Clinician characteristics and primary care telemedicine use in a large Midwestern healthcare system: A cross-sectional analysis

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Submitted to: Journal of Medical Internet Research
on: November 27, 2024

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Abstract

Background: While many studies have examined the patient characteristics associated with telemedicine use, few have examined the influence of clinicians on patients' telemedicine use.

Objective: This study assessed clinician contribution to and characteristics associated with primary care visit mode.

Methods: Cross-sectional study of adult (18+ years) primary care patients in a large Midwestern healthcare system in 2022. Our main exposure was clinician characteristics and primary outcomes were primary care visit mode (any telemedicine visits vs. in-person visits only) and telemedicine mode (video vs. audio-only). Logistic regression was used to assess the association between outcomes and clinician characteristics. Pseudo r2 and Bayesian Information Criterion were used to assess changes in variance and model fit.

Results: In 2022, 3.5% of primary care visits were telemedicine visits and 6% of primary care patients had a telemedicine visit (85% had any video visits and 15% had audio-only visits). Controlling for patient characteristics, patients with clinicians with moderate-sized patient panels (aOR: 1.05, 95%CI: 1.03-1.08), more telemedicine visits (aOR: 4.39, 95%CI: 4.30-4.49), and more patients in racial/ethnic minority groups (OR: 1.04, 95%CI: 1.01-1.07) were more likely to have telemedicine visits. Those with clinicians with large patient panels (aOR: 0.88, 95%CI: 0.86-0.90) and more patients with non-English language preference (NELP; aOR: 0.93, 95%CI: 0.91-0.95) were less likely to have telemedicine visits. Among telemedicine users, patients with only audio-only visits were more likely attributed to clinicians with more telemedicine visits (aOR: 1.33, 95%CI: 1.24-1.42), more patients with NELP (aOR: 1.27, 95%CI: 1.19-1.35), and more elderly patients (aOR: 1.34, 95%CI: 1.26-1.42) and less likely attributed to clinicians who are physicians (aOR: 0.82, 95%CI: 0.76-0.89), with larger patient panels (aOR: 0.47, 95%CI: 0.44-0.50 for ?1400 patients; aOR: 0.82, 95%CI: 0.77-0.88 for 1000-1399 patients) and with more patients in racial/ethnic minority groups (aOR: 0.75, 95%CI: 0.70-0.81). Adding clinician characteristics improved model fit and explained more variability than patient characteristics alone in the primary care visit mode model.

Conclusions: Telemedicine use was associated with clinician type and patient panel characteristics. Clinician characteristics explained greater variability in telemedicine use than patient characteristics alone. Healthcare systems may increase telemedicine uptake by targeting interventions toward clinicians.

(JMIR Preprints 27/11/2024:69364)
DOI: https://doi.org/10.2196/preprints.69364

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Clinician characteristics and primary care telemedicine use in a large Midwestern healthcare system: A cross-sectional analysis

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Abstract word count (max 450): 351

Abstract

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Results: In 2022, 3.5% of primary care visits were telemedicine visits and 6% of primary care patients had a telemedicine visit (85% had any video visits and 15% had audio-only visits). Controlling for patient characteristics, patients with clinicians with moderate-sized patient panels (aOR: 1.05, 95%CI: 1.03-1.08), more telemedicine visits (aOR: 4.39, 95%CI: 4.30-4.49), and more patients in racial/ethnic minority groups (OR: 1.04, 95%CI: 1.01-1.07) were more likely to have telemedicine visits. Those with clinicians with large patient panels (aOR: 0.88, 95%CI: 0.86-0.90) and more patients with non-English language preference (NELP; aOR: 0.93, 95%CI: 0.91-0.95) were less likely to have telemedicine visits. Among telemedicine users, patients with only audio-only visits were more likely attributed to clinicians with more telemedicine visits (aOR: 1.33, 95%CI: 1.24-1.42), more patients with NELP (aOR: 1.27, 95%CI: 1.19-1.35), and more elderly patients (aOR: 1.34, 95%CI: 1.26-1.42) and less likely attributed to clinicians who are physicians (aOR: 0.82, 95%CI: 0.76-0.89), with larger patient panels (aOR: 0.47, 95%CI:

0.44-0.50 for ≥1400 patients; aOR: 0.82, 95%CI: 0.77-0.88 for 1000-1399 patients) and with more patients in racial/ethnic minority groups (aOR: 0.75, 95%CI: 0.70-0.81). Adding clinician characteristics improved model fit and explained more variability than patient characteristics alone in the primary care visit mode model.

