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Disruptions in Rheumatology Care and the Rise of Telehealth in Response to the COVID-19 Pandemic in a Community Practice–Based Network

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Objective. The effect of the COVID-19 pandemic on community-based rheumatology care and the use of telehealth is unclear. We undertook this study to investigate the impact of the pandemic on rheumatology care delivery in a large community practice–based network.

Methods. Using a community practice–based rheumatologist network, we examined trends in in-person versus telehealth visits versus canceled visits in 3 time periods: pre–COVID-19, COVID-19 transition (6 weeks beginning March 23, 2020), and post–COVID-19 transition (May-August). In the transition period, we compared patients who received in-person care versus telehealth visits versus those who cancelled all visits. We used multivariable logistic regression to identify factors associated with canceled or telehealth visits.

Results. Pre–COVID-19, there were 7,075 visits/week among 60,002 unique rheumatology patients cared for by ~300 providers practicing in 92 offices. This number decreased substantially (24.6% reduction) during the COVID-19 transition period for in-person visits but rebounded to pre–COVID-19 levels during the post–COVID-19 transition. There were almost no telehealth visits pre–COVID-19, but telehealth increased substantially during the COVID-19 transition (41.4% of all follow-up visits) and slightly decreased during the post–COVID-19 transition (27.7% of visits). Older age, female sex, Black or Hispanic race/ethnicity, lower socioeconomic status, and rural residence were associated with a greater likelihood of canceling visits. Most factors were also associated with a lower likelihood of having telehealth versus in-office visits. Patients living further from the rheumatologists' office were more likely to use telehealth.

Conclusion. COVID-19 led to large disruptions in rheumatology care; these disruptions were only partially offset by increases in telehealth use and disproportionately affected racial/ethnic minorities and patients with lower socioeconomic status. During the COVID-19 era, telehealth continues to be an important part of rheumatology practice, but disparities in access to care exist for some vulnerable groups.

INTRODUCTION

Telehealth use in rheumatology prior to the COVID-19 pandemic was primarily limited to treating patients in rural areas that were medically underserved (1,2). The COVID-19 pandemic, however, has led to substantial health care disruptions and a rapid rise in telehealth use among patients with rheumatic and musculoskeletal diseases (RMDs) (3–6). Many of these patients are at increased risk of infection and may be at increased risk of severe COVID-19 due to immune dysregulation from their rheumatic

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SIGNIFICANCE & INNOVATIONS

- The COVID-19 pandemic has had major impacts on rheumatology care delivery, but most reports have described the experience of single centers or small regional practice networks.
- Within a large, multistate, community rheumatology practice network, follow-up visit cancellations were as high as 60% at the height of the COVID-19 pandemic and were more common in patients who were older, Black, Hispanic, of lower socioeconomic status, and residing in rural areas.
- Telehealth grew from almost no use to >40% of follow-up visits at the height of the COVID-19 pandemic, but older age, lower socioeconomic status, and rural residence were associated with lower use of telehealth.
- Telehealth has partially offset disruptions in care sparked by the pandemic, but lower telehealth use in vulnerable populations threatens to exacerbate existing disparities in rheumatology care.

condition, immunosuppressive medications, or multiple comorbid health conditions (i.e., multimorbidity) (7–9). Concerns about COVID-19 may further exacerbate health care disruptions in this population, yet these patients also require frequent health care visits for the evaluation and management of their conditions. Telehealth, defined as the use of electronic information and telecommunications technologies to support long-distance clinical health care (10), offers an attractive alternative to face-to-face visits for at least a subset of patients, especially for those with an already-established diagnosis from their rheumatology provider.

Little is known, however, about the patterns of health care disruptions and telehealth use in rheumatology practices during the pandemic, or the degree to which vulnerable patient populations have been disproportionately affected. We sought to understand the impact of the pandemic on rheumatology care in the setting of a large rheumatology community practice–based network. We described use of telehealth services within this provider network and tested the hypothesis that social determinants of health, including age, sex, race/ethnicity, socioeconomic status, and geographic location would influence missed rheumatology visits or infusion therapies given at rheumatology offices. We also evaluated whether these same social determinants of health (11–14) were associated with use of telehealth services.

