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The Impact of Telemedicine Visits on Controlling High Blood Pressure Quality Measure During the Covid-19 Pandemic: Observational Study

Siqin Ye, D. Edmund Anstey, Anne Grauer, Gil Metser, Nathalie Moise, Joseph Schwartz, Ian Kronish, Marwah Abdalla

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Abstract

Background: Telemedicine use vastly expanded during the Covid-19 pandemic, with uncertain impact on cardiovascular care quality.

Objective: We sought to examine the association between telemedicine use and blood pressure (BP) control.

Methods: This is a retrospective cohort study of 32,727 adult patients with hypertension (HTN) seen in primary care and cardiology clinics at an urban, academic medical center from February to December, 2020. The primary outcome was poor BP control, defined as having no BP recorded OR if the last recorded BP was ?140/90 mmHg. Multivariable logistic regression was used to assess the association between telemedicine use during the study period (none, 1 telemedicine visit, 2+ telemedicine visits) and poor BP control, adjusting for demographic and clinical characteristics.

Results: During the study period, no BP was recorded for 486/20,745 (2.3%) patients with in-person visits only, for 1,863/6,878 (27.1%) patients with 1 telemedicine visit, and for 1,277/5,104 (25.0%) patients with 2+ telemedicine visits. After adjustment, telemedicine use was associated with poor BP control (odds ratio [OR], 2.06, 95% confidence interval [CI] 1.94 to 2.18, p<.001 for 1 telemedicine visit, and OR 2.49, 95% CI 2.31 to 2.68, p<.001 for 2+ telemedicine visits; reference, in-person visit only). This effect disappears when analysis was restricted to patients with at least one recorded BP (OR 0.89, 95% CI 0.83 to 0.95, p=.001 for 1 telemedicine visit, and OR 0.91, 95% CI 0.83 to 0.99, p=.03 for 2+ telemedicine visits).

Conclusions: BP is less likely to be recorded during telemedicine visits, but telemedicine use does not negatively impact BP control when BP is recorded. Clinical Trial: NA

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The Impact of Telemedicine Visits on Controlling High Blood Pressure Quality Measure During the Covid-19 Pandemic: Observational Study

Brief Title: Telemedicine and BP Control

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Background: Telemedicine visit use vastly expanded during the Covid-19 pandemic, with uncertain impact on cardiovascular care quality.

Objective: We sought to examine the association between telemedicine visits and failure to meet the Controlling High Blood Pressure (BP) quality measure from the Center for Medicare & Medicaid Services.

Methods: This is a retrospective cohort study of 32,727 adult patients with hypertension (HTN) seen in primary care and cardiology clinics at an urban, academic medical center from February to December, 2020. The primary outcome was failure to meet the Controlling High Blood Pressure quality measure, defined as having no BP recorded OR if the last recorded BP was ≥140/90 mmHg (i.e. “poor BP control”). Multivariable logistic regression was used to assess the association between telemedicine visit use during the study period (none, 1 telemedicine visit, 2+ telemedicine visits) and poor BP control, adjusting for demographic and clinical characteristics.

Results: During the study period, no BP was recorded for 486/20,745 (2.3%) patients with in-person visits only, for 1,863/6,878 (27.1%) patients with 1 telemedicine visit, and for 1,277/5,104 (25.0%) patients with 2+ telemedicine visits. After adjustment, telemedicine use was associated with poor BP control (odds ratio [OR], 2.06, 95% confidence interval [CI] 1.94 to 2.18, p<.001 for 1 telemedicine visit, and OR 2.49, 95% CI 2.31 to 2.68, p<.001 for 2+ telemedicine visits; reference, in-person visit only). This effect disappeared when analysis was restricted to patients with at least one recorded BP (OR 0.89, 95% CI 0.83 to 0.95, p=.001 for 1 telemedicine visit, and OR 0.91, 95% CI 0.83 to 0.99, p=.03 for 2+ telemedicine visits).

Conclusions: Increased telemedicine visit use is associated with poorer performance on the Controlling High Blood Pressure quality measure. However, telemedicine visit use may not negatively impact BP control when BP is recorded.

