas that have been hard hit by COVID-19.

Key words access to care, COVID-19, demography, technology, telehealth.

Telehealth has played a growing role in improving patient access and care in the United States.¹ The ability for patients to have access to quality care remotely has important implications particularly for those in rural areas, or in cases where it is necessary to quarantine patients, such as in the case of the 2020 COVID-19 outbreak.² The rapid spread of the disease has been dominating world headlines and agendas, and its characteristics have highlighted the need for quick solutions. One potential

solution, which calls for rapid adaptation within the health care space, is to replace conventional diagnostics with newer technological methods of consultation to ensure all patients receive the attention and diagnosis from a health care professional. This is especially important in rural areas, which lack the usual preparedness and resources to which urban areas have access. This fact has not gone unnoticed by policy makers, as the March 27, 2020, legislation passed in response to the

pandemic includes provisions for increased telehealth capabilities.³

Research has examined to some extent the effectiveness of telehealth on particular outcomes. For example, it is known that hospitals adopting telehealth possess the potential to improve outcomes for high-risk obstetric patients in rural communities.² Additionally, telehealth facilitated the use of anti-microbial stewardship programs in rural areas where infectious disease physicians were not available.⁴ It is of particular importance in the case of pandemics, such as COVID-19, where severe respiratory complications are common and widespread contagion threatens to overwhelm hospitals' limited resources. Telehealth capabilities have shown remarkable abilities to facilitate emergency airway management in rural emergency departments (EDs).⁵ Yet, there are barriers to adoption that still remain, hindering the ability to maximize the potential of telehealth.

For one, although there is demand for telehealth services in rural areas, rural ED providers perceive its usefulness in particular specialties and its anticipated frequency of use less favorably than their academic center counterparts;⁶ clinician acceptance barriers in general can pose a threat to successful telehealth implementation.⁷ Furthermore, it is apparent that demand and availability vary systematically by region,⁶ and that other barriers, such as Internet connectivity, state reimbursement, technological, regulatory, insurance and geographic restrictions, play a role in limiting adoptions.⁷⁻¹⁰ Recent popular press articles even call into question hospital telehealth readiness.¹¹ Thus, a timely and important question exists as to the state of US hospital readiness with respect to telehealth capabilities.

The objective of this brief report is to explore the readiness of US hospitals with respect to the availability of telehealth resources. With this examination, we hope to gain deeper insight into the factors affecting the ability to provide these valuable resources, and how they vary between rural and urban areas. Ultimately, we aim to help policy makers and hospital stakeholders ascertain the extent to which hospitals are ready for events such as a pandemic, and how they can understand more about characteristics that facilitate increased telehealth availability.

Methods

This study utilized a cross-sectional analysis of acute care hospitals in the United States to examine the association between various organizational and environmental factors, and rural hospitals' possession of telehealth and eICU capabilities. Broadly speaking, telehealth and telemedicine encompass the abilities to consult specialists

when patients are unable to be physically present with the provider, and for providers to consult remotely with other specialists in the event that assistance is necessary. Provision of eICU services allows remote monitoring of ICU patients when sufficient ICU staffing is unavailable, whether due to excess demand, remote location, or off hours.¹²

We relied on national data from the American Hospital Association (AHA), which included 3,268 unique acute care hospitals from 2017. Data from the AHA Annual Survey were combined with county-level data from Area Health Resource Files and Medicare Cost reports to obtain the independent variables, which were lagged by 1 year. First, we tabulated the distribution of rural hospitals that possess telehealth and eICU capabilities as a percentage of all rural hospitals by state. Subsequently, we ran 2 separate logistic regression models with our 2 dependent variables: (1) possession of telehealth capabilities by hospitals and (2) possession of eICU capabilities by hospitals.

Dependent Variables

Hospital-Based Telehealth and eICU Capability

We used 2 survey questions from the AHA data to measure 2 dependent variables. The first dependent variable for this study was a binary variable that captured whether or not a hospital reported possession of telehealth capability. The second dependent variable for this study was also a binary variable that captured whether or not a hospital reported possession of eICU capabilities. The variables were coded as "1" if the hospitals possessed these capabilities and "0" if otherwise (the organization did not possess telehealth or eICU capabilities, respectively). Specifically, we used hospitals' responses to the AHA survey questions referring to the possession of "telehealth consultation and office visits," and "Telehealth eICU" capabilities.

Independent Variables

Organizational Factors

Hospital size was a continuous variable measured as the number of staffed hospital beds. System affiliation was assessed with a binary indicator variable (0 = independent, 1 = system). Teaching status was assessed with a binary indicator variable (0 = independent, 1 = part of Council of Teaching hospitals).