Conclusions and Relevance: Telemedicine use was associated with clinician type and patient panel characteristics. Clinician characteristics explained greater variability in telemedicine use than patient characteristics alone. Healthcare systems may increase telemedicine uptake by targeting interventions toward clinicians.

Keywords: telemedicine; primary healthcare; physician practice patterns; cross-sectional studies

Introduction

Telemedicine use increased dramatically during the early phases of the COVID-19 pandemic with numerous studies documenting increases in telemedicine use across various healthcare settings and systems.[1-3] In the post-pandemic period, research indicates that telemedicine use has persisted.[4-8] These studies assume that patients have equal access to telemedicine; however, the ability to access telemedicine visits, and the mode by which it is available, may differ by clinician factors.[9-11] Specifically, clinician transition to telemedicine early in the pandemic has been found to vary by gender, age, and specialty.[9,12] Further, one study found clinician characteristics to account for as much as 26% of the variance in video versus telephone visits while patients only accounted for 9%.[2] While research suggests that clinicians play a key role in telemedicine use, little work has been done to understand the role of clinicians and their characteristics in patient telemedicine use.

We assessed the contribution of clinicians to the mode of primary care visits, and examined the clinician characteristics associated with primary care visit mode in 2022 within a large Midwestern healthcare system. Understanding the role clinicians play in patient telemedicine use may help healthcare systems ensure equitable access to the desired mode of care delivery.

Methods

The Advocate Aurora Health Institutional Review Board approved the study protocol and waived the requirement for written informed consent for this retrospective study. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.[13]

Setting

This cross-sectional study was using electronic health record (EHR) data from a large, diverse

healthcare system in Wisconsin and Illinois with over 3 million patients, 26 hospitals, over 500 ambulatory sites, and over 1,000 primary care providers. Prior to the start of the COVID-19 public health emergency in March 2020, use of video telemedicine was limited to select pilot primary care sites in a single county; most primary care providers started using telemedicine after the start of the pandemic. In-person office visits returned to full availability for primary care appointments in Summer of 2020. Telephone telemedicine was available throughout.

Study population

We used the EHR data to identify adult patients (18 years and older) who had a primary care visit (Family Medicine or Internal Medicine) with a physician, nurse practitioner, or physician assistant in 2022. To focus on the care provided in general primary care practice, we excluded urgent care visits, patients with urgent care visits only, and visits with clinicians who had ≤100 distinct adult primary care patients in 2022.

Measures

The primary outcome was primary care visit mode; patients were categorized as having only in-person visits or any telemedicine visits. Secondarily, patients with any telemedicine visits were categorized as having video visits or audio-only visits only. Patients were attributed to clinicians based on visit frequency and, if tied, recency. Clinician characteristics included clinician type (physician, advance practice provider), adult panel size (<1000 patients, 1000-1399 patients, ≥1400 patients), proportion of visits that were telemedicine, and clinicians' panel characteristics (proportion of patients with non-English language preference [NELP], from racial or ethnic minority groups, and aged 65+ years).

Patient characteristics included sex, age, race or ethnicity, language preference, insurance type, Charlson Comorbidity Index, patient portal status, neighborhood education, race-specific

neighborhood income, neighborhood broadband access, and state. Language preference was constructed using the preferred language and translator needed fields; patients with a preferred language other than English or needed a translator were categorized as NELP. Income, education, and broadband internet access were obtained by merging patient zip codes with American Community Survey data.