Keywords: telemedicine, hypertension, blood pressure, quality of care

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Introduction

The Covid-19 pandemic led to rapid expansion of telemedicine as an integral part of outpatient care.[1-7] Telemedicine visits, defined as using video and telephone technology to connect patients to their clinicians as a substitute for in-person office visits, helped maintain continuity of care and preserve patient access to care, and is expected to remain a significant part of the healthcare delivery landscape even after the Covid-19 pandemic ends.[8, 9] However, despite its increased utilization, concern has arisen that the content of care delivered by telemedicine visits may differ from that delivered during in-person visits. In particular, studies have shown that telemedicine visits are less likely to address standard components of care such as blood pressure (BP) assessment, laboratory testing, and medication prescriptions and test orderings.[10, 11]

BP measurement is a fundamental component of hypertension (HTN) management,[12, 13] and there has been increasing concern that increased use of telemedicine visits in primary care and cardiology outpatient settings may impact the accurate assessment of BP and, in turn, how well BP is controlled for patients with HTN.[14] To address this potentially unintended consequence of telemedicine expansion, we performed an electronic health records (EHR) based, retrospective analysis of a diverse population of HTN patients receiving care at a large urban academic medical center across an 11-month period during the Covid-19 pandemic. Using the specification of the Controlling High Blood Pressure quality measure from the Center for Medicare & Medicaid Services that defined poor BP control as having no recorded BP measurements or a last recorded BP ≥140/90 mmHg,[15, 16] we sought to determine the association of telemedicine visit use with the failure to meet this widely-used measure for benchmarking population-level quality of care, hypothesizing that increased use telemedicine visits can lead to poorer performance on this quality measure.

Methods

After approval by the Institutional Review Board, we queried our EHR (Epic Systems,

Verona, Wisconsin, 2020) to identify all completed outpatient visits to primary care and cardiology clinics at Columbia University Irving Medical Center from Feb 1st, 2020 to December 31st, 2020. The Medical Center transitioned to Epic EHR on Feb 1st, 2020, 1 month prior to the start of the COVID-19 pandemic in New York City. For each visit, we extracted information including date of birth, sex, race, ethnicity, primary payer, and International Classification of Disease, 10th Revision (ICD-10) codes associated with the visits. BP data associated with the visits were extracted from Epic flowsheets, and BP measurements were recorded following standard clinical protocols (i.e., by staff or clinicians in the office during in-person visits, and by obtaining self-reported BP values measured at home during telemedicine visits at clinician discretion).

For this analysis, we defined the study population using specifications published by the Center for Medicare & Medicaid Services (CMS) for the 2020 version of the quality measure HTN-2: Controlling High Blood Pressure.[16] Specifically, we included all patients between the ages of 18 and 85 years with a diagnosis of HTN, defined as having the ICD-10 code “E10” associated with any visit during the study period. Patients with end-stage renal disease, history of kidney transplant, or were pregnant during the study period were excluded, using ICD-10 codes for these conditions published by CMS. For the primary outcome, following the above CMS specification, we defined a patient as failing to meet the Controlling High Blood Pressure quality measure if 1) BP was not recorded during any visit included in the study period, or 2) if the last BP recorded during the study period was ≥140/90 mmHg.

For the primary exposure variable of telemedicine visit use, we defined telemedicine visits based on appointment type as visits that were scheduled as using video technology and/or using telephone.[2] Because the distribution of telemedicine visits is right-skewed, we classified patients into three categories: those with in-person visits only, those with 1 telemedicine visit, and those with 2+ telemedicine visits. To adjust for total number of visits (including in-person and telemedicine), we similarly defined categories of patients with 1, 2, and 3+ total number of outpatient visits during the

study period.

We used patient self-reported race and ethnicity to classify patients into the following race/ethnicity categories: non-Hispanic White; non-Hispanic Black; Hispanic; Asian, Hawaiian & Pacific Islander; and Other / Declined / Unknown. Patient insurance was categorized as Commercial, Medicare, or Medicaid, using the primary payer field associated with the last visit during the study period. Using a similar approach as described above for HTN, we identified patients with a diagnosis of atherosclerotic cardiovascular disease (ASCVD) and diabetes mellitus (DM) through visit-associated ICD-10 codes.