County Population Variables

Environmental complexity was measured using 2 variables: market competition (Herfindahl-Hirschman Index

[HHI]) and Medicare market penetration.¹³ HHI, which measures market competition, was a continuous variable ranging from 0 to 1, or low concentration/high competition to high concentration/low competition and calculated as a ratio of number of hospital's admissions in a given year by county's hospital admissions in a given year.

Geospatial Factors

Geospatial factors are important in addressing access to telehealth and eICU services to a total population size within a defined population and defined area range. We used the 2013 Rural-Urban Continuum Codes (RUCC) to group counties into metropolitan counties (RUCC 1-3), nonmetropolitan/urban adjacent counties (RUCC 4-6), and rural counties (RUCC 7-9).

Census Division

We divided states into 9 census regions (1: New England, 2: Mid Atlantic, 3: South Atlantic, 4: East North Central, 5: East South Central, 6: West North Central, 7: West South Central, 8: Mountain, 9: Pacific), according to AHA.

Control Variables

To account for other differences in the organizational and environmental characteristics, hospital ownership (not-for-profit, for-profit, and government), coded using a categorical variable (0, 1, and 2, respectively), Medicaid payor mix, Medicare payor mix, and whether hospital was financially distressed (0: no, 1: yes) were controlled for. We used Altman Z score to measure financial performance of the hospital. An Altman Z score below 1.8 was considered a measure of financial distress for a hospital.^{14,15}

Results

Univariate Summary

Descriptive statistics for the entire sample of hospitals ($N = 3,268$) are shown in Table 1. More than one quarter (27.4%) of the hospitals possessed telehealth capabilities, while 14% of the hospitals possessed eICU capabilities. Most hospitals included in the sample were not-for-profit (67.5%) and affiliated with a multihospital system (65.98%). On average, hospitals in the sample had approximately 183 beds staffed for use. The sample hospitals were also located in relatively highly concentrated markets with an average HHI score of 0.69, and a Medicare managed care penetration rate of 27.4%.

Second, we displayed graphically the percentages of rural hospitals with telehealth capabilities (measured as a

ratio of rural hospitals with telehealth capabilities to the number of rural hospitals in each state) (see Figure 1). Noticeably, coastal states, which have been hit the hardest by the initial wave of COVID-19 cases, had the lowest prevalence of rural telehealth capability. The concentrations range from 0% in multiple states to 50% in Connecticut.

Multivariable Results

Model 1 in Table 2 presents the results of a logistic regression model predicting hospitals' possession of telehealth capabilities. Hospitals that were members of a system ($OR = 1.55, P < .01$) and had teaching status ($OR = 2.62, P < .01$) had higher odds of possessing telehealth capabilities. Regarding hospital size, an increase of 10 staffed beds per hospital increased the odds of telehealth capability possession by 1.3% ($P < .01$). Hospitals in rural areas were more likely to possess telehealth capabilities compared to hospitals in urban areas, although the odds ratio was only marginally significant ($OR = 1.34, P < .10$). However, hospitals that possessed telehealth capabilities were clustered in the West North Central Census region ($OR = 1.49, P < .10$), while hospitals in the East South Central region ($OR = 0.54, P < .05$) and West South Central census region ($OR = 0.64, P < .10$) were less likely to possess telehealth capabilities.

Model 2 in Table 2 presents the results of a logistic regression model predicting hospitals' possession of eICU capabilities. Hospitals that were members of a system ($OR = 1.65, P < .01$) were more likely to possess eICU capabilities. Hospitals that possessed eICU capabilities were clustered in the South Atlantic ($OR = 2.23, P < .05$), East North Central ($OR = 4.69, P < .01$), West North Central ($OR = 2.15, P < .05$), and Mountain regions ($OR = 4.02, P < .01$), as they had systematically higher odds of possessing eICU capabilities.

Discussion

In this brief report, we undertook an examination of the extent to which US hospitals are prepared to use telehealth and telemedicine to aid in the battle with COVID-19, among other patient issues. We found that hospitals' odds of possessing such capabilities vary to a large extent by region; overall, the rural health system appears to have more widespread telehealth capabilities than urban hospitals. US hospitals have the potential to greatly expand these capabilities, especially in hard-hit areas. This research has the potential to inform policy makers and health administrators with regard to successful pursuit of this important capability.