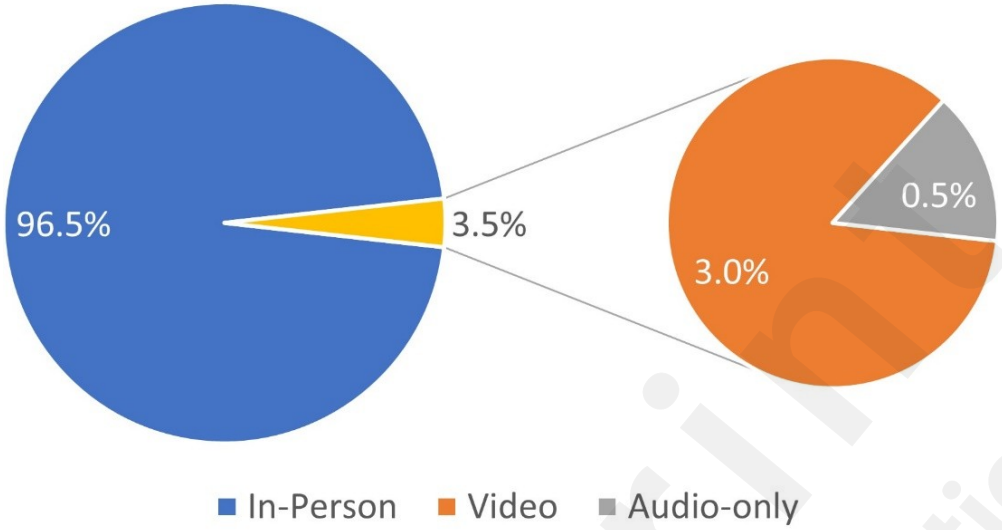
Analysis

Descriptive statistics characterized patients by visit mode. We ran patient-level univariable and multivariable logistic regression models controlling first for patient characteristics and then adding clinician characteristics. We used pseudo r^2 and Bayesian Information Criterion to assess changes in variance and model fit, respectively. We used listwise deletion for patients missing covariates, accounting for 2.3% of the sample population. Analyses were conducted in Stata version 17.0 (StataCorp).

Results

Among 988,326 adults with over 2.1 million primary care visits from 1,143 clinicians in 2022, 96.5% of visits were in-person visits and 3.5% were telemedicine visits (**Figure 1**); 84.9% of telemedicine visits were video visits and 15.1% were audio-only visits. Among patients, 94.2% had in-person visits only and 5.8% had any telemedicine visits (**Table 1**). Of patients with telemedicine visits, 85.4% had video visits while 14.6% had only audio-only visits.

Figure 1. Percentage of primary care visits delivered in person, via video, and via audio-only, 2022



Demographically, younger patients, those from racial or ethnic minority groups, and those with commercial insurance were more likely to have used telemedicine. A greater percentage of telemedicine patients were attributed to clinicians with more patients with NELP, more patients from racial or ethnic minority groups, and younger patients. A greater percentage of patients with only audio-only visits were attributed to clinicians who were advanced practice providers, had smaller panel sizes, had fewer patients from racial or ethnic minority groups, and had older patients.

Table 1. Clinician and patient characteristics of primary care patients by primary care visit and telemedicine mode, 2022