Descriptive statistics were calculated for the proportion of visits with BP recorded by the type of visit (in-person, video, or telephone), and for demographic and clinical characteristics according to categories of telemedicine use. Chi-squared test, one-way analysis of variance (ANOVA), and the Kruskal–Wallis test was used for categorical, normally distributed continuous, and non-normally distributed continuous variables, respectively. A multivariable logistic regression model was used to determine if telemedicine use was associated with higher odds of poor BP control, adjusting for age, race/ethnicity, payer, and presence of comorbidities. Because telemedicine visits frequently do not have BP recorded, we applied the same model for the subgroup of patients with at least one recorded BP. As disparities in telemedicine visit use have been previously described for older patients and by race/ethnicity and insurance status,[2, 4, 5] we conducted additional subgroup analyses for patients who are 65 years or older, for non-Hispanic Black patients, for Hispanic patients, and for patients with Medicaid. All analyses were carried out using Stata statistical software, version 16 (StataCorp, College Station, TX).

Results

For the study population, we identified 32,727 patients between the age of 18 to 85 years who had at least one completed outpatient visit to primary care or cardiology clinics at Columbia

University Irving Medical Center between Feb 1st, 2020 to December 31st, 2020, and who had a diagnosis of hypertension but not end stage renal disease, history of kidney transplant, or pregnancy. Of these patients, 20,745 (63.3%) had an in-person visit only, 6,878 (21.0%) had 1 telemedicine visit, and 5,104 (15.6%) had 2+ telemedicine visits. Detailed baseline characteristics are described in **Table 1**. Specifically, patients with more telemedicine visit use were more likely to be female, have Hispanic and non-Hispanic Black race/ethnicity, have Medicaid insurance, were less likely to have ASCVD but more likely to have diabetes mellitus, and had higher total number of visits.

Table 1. Demographic and clinical characteristics of patients with hypertension (HTN) by telemedicine use. ASCVD: atherosclerotic cardiovascular disease. Age, systolic blood pressure (BP) and diastolic BP are shown as mean (standard deviation), and number of visits is shown as median (interquartile range). Other variables are shown as number (column percent).

	All In-Person (n=20,745)	**1 Telemedicine Visit (n=6,878)**	**2+ Telemedicine Visits (n=5,104)**	***p*-value**
Age	66.7 (11.8)	65.7 (11.9)	65.4 (12.1)	.08
Sex				
Male	10,489 (50.6%)	3,325 (48.3%)	1,868 (36.6%)	<.001
Female	10,256 (49.4%)	3,553 (51.7%)	3,236 (63.4%)	
Race				
Non-Hispanic White	7,492 (36.1%)	1,946 (28.3%)	883 (17.3%)	
Hispanic	3,127 (15.1%)	1,810 (26.3%)	2,484 (48.7%)	
Non-Hispanic Black	1,518 (7.3%)	600 (8.7%)	537 (10.5%)	<.001
Asian, Hawaiian & Pacific Islander	485 (2.3%)	140 (2.0%)	90 (1.8%)	
Other / Declined / Unknown	8,123 (39.2%)	2,382 (28.3%)	1,110 (21.8%)	
Primary Insurance				
Commercial	7,169 (34.6%)	2,150 (31.3%)	927 (18.2%)	
Medicare	11,865 (57.2%)	3,826 (55.6%)	2,982 (58.4%)	<.001
Medicaid	1,711 (8.3%)	902 (13.1%)	1,195 (23.4%)	
Comorbidities				
ASCVD	6,375 (30.7%)	1,990 (28.9%)	1,257 (24.6%)	<.001
Diabetes Mellitus	3,439 (16.6%)	1,532 (22.3%)	1,792 (35.1%)	<.001
Total Number of Visits	2 (1-3)	2 (1-4)	4 (3-7)	<.001
Blood Pressure* (in mmHG)				
Systolic	132.4 (16.3)	132.5 (17.0)	134.3 (17.9)	<.001
Diastolic	77.5 (9.7)	77.3 (9.7)	78.0 (10.0)	.004
HTN Control Status				
No BP Measured	486 (2.3%)	1,863 (27.1%)	1,277 (25.0%)	
Last BP <140/90 mm/Hg	13,374 (64.5%)	3,346 (48.7%)	2,384 (46.7%)	<.001
Last BP ≥140/90 mm/Hg	6,885 (33.2%)	1,863 (27.1%)	1,443 (28.3%)	

*****Calculated from patients with at least one recorded BP.

Among a total of 87,309 visits across the study period, 59,409 were in-person, 14,982 were video visits, and 12,918 were telephone visits. BP was recorded for 93% of in-person visits, but only

for 20% of video visits and 9% of telephone visits (**Figure 1**).