Table 1 Descriptive Statistics

Variable	Overall		Telehealth Capabilities		eICU Capabilities	
	(n = 3268) Mean/N (SD/%)	Yes (n = 897) Mean/N (SD/%)	No (n = 2,371) Mean/N (SD/%)	Yes (n = 461) Mean/N (SD/%)	No (n = 2,807) Mean/N (SD/%)	
System membership (no)	1,099 (33.63%)	243 (27.09%)	856 (36.10%)	98 (21.26%)	1,001 (35.66%)	
System membership (yes)	2,169 (66.37%)	654 (72.91%)	1,515 (63.90%)	363 (78.74%)	1,806 (64.34%)	
Hospital size	183.72 (222.94)	249.7 (303.3)	158.76 (177.38)	226.91 (269.31)	176.63 (213.60)	
Teaching status (no)	3,049 (93.30%)	764 (85.17%)	2,285 (96.37%)	413 (89.59%)	2,636 (93.91%)	
Teaching status (yes)	219 (6.70%)	133 (14.83%)	86 (3.63%)	48 (10.41%)	171 (6.09%)	
HHI	0.68 (0.55)	0.65 (0.36)	0.70 (0.34)	0.68 (0.35)	0.68 (0.35)	
Managed care penetration	27.43% (14.67%)	28.01% (14.98%)	27.21% (14.55%)	31.13% (14.43%)	26.82% (14.62%)	
RUCC 1-3	1,933 (59.15%)	566 (63.10%)	1,367 (57.65%)	305 (66.16%)	1,628 (58%)	
RUCC 4-6	788 (24.11%)	181 (20.18%)	607 (25.6%)	105 (22.78%)	683 (24.33%)	
RUCC 7-9	547 (16.74%)	150 (16.72%)	397 (16.74%)	51 (11.06%)	496 (17.67%)	
1. New England	126 (3.86%)	38 (4.24%)	88 (3.71%)	9 (1.95%)	117 (4.17%)	
2. Mid Atlantic	301 (9.21%)	99 (11.04%)	202 (8.52%)	42 (9.11%)	259 (9.23%)	
3. South Atlantic	449 (13.74%)	116 (12.93%)	333 (14.04%)	65 (14.10%)	384 (13.68%)	
4. East North Central	583 (17.84%)	181 (20.18%)	402 (16.95%)	160 (34.71%)	423 (15.07%)	
5. East South Central	237 (7.25%)	38 (4.24%)	199 (8.39%)	19 (4.12%)	218 (7.77%)	
6. West North Central	510 (15.61%)	172 (19.18%)	338 (14.26%)	61 (13.23%)	449 (16%)	
7. West South Central	540 (16.52%)	85 (9.48%)	455 (19.19%)	26 (5.64%)	514 (18.31%)	
8. Mountain	202 (6.18%)	59 (6.58%)	143 (6.03%)	35 (7.59%)	167 (5.95%)	
9. Pacific	320 (9.79%)	109 (12.15%)	211 (8.90%)	44 (9.54%)	276 (9.83%)	
0 Not-for-profit	2,206 (67.5%)	686 (76.48%)	1520 (64.11%)	415 (90.02%)	1,791 (63.8%)	
1 For-profit	375 (11.47%)	51 (5.69%)	324 (13.67%)	6 (1.30%)	369 (13.15%)	
2 Government	687 (21.02%)	160 (17.84%)	527 (22.23%)	40 (8.68%)	647 (23.05%)	
Medicaid payor mix	19% (0.15%)	21% (1.4%)	19% (15%)	19.2% (12.2%)	19.7% (15.4%)	
Medicare payor mix	52% (19%)	50% (18%)	53 (19%)	52.3% (16.1%)	52.3% (19.4%)	
Distress (no)	2,606 (79.74%)	747 (83.28%)	1,859 (78.41%)	391 (84.82%)	2,215 (78.91%)	
Distress (yes)	662 (20.26%)	150 (16.72%)	512 (21.59%)	70 (15.18%)	592 (21.09%)	

Figure 1 Percentage of Rural Hospitals Equipped with Telehealth Capabilities, by State.

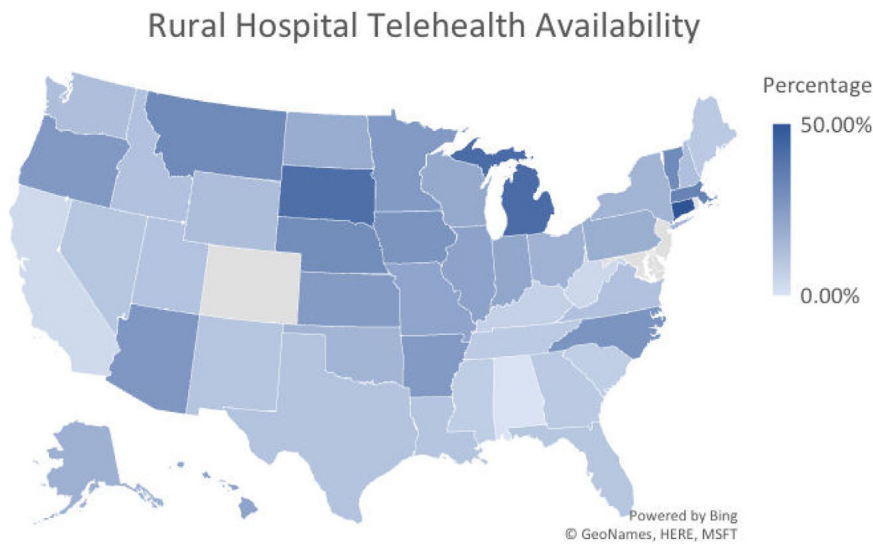


Table 2 Logistic Regression Models With Hospital Telehealth and eICU Capabilities Odds Ratios