Characteristics	Total	In-person visit only	Any telemedicine visit	Telemedicine mode	
				Any video	Audio-only
N	988,326 (100.0%)	930,547 (94.2%)	57,779 (5.8%)	49,366 (85.4%)	8,413 (14.6%)
Clinician characteristics (at the patient level)					
Clinician type					
Advanced practice provider (NP, PA)	167,168 (16.9%)	157,089 (16.9%)	10,079 (17.4%)	8,051 (16.3%)	2,028 (24.1%)
Physician	821,158 (83.1%)	773,458 (83.1%)	47,700 (82.6%)	41,315 (83.7%)	6,385 (75.9%)
Adult patient panel size					
<1000 patients	218,922 (22.2%)	204,999 (22.0%)	13,923 (24.1%)	10,602 (21.5%)	3,321 (39.5%)
1000-1399 patients	275,250 (27.9%)	258,853 (27.8%)	16,397 (28.4%)	13,515 (27.4%)	2,882 (34.3%)
≥1400 patients	494,154 (50.0%)	466,695 (50.2%)	27,459 (47.5%)	25,249 (51.1%)	2,210 (26.3%)
% of visits that were telemedicine*					
At or below median	513,705 (52.0%)	502,693 (54.0%)	11,012 (19.1%)	9,395 (19.0%)	1,617 (19.2%)
Above median	474,621 (48.0%)	427,854 (46.0%)	46,767 (80.9%)	39,971 (81.0%)	6,796 (80.8%)
% of patients have non-English language preference*					
At or below median	516,624 (52.3%)	488,712 (52.5%)	27,912 (48.3%)	24,035 (48.7%)	3,877 (46.1%)
Above median	471,702 (47.7%)	441,835 (47.5%)	29,867 (51.7%)	25,331 (51.3%)	4,536 (53.9%)
% of patients from a racial or ethnic minority group*					
At or below median	514,442 (52.1%)	491,002 (52.8%)	23,440 (40.6%)	19,270 (39.0%)	4,170 (49.6%)
Above median	473,884 (47.9%)	439,545 (47.2%)	34,339 (59.4%)	30,096 (61.0%)	4,243 (50.4%)
% of patients 65 or over*					
At or below median	398,345 (40.3%)	371,550 (39.9%)	26,795 (46.4%)	23,521 (47.6%)	3,274 (38.9%)
Above median	589,981 (59.7%)	558,997 (60.1%)	30,984 (53.6%)	25,845 (52.4%)	5,139 (61.1%)
Patient characteristics					
Age (years)					
18-29	127,713 (12.9%)	118,219 (12.7%)	9,494 (16.4%)	8,785 (17.8%)	709 (8.4%)
30-49	275,441 (27.9%)	255,580 (27.5%)	19,861 (34.4%)	18,075 (36.6%)	1,786 (21.2%)
50-64	292,904 (29.6%)	277,636 (29.8%)	15,268 (26.4%)	12,849 (26.0%)	2,419 (28.8%)
65-74	179,458 (18.2%)	171,790 (18.5%)	7,668 (13.3%)	5,841 (11.8%)	1,827 (21.7%)
≥75	112,810 (11.4%)	107,322 (11.5%)	5,488 (9.5%)	3,816 (7.7%)	1,672 (19.9%)
Sex					
Male	415,770 (42.1%)	398,138 (42.8%)	17,632 (30.5%)	14,748 (29.9%)	2,884 (34.3%)
Female	572,556 (57.9%)	532,409 (57.2%)	40,147 (69.5%)	34,618 (70.1%)	5,529 (65.7%)