In a multivariable model adjusting for demographic and clinical characteristics, telemedicine use was associated with higher odds of not meeting the Controlling High Blood Pressure quality measure (OR 2.06, 95% CI 1.94 to 2.18, p<.001 for 1 telemedicine visit, and OR 2.49, 95% CI 2.31 to 2.68, p<.001 for 2+ telemedicine visits; reference, in-person visit only; **Table 2**). Older age, being Hispanic or Black, having Medicaid insurance, and having diabetes mellitus were also associated with higher odds of not meeting the measure, while having ASCVD and having 2 or 3+ total visits during the study periods were associated with lower odds of not meeting the measure.

Table 2. Multivariable analysis for predictors of failure to meet the Controlling High Blood Pressure (BP) quality measure, including all patients with hypertension (HTN) (*left*) and only those with at least one recorded BP (r*ight*). Failure to meet the measure is defined as having 1) no BP recorded at any visit or 2) last recorded BP ≥ 140/90 mm/Hg. OR: odds ratio; CI: confidence interval.

	All HTN Patients (n=32,727)		**With BP Recorded (n=29,101)**	
	OR (95% CI)	***p*-value**	**OR (95% CI)**	***p*-value**
Age (per 10-year increase)	1.03 (1.00 to 1.05)	.04	1.02 (0.99 to 1.05)	.14
Sex				
Male	Ref	Ref	Ref	Ref
Female	1.03 (0.99 to 1.08)	.18	1.07 (1.02 to 1.13)	.009
Race/Ethnicity				
Non-Hispanic White	Ref	Ref	Ref	Ref
Hispanic	1.45 (1.36 to 1.55)	<.001	1.43 (1.33 to 1.54)	<.001
Non-Hispanic Black	1.58 (1.45 to 1.73)	<.001	1.63 (1.48 to 1.79)	<.001
Asian, Hawaiian & Pacific Islander	0.97 (0.82 to 1.13)	.67	0.96 (0.81 to 1.14)	.65
Other / Declined / Unknown	1.03 (0.97 to 1.09)	.29	1.05 (0.99 to 1.12)	.10
Primary Insurance				
Commercial	Ref	Ref	Ref	Ref
Medicare	0.97 (0.91 to 1.04)	.36	1.00 (0.94 to 1.08)	.94
Medicaid	1.28 (1.18 to 1.38)	<.001	1.28 (1.17 to 1.39)	<.001
Comorbidities				
ASCVD	0.71 (0.68 to 0.75)	<.001	0.72 (0.68 to 0.76)	<.001
Diabetes Mellitus	1.10 (1.04 to 1.16)	.002	1.12 (1.05 to 1.19)	<.001
Total Number of Visits				
1	Ref	Ref	Ref	Ref
2	0.72 (0.69 to 0.77)	<.001	1.09 (1.02 to 1.16)	.01
3+	0.49 (0.46 to 0.52)	<.001	1.11 (1.04 to 1.19)	<.002
Number of Telemedicine Visits				
In-person visit only	Ref	Ref	Ref	Ref
1 telemedicine visit	2.06 (1.94 to 2.18)	<.001	0.89 (0.83 to 0.95)	.001
2+ telemedicine visits	2.49 (2.31 to 2.68)	<.001	0.91 (0.83 to 0.99)	.03

When restricting the analysis to the 29,101 patients (20,259 [69.6%] patients with in-person

visit only, 5015 [17%] with 1 telemedicine visit, and 3,825 [13%]with 2+ telemedicine visits) with a least one BP recorded, telemedicine use was associated with lower odds of not meeting the Controlling High Blood Pressure quality measure (OR 0.89, 95% CI 0.83 to 0.95, p<.001 for 1 telemedicine visit, and OR 0.91, 95% CI 0.83 to 0.99, p=.03 for 2+ telemedicine visits; reference, in-person visit only). In this model, female sex, non-White Hispanic and Black race/ethnicity, Medicaid insurance, and diabetes mellitus were associated with higher odds of not meeting the measure, while ASCVD and having 2 or 3+ total visits during the study periods continued to be associated with lower odds of not meeting the measure (**Table 2**).