Telehealth	Model 1 Telehealth Capabilities (N = 897)			Model 2 eICU (N = 461)		
	Adjusted odds ratio	SE	Sig	Adjusted odds ratio	SE	Sig
Organizational factors						
System membership	1.548	0.156	***	1.645	0.222	***
Hospital size (#beds/10)	1.013	0.003	***	1.006	0.000	**
Teaching status	2.624	0.482	***	1.290	0.300	
County-level factors						
HHI	1.066	0.163		1.519	0.295	**
Managed care penetration	0.994	0.003	*	1.012	0.004	***
Geospatial						
1b. RUCC 1-3	1.000			1.000		
2. RUCC 4-6	1.084	0.132		1.031	0.156	
3. RUCC 7-9	1.335	0.195	*	0.838	0.168	
Census region						
1. New England	1.000			1.000		
2. Mid Atlantic	1.094	0.270		1.756	0.690	
3. South Atlantic	0.844	0.202		2.234	0.850	**
4. East North Central	1.235	0.283		4.689	1.720	***
5. East South Central	0.539	0.152	**	1.607	0.698	
6. West North Central	1.488	0.348	*	2.150	0.827	**
7. West South Central	0.641	0.159	*	1.094	0.452	
8. Mountain	1.246	0.331		4.021	1.638	***
9. Pacific	1.460	0.361		1.927	0.766	*
Control variables						
Medicaid payor mix	0.863	0.320		0.295	0.152	**
Medicare Payor mix	0.653	0.193		0.486	0.195	*
0 Not-for -profit	1.000			1.000		
1 For-profit	0.486	0.081	***	0.086	0.036	***
2 Government	0.849	0.101		0.408	0.076	***
Distress	0.848	0.093		0.894	0.131	
Constant	0.297	0.100	***	0.055	0.028	***

****P* < .01.

***P* < .05.

**P* < .1.

The concentrations of rural hospitals possessing these capabilities varied widely by state. Coastal areas, such as New York, Florida, California, and Washington, lacked to a great extent the capability to provide e-services in rural areas. Telehealth in particular is in short supply in these states. Across all hospitals, telehealth capabilities are predictably available in larger hospitals and teaching hospitals; thus, a focus on providing support to smaller hospitals appears to be a wise policy move. Another key predictor of telehealth capabilities is system membership. Those hospitals that belong to systems presumably tap into the support network available, and benefit from the economies of scale and stores of knowledge present in these networks.

Limitations and Future Research

There were some limitations in this study. First, the most recent data that we had available for all of our variables was 2017. From what we can ascertain, however, telehealth did not spread appreciably in 2018; we cannot be certain, however, as to the spread of telehealth in 2019 through March 2020. Second, there are potential barriers to adoption for which data were not available to us for the time frame under study. These included such issues as the adequacy, reliability, and quality of Internet services in the rural community, the proportion of residents who are subscribers to high-quality Internet services and have devices that can connect to currently used telehealth systems, and the attitudes of providers and patients in the rural health system toward having patient visits using telehealth services. State Medicaid and other payer telehealth reimbursement policies could also affect adoption, and they might also be examined in future research.

Future research could explore the extent to which the education and technology literacy level of the rural community influences telehealth availability and utilization. In particular, it could be that among less educated seniors, the use of their cell phone may be limited to simply the telephone function, they may have outdated technology, or they may have issues related to updating the technology that they are using to connect for telehealth. From a strategic planning/financial return point of view, a rural health system has to be sure that both the community and providers are likely to use telehealth, in addition to the extent to which structural barriers prevent it.

Conclusions

In conclusion, it is important to realize where the readiness of our health system is in terms of capabilities to provide remote services. Not only are rural populations

some of the most vulnerable to diseases such as COVID-19, they might be called upon to provide back-up service to overflowing urban hospitals in the event such systems are overwhelmed. Going forward, telehealth is likely to play a large role in diagnosing patients, particularly in coming months as long as social distancing is a preferred strategy for preventing the spread of COVID-19. This virus might also become seasonal, and until a vaccine is introduced, telehealth will likely be increasingly integral to diagnosis and treatment. Furthermore, including telehealth generally as an option for reaching and maintaining rural patient contact and providing care can be an integral mechanism to improving rural health.

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