Characteristics	Total	In-person visit only	Any telemedicine	Telemedicine mode	
				Any video	Audio-only
Race or ethnicity					
White, non-Hispanic	697,538 (70.6%)	660,198 (70.9%)	37,340 (64.6%)	31,903 (64.6%)	5,437 (64.6%)
Black, non-Hispanic	140,585 (14.2%)	129,441 (13.9%)	11,144 (19.3%)	9,594 (19.4%)	1,550 (18.4%)
Asian, non-Hispanic	39,319 (4.0%)	37,341 (4.0%)	1,978 (3.4%)	1,748 (3.5%)	230 (2.7%)
Hispanic	91,089 (9.2%)	85,053 (9.1%)	6,036 (10.4%)	4,973 (10.1%)	1,063 (12.6%)
Another non-Hispanic race	19,795 (2.0%)	18,514 (2.0%)	1,281 (2.2%)	1,148 (2.3%)	133 (1.6%)
Language preference					
English language preference	951,719 (96.3%)	895,708 (96.3%)	56,011 (96.9%)	48,338 (97.9%)	7,673 (91.2%)
Non-English language preference	36,607 (3.7%)	34,839 (3.7%)	1,768 (3.1%)	1,028 (2.1%)	740 (8.8%)
Insurance type					
Commercial	568,758 (57.5%)	534,499 (57.4%)	34,259 (59.3%)	31,447 (63.7%)	2,812 (33.4%)
Medicare	298,393 (30.2%)	284,030 (30.5%)	14,363 (24.9%)	10,575 (21.4%)	3,788 (45.0%)
Medicaid or other non-commercial	106,753 (10.8%)	98,917 (10.6%)	7,836 (13.6%)	6,620 (13.4%)	1,216 (14.5%)
Self-Pay	14,422 (1.5%)	13,101 (1.4%)	1,321 (2.3%)	724 (1.5%)	597 (7.1%)
Charlson Comorbidity Index category					
Minimal	626,641 (63.4%)	591,614 (63.6%)	35,027 (60.6%)	31,154 (63.1%)	3,873 (46.0%)
Mild	248,896 (25.2%)	233,561 (25.1%)	15,335 (26.5%)	12,697 (25.7%)	2,638 (31.4%)
Moderate	71,267 (7.2%)	66,812 (7.2%)	4,455 (7.7%)	3,377 (6.8%)	1,078 (12.8%)
Severe	41,522 (4.2%)	38,560 (4.1%)	2,962 (5.1%)	2,138 (4.3%)	824 (9.8%)
Patient portal status					
Active	815,038 (82.5%)	762,503 (81.9%)	52,535 (90.9%)	46,670 (94.5%)	5,865 (69.7%)
Inactive	173,288 (17.5%)	168,044 (18.1%)	5,244 (9.1%)	2,696 (5.5%)	2,548 (30.3%)
% of neighborhood adults with a college or professional degree					
≥75%	28,726 (2.9%)	26,239 (2.8%)	2,487 (4.3%)	2,302 (4.7%)	185 (2.2%)
50%-74.9%	291,697 (29.5%)	273,732 (29.4%)	17,965 (31.1%)	16,191 (32.8%)	1,774 (21.1%)
25%-49.9%	607,092 (61.4%)	574,196 (61.7%)	32,896 (56.9%)	27,482 (55.7%)	5,414 (64.4%)
<25%	60,811 (6.2%)	56,380 (6.1%)	4,431 (7.7%)	3,391 (6.9%)	1,040 (12.4%)
Neighborhood median income by race or ethnicity					
≥$100,000	189,600 (19.2%)	176,463 (19.0%)	13,137 (22.7%)	12,085 (24.5%)	1,052 (12.5%)
75,000-$99,999	289,492 (29.3%)	273,657 (29.4%)	15,835 (27.4%)	13,877 (28.1%)	1,958 (23.3%)
$50,000-$74,999	385,578 (39.0%)	366,397 (39.4%)	19,181 (33.2%)	15,925 (32.3%)	3,256 (38.7%)
<$50,000	123,656 (12.5%)	114,030 (12.3%)	9,626 (16.7%)	7,479 (15.2%)	2,147 (25.5%)
% of households with broadband internet					
≥90%	388,397 (39.3%)	363,737 (39.1%)	24,660 (42.7%)	22,356 (45.3%)	2,304 (27.4%)
85 to 89.9%	364,373 (36.9%)	345,738 (37.2%)	18,635 (32.3%)	15,535 (31.5%)	3,100 (36.8%)
<85%	235,556 (23.8%)	221,072 (23.8%)	14,484 (25.1%)	11,475 (23.2%)	3,009 (35.8%)

Characteristics	Total	In-person visit only	Any telemedicine	Telemedicine mode	
				Any video	Audio-only
State					
Illinois	426,550 (43.2%)	392,981 (42.2%)	33,569 (58.1%)	31,169 (63.1%)	2,400 (28.5%)
Wisconsin	561,776 (56.8%)	537,566 (57.8%)	24,210 (41.9%)	18,197 (36.9%)	6,013 (71.5%)

Abbreviations: NP=nurse practitioner; PA=physician assistant

* The median value for the proportion of telemedicine visits was 0.020. The median values for the proportion of patients with non-English language preference, from a racial or ethnic minority group, and 65 years and older were 0.013, 0.174, and 0.236, respectively.

In the multivariable analysis looking at primary care visit mode (**Table 2**), we found that patients with clinicians with 1000-1399 adult patients (adjusted odds ratio [aOR]: 1.05, 95%CI: 1.03-1.08), more telemedicine visits (aOR: 4.39, 95%CI: 4.30-4.49), and more patients in racial or ethnic minority groups (aOR: 1.04, 95%CI: 1.01-1.07) had greater odds of having telemedicine visits. In contrast, patients with clinicians with ≥1400 adult patients (aOR: 0.88, 95%CI: 0.86-0.90) and with more patients with NELP (aOR: 0.93, 95%CI: 0.91-0.95) had lower odds of having telemedicine visits.

In the multivariable telemedicine mode model (**Table 2**), telemedicine patients with clinicians who provided more telemedicine visits (aOR: 1.33, 95%CI: 1.24-1.42), with more patients with NELP (aOR: 1.27, 95%CI: 1.19-1.35), and with more elderly patients (aOR: 1.34, 95%CI: 1.26-1.42) had greater odds of having only audio-only visits. Conversely, patients with clinicians who were physicians (aOR: 0.82, 95%CI: 0.76-0.89), with larger panel sizes (aOR: 0.47, 95%CI: 0.44-0.50 for ≥1400 patients; aOR: 0.82, 95%CI: 0.77-0.88 for 1000-1399 patients), and with more patients from racial or ethnic minority groups (aOR: 0.75, 95%CI: 0.70-0.81) had lower odds of having only audio-only visits.