Subgroups analyses for patients who are 65 years or older, Hispanic patients, non-Hispanic Black patients, and those with Medicaid insurance are shown in **the Multimedia Appendix**. The impact of telemedicine use on BP control in these subgroups was similar to the main analysis, both in the model that included all HTN patients and when only patients with at least one recorded BP was included.

Discussion

In our analysis of patients with HTN seen in primary care and cardiology clinics at an urban, academic medical center during the Covid-19 pandemic in 2020, we found that increased telemedicine visit use was associated with poorer performance on the Controlling High Blood Pressure quality measure. These findings are largely driven by BP being recorded in less than 20% of telemedicine visits, as compared to 93% of the time for in-person visits. When the analysis was restricted to those patients with at least one recorded BP, patients with higher telemedicine visit use had better or similar likelihood of attaining performance on the Controlling High Blood Pressure quality measure. These findings were also robust for the subgroups of patients previously described to have more difficulty using telemedicine services, including patients with age ≥ 65 years old, Black or Hispanic patients, and those with Medicaid insurance.[2, 4, 5, 17, 18]

Our finding that primary care and cardiology telemedicine visits are less likely to have

recorded BP values when compared to in-person visits is consistent with prior literature. A recent report from a large US database containing 125.8 million primary care visits from 2018 to 2020 demonstrated that BP is recorded in less than 10% of telemedicine visits, as compared to approximately 70% of in-person visits.[10] In our analysis, we additionally found that the disparate rate of BP being recorded at telemedicine vs in-person visits led to patients who utilized telemedicine visits being more likely to not meet the Controlling High Blood Pressure quality measure. These findings highlight potential unintended consequence of rapid adoption of telemedicine visits, and also have direct implications for various quality payment programs such as Medicare Accountable Care Organizations that uses BP control as a key quality benchmark.[16] More broadly, our findings highlight the importance of continued assessment of the content and quality of care delivered via telemedicine service,[10, 11] especially as telemedicine visits are expected to remain an integral part of the healthcare delivery landscape after the Covid-19 pandemic ends.

Nonetheless, it is reassuring that telemedicine visit use did not negatively impact the Controlling High Blood Pressure quality measure when the analysis was restricted to patients with at least one recorded BP. This suggest that while BP is less likely to be recorded during telemedicine visits, in general the quality of BP management in primary care and cardiology settings may be similar regardless of telemedicine visit use. It is also reassuring that we observed similar results even in populations known to have decreased telemedicine use and poorer BP control, such as the elderly, Black or Hispanic patients, or patients with Medicaid.[2, 4, 5, 19] However, we cannot fully exclude residual confounding, such as patients who utilize more telemedicine services also being more likely to maintain continuity of care and other health behaviors during the Covid-19 pandemic[6, 7, 20]. Future studies would need to more rigorously evaluate how telemedicine use can impact BP management, as well as best approaches to incorporate BP management strategies including BP telemonitoring into routine clinical practice during the telemedicine era.[21, 22] Examples of these might include randomized clinical trials of interventions to improve accurate home BP assessment by

patients in advance of telemedicine and office-visits,[23] as well as approaches to integrate telemedicine visits as part of novel BP telemonitoring and medication titration programs.[24, 25]

There are several additional limitations to our study. As a retrospective cohort study using EHR data, our study is necessarily hypothesis generating, and additional confounding factors, including those outside of EHR data capture, cannot be excluded. Because we did not assess the quality of BP medications and potential clinical inertia, we have limited insight in how telemedicine use can affect clinical management practices for HTN. Furthermore, BP recordings used for this analysis reflect actual clinical practice, and we could not assess the quality of BP measurements done at home that was then recorded during telemedicine visits, although home BP measurement has been shown to be potentially more reliable than office visit BP.[23, 26] The Controlling High Blood Pressure quality measure may also not accurately reflect patient's true BP control status at a given point in time. Finally, because there were dramatic care disruptions during the Covid-19 pandemic, our findings may not be generalizable for when the Covid-19 pandemic ends, and longitudinal research is needed to assess the continued impact of telemedicine visits on cardiovascular care delivery.

Despite these limitations, our study is among the first to describe the real-world impact of telemedicine visits on BP control for a diverse population of patients accessing ambulatory care. We found that while higher use of telemedicine visits was associated with poorer performance on the Controlling High Blood Pressure quality measure, this was mainly driven by BP being much less likely to be recorded during telemedicine visits. When BP was recorded, telemedicine use was found to be associated with similar or slightly improved BP control. These results provide timely insights into the impact of telemedicine on cardiovascular care quality, with important implications for research, implementation, and policy making in the telemedicine era.