Adding clinician characteristics improved model fit for both models and explained more variability than patient characteristics alone in the primary care visit mode model (pseudo r^2: 9% for clinician and patient characteristics, 4% for patient-only characteristics; for telemedicine mode model, pseudo r^2: 22% for clinician and patient characteristics, 21% for patient-only characteristics) (see **eTable 1**).

Table 2. Multivariable logistic associations with primary care patients with any telemedicine visit and primary care patients with only audio-only telemedicine visits, 2022

	Odds ratios (95% CI)			
	Any telemedicine (ref: in-person visit)		Audio-only visit (ref: video visit)	
Characteristics	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Clinician characteristics (at the patient level)				
Clinician type				
Advanced practice provider (NP, PA)	ref.	ref.	ref.	ref.
Physician	0.96 (0.94, 0.98)	1.00 (0.97, 1.03)	0.61 (0.58, 0.65)	0.82 (0.76, 0.89)
Adult patient panel size				
<1000 patients	ref.	ref.	ref.	ref.
1000-1399 patients	0.93 (0.91, 0.95)	1.05 (1.03, 1.08)	0.68 (0.64, 0.72)	0.82 (0.77, 0.88)
≥1400 patients	0.87 (0.85, 0.88)	0.88 (0.86, 0.90)	0.28 (0.26, 0.30)	0.47 (0.44, 0.50)
% of visits that were telemedicine*				
At or below median	ref.	ref.	ref.	ref.
Above median	4.99 (4.89, 5.10)	4.39 (4.30, 4.49)	0.99 (0.93, 1.05)	1.33 (1.24, 1.42)
% of patients have non-English language preference*				
At or below median	ref.	ref.	ref.	ref.
Above median	1.18 (1.16, 1.20)	0.93 (0.91, 0.95)	1.11 (1.06, 1.16)	1.27 (1.19, 1.35)
% of patients from a racial or ethnic minority group*				
At or below median	ref.	ref.	ref.	ref.
Above median	1.64 (1.61, 1.66)	1.04 (1.01, 1.07)	0.65 (0.62, 0.68)	0.75 (0.70, 0.81)
% of patients 65 or over*				
At or below median	ref.	ref.	ref.	ref.
Above median	0.77 (0.76, 0.78)	1.02 (1.00, 1.04)	1.43 (1.36, 1.50)	1.34 (1.26, 1.42)
Patient characteristics				
Age (years)				
18-29	ref.	ref.	ref.	ref.
30-49	0.97 (0.94, 0.99)	0.99 (0.96, 1.01)	1.22 (1.12, 1.34)	1.27 (1.15, 1.40)
50-64	0.68 (0.67, 0.70)	0.71 (0.69, 0.73)	2.33 (2.14, 2.55)	2.53 (2.29, 2.79)
65-74	0.56 (0.54, 0.57)	0.47 (0.45, 0.50)	3.88 (3.53, 4.25)	3.34 (2.92, 3.81)
≥75	0.64 (0.62, 0.66)	0.54 (0.51, 0.57)	5.43 (4.93, 5.97)	3.70 (3.20, 4.28)
Sex				
Male	ref.	ref.	ref.	ref.
Female	1.70 (1.67, 1.73)	1.46 (1.44, 1.49)	0.82 (0.78, 0.86)	0.85 (0.80, 0.90)
Race or ethnicity				

	Odds ratios (95% CI)			
	Any telemedicine (ref: in-person visit)		Audio-only visit (ref: video visit)	
Characteristics	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
White, non-Hispanic	ref.	ref.	ref.	ref.
Black, non-Hispanic	1.52 (1.49, 1.56)	1.02 (0.98, 1.05)	0.95 (0.89, 1.01)	1.11 (1.00, 1.23)
Asian, non-Hispanic	0.94 (0.89, 0.98)	0.71 (0.68, 0.75)	0.77 (0.67, 0.89)	1.17 (0.99, 1.39)
Hispanic	1.25 (1.22, 1.29)	0.87 (0.85, 0.90)	1.25 (1.17, 1.35)	1.18 (1.06, 1.32)
Another non-Hispanic race	1.22 (1.15, 1.30)	0.87 (0.82, 0.92)	0.68 (0.57, 0.82)	0.96 (0.78, 1.18)
Language preference				
English language preference	ref.	ref.	ref.	ref.
Non-English language preference	0.81 (0.77, 0.85)	0.84 (0.80, 0.89)	4.53 (4.11, 5.00)	1.55 (1.34, 1.80)
Insurance type				
Commercial	ref.	ref.	ref.	ref.
Medicare	0.79 (0.77, 0.80)	1.27 (1.22, 1.32)	4.01 (3.80, 4.23)	1.50 (1.36, 1.65)
Medicaid or other non-commercial	1.24 (1.20, 1.27)	1.17 (1.14, 1.20)	2.05 (1.91, 2.21)	1.65 (1.53, 1.79)
Self-Pay	1.57 (1.49, 1.67)	2.02 (1.90, 2.14)	9.22 (8.22, 10.35)	3.16 (2.70, 3.69)
Charlson Comorbidity Index category				
Minimal	ref.	ref.	ref.	ref.
Mild	1.11 (1.09, 1.13)	1.34 (1.32, 1.37)	1.67 (1.58, 1.76)	1.08 (1.02, 1.16)
Moderate	1.13 (1.09, 1.16)	1.65 (1.59, 1.71)	2.57 (2.38, 2.77)	1.06 (0.96, 1.16)
Severe	1.30 (1.25, 1.35)	2.04 (1.96, 2.14)	3.10 (2.84, 3.38)	1.00 (0.89, 1.11)
Patient portal status				
Active	ref.	ref.	ref.	ref.
Inactive	0.45 (0.44, 0.47)	0.50 (0.48, 0.51)	7.52 (7.08, 7.99)	3.80 (3.53, 4.09)
% of neighborhood adults with a college or professional degree				
≥75%	ref.	ref.	ref.	ref.
50%-74.9%	0.69 (0.66, 0.72)	0.86 (0.82, 0.90)	1.36 (1.16, 1.60)	1.07 (0.90, 1.27)
25%-49.9%	0.60 (0.58, 0.63)	0.89 (0.85, 0.93)	2.45 (2.10, 2.86)	1.25 (1.05, 1.49)
<25%	0.83 (0.79, 0.87)	0.93 (0.87, 0.98)	3.82 (3.24, 4.50)	1.06 (0.87, 1.31)
Neighborhood median income by race or ethnicity				
≥$100,000	ref.	ref.	ref.	ref.
75,000-$99,999	0.78 (0.76, 0.80)	1.00 (0.97, 1.03)	1.62 (1.50, 1.75)	0.92 (0.83, 1.01)
$50,000-$74,999	0.70 (0.69, 0.72)	1.01 (0.97, 1.04)	2.35 (2.18, 2.53)	0.95 (0.85, 1.06)
<$50,000	1.13 (1.10, 1.17)	1.27 (1.21, 1.34)	3.30 (3.05, 3.57)	1.17 (1.00, 1.37)
% of households with broadband internet				
≥90%	ref.	ref.	ref.	ref.
85 to 89.9%	0.80 (0.78, 0.81)	0.96 (0.93, 0.98)	1.94 (1.83, 2.05)	1.15 (1.06, 1.24)
<85%	0.97 (0.95, 0.99)	0.94 (0.91, 0.97)	2.54 (2.40, 2.70)	1.32 (1.20, 1.46)

	Odds ratios (95% CI)			
	Any telemedicine (ref: in-person visit)		Audio-only visit (ref: video visit)	
Characteristics	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
State				
Illinois	ref.	ref.	ref.	ref.
Wisconsin	0.53 (0.52, 0.54)	0.67 (0.66, 0.69)	4.29 (4.08, 4.51)	4.12 (3.84, 4.42)

Abbreviations: NP=nurse practitioner; PA=physician assistant

* The median value for the proportion of telemedicine visits was 0.020. The median values for the proportion of patients with non-English language preference, from a racial or ethnic minority group, and 65 years and older were 0.013, 0.174, and 0.236, respectively.