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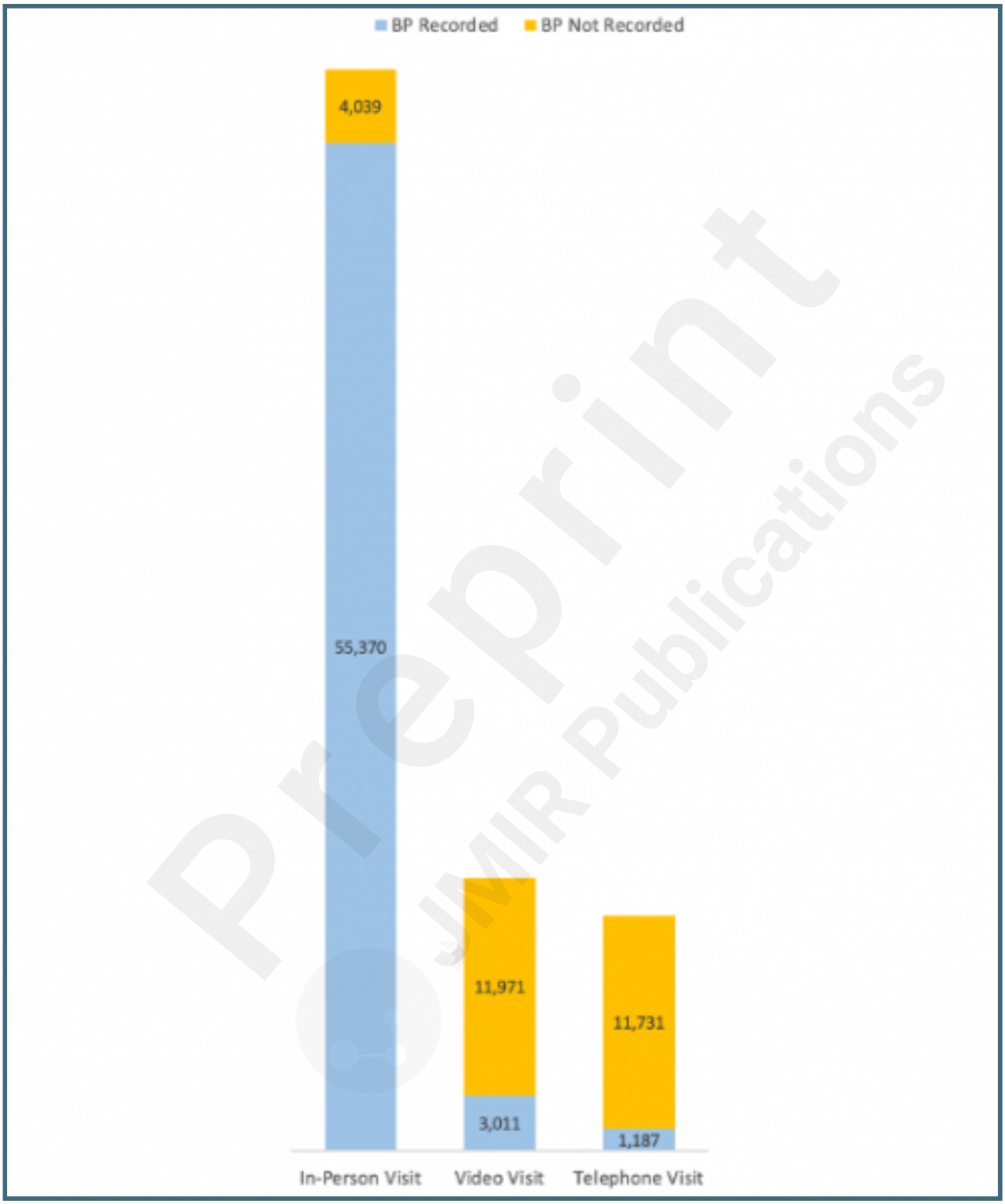
Number of visits by modality (in-person, video visit, or telephone visit). For each modality, whether BP was or was not recorded during the visit is also indicated.



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Multimedia Appendixes

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