Discussion

Summary of Findings

In a large regional healthcare system, we found clinician characteristics combined with patient characteristics explained more variability in primary care visit mode and a similar amount of variability in telemedicine mode compared to patient characteristics alone. Our findings suggest that clinician characteristics have a strong influence on overall use of telemedicine in primary care as well as an important effect on the mode that telemedicine care is provided. Notably, we observed 3.5% of primary care visits to be telemedicine visits and 6% of primary care patients to have a telemedicine visit in 2022. These estimates are lower than the 5.5% of claims reported in December 2022 and markedly lower than the 30-50% of visits and 20-42% of patients reported from other healthcare systems or national estimates.[4-7,14]

Like previous studies,[15] we found systematic differences in the clinician characteristics associated with the provision of telemedicine. Specifically, we found that patients with telemedicine visits were more likely to have clinicians with moderate-sized patient panels, more telemedicine visits, and more patients in racial or ethnic minority groups while patients with only in-person visits were more likely to have clinicians with large patient panels and more patients with NELP. While we cannot determine whether clinicians are responding to patient demand for telemedicine or whether patients are seeking clinicians who provide telemedicine in our study, we hypothesize that clinicians with more patients or with patients who need longer visits may not feel like they have the time to manage technological problems that may arise during telemedicine visits, a common clinician concern raised in previous studies.[11,16] Given the contribution of clinician characteristics to explaining variability in primary care visit mode, healthcare systems

interested in increasing telemedicine use may find targeting clinicians for intervention to be more effective than targeting patients alone.

Additionally, 15% of patients using telemedicine in this study had only audio-only visits; this is on the lower end of estimates compared to other healthcare systems.[17,18] Our study extends prior work focusing on patients characteristics associated with telemedicine mode[17,19] to find that there are also significant clinician differences in patient use of video versus audio-only visits. Our multivariable analysis found primary care patients with only audio-only visits were more likely to have advanced practice providers, and clinicians with smaller panels, more patients with NELP, more elderly patients, and fewer patients from racial or ethnic minority groups. The research suggests that the choice of telemedicine modality is a complex interplay among patient, clinician, and healthcare system needs and preferences. Previous studies have found that patients value both telemedicine modes (e.g., audio-only for convenience and privacy, video for more effective communication),[5,20] however, one study found that only one-third of Medicare enrollees were offered audio-only telemedicine visits.[10] Another study found primary care clinicians in the Veterans Health Administration rated audio-only care to be lower quality than video care for new patients and equivalent in quality for established patients; yet they were more than 7 times more likely to provide audio-only visits than video visits, likely because of the ease of providing audio-only visits.[11] Finally, many state and commercial insurers have limited reimbursement for audio-only visits which may influence whether they are made available by clinicians and healthcare systems. [21,22] Our findings highlight the need to ensure that patient preferences are fully incorporated in decisions related to telemedicine mode and suggest that future research may further explore how clinician characteristics contribute to visit and telemedicine mode choices.

Limitations

This study has some limitations. First, we examined only primary care visits from a single midwestern healthcare system and may not be generalizable to other settings and regions of the US. Second, our analysis was limited to electronic health record data so we were unable to assess other clinician characteristics (e.g., clinician age, gender) that have been linked to telemedicine use.[15] Finally, we do not have information on patient preferences for telemedicine and telemedicine mode.

Conclusions

We found clinician characteristics to significantly explain variation in telemedicine use. Primary care visit and telemedicine mode were associated with clinician type, patient panel size, and clinicians' patient characteristics. Healthcare systems interested in increasing telemedicine use develop clinician-focused interventions.

Acknowledgments

Acknowledgements: The authors thank Edmund Fernandez, MD, and Thomas Moen, MBA, BSN, RN for their assistance and feedback on this study.

Funding: This research was funded by a Live Well Intramural Pilot Grant from the Advocate Aurora Research Institute

Conflicts of interest

The authors declared no conflicts of interest.

Abbreviations

aOR: adjusted odds ratio

CI: confidence interval

EHR: electronic health record

NELP: non-English language preference

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Supplementary Files

Multimedia Appendixes

Model fit and variance statistics.
URL: http://asset.jmir.pub/assets/885762e39751c53dda64ef24da175766.doc