MATERIALS AND METHODS

Definitions of telehealth services. We extracted the analytic cohort from the Columbus electronic health record (EHR) data warehouse of the American Arthritis and Rheumatology Associates (AARA) network, which represents ~300 full-time practicing rheumatology clinicians across 27 states. AARA and its business affiliate, Bendcare, is the largest US super group of rheumatology specialist providers in the US and was founded to promote high-quality, value-based rheumatology care within the context of a community practice-based network. Its providers use a common EHR system with an embedded video-based telehealth platform. Structured and selected unstructured data elements are normalized to a common data model, and the EHR data are augmented by a variety of internal and external data feeds, including patient-reported outcome data from the National Institutes of Health Patient-Reported Outcomes Measurement Information System (15) and linked laboratory, pharmacy, and health plan claims data from several sources. This infrastructure supports both prospective and retrospective clinical projects, quality improvement initiatives, and research studies.

Telehealth services were defined based on billed visits from the Evaluation and Management Current Procedure Terminology (CPT) code set (e.g., 99214) that included the modifiers -95, -GT, and -GQ, reflecting use of synchronous or asynchronous telecommunication services. The CPT codes for phone visits (i.e., 99441-3), and digital evaluation and management services (99421-3), and virtual visits (G2010, G2012) were also included. In-person visits were additionally identified using similar CPT codes without the telehealth modifiers, and visits were stratified as to whether they were for consultations/new patient encounters versus return patient visits for established patients.

Longitudinal trends in telehealth and traditional rheumatology services. We examined calendar trends in the frequency of in-person versus telehealth (video and/or phone) visits in 2020 over all AARA practices. The key intervals of time were subdivided a priori into the pre–COVID-19 time interval (i.e., the first full 10 weeks of 2020), the COVID-19 transition period (i.e., week 12 of 2020, beginning the week of March 23, and the ensuing 6 weeks), and the post–COVID-19 transition interval (i.e., beginning the week of May 4). The transition interval was anchored at week 12, given multiple news and public health authority announcements that recommended social distancing and encouraged restriction of discretionary travel (16). The data were censored at September 1 to allow for complete adjudication of billed visits and health care services. Scheduling data from the EHR were used to examine whether visits were canceled or missed (i.e., no show), or kept, stratified by visit type. Canceled/missed visits that were rescheduled within the same time period (i.e., COVID-19 transition period) were considered kept. We included in this evaluation administration for intravenous (IV) rheumatology therapies typically given in a provider's office, focusing on treatments for rheumatoid arthritis (RA) that included IV abatacept, IV tocilizumab, IV golimumab, and infliximab.

Social determinants of health and other factors potentially associated with telehealth services. In addition to age, sex, and race/ethnicity, we evaluated a number of additional social determinants of health. Factors of interest included the national percentile ranking of the Area Deprivation Index (ADI) (17). The ADI is based on the American Community Survey (18) and ranks neighborhoods by socioeconomic status disadvantage within either the entire US (used for this analysis), or at a state level. It encompasses domains of income, education, employment, and housing quality and is based on census block group, obtained by use of patients' individual 9-digit zip code. We also evaluated the door-to-door driving distance between each patient's residence and their rheumatologist's office address, computed based on estimates from Google Maps. Rural/urban status was classified according to the categorization developed by the Centers for Disease Control and Prevention National Center for Health Statistics (19), with rural status being assigned as noncore areas. Finally, given the possibility that patients' willingness to receive in-person care would be influenced by local COVID-19 activity, we evaluated the tertile of COVID-19 cases per capita in each patient's county of residence (relative to all other US counties) on May 1 (near the end of the COVID-19 transition period) obtained from USAFACTS.org (20).

COVID-19 as a potential disruptor of clinical management of RA, and the availability of telehealth as a moderating influence. Among the subset of patients with RA who had disease activity measured using the Clinical Disease Activity Index (CDAI) available both in the pre–COVID-19 period and in the post–COVID-19 transition period at in-person visits, we examined the within-person change in CDAI score to assess whether patients experienced disease activity worsening in the COVID-19 transition period. While some practices did collect CDAI scores during telehealth visits, the methods by which these data were collected were highly variable across practices, and these CDAI observations were therefore excluded.

Additionally, to evaluate the hypothesis that COVID-19 reduced clinician and patients' willingness to start a new targeted RA therapy, we examined the likelihood that patients would start a new biologic or JAK inhibitor treatment in the COVID-19 transition period. The analysis was restricted to rheumatology practices that contributed data both in 2019 and 2020, and we compared the likelihood of treatment initiation during that 6-week interval to the corresponding 6-week interval in spring 2019.

Statistical analysis. Given the expectation that the COVID-19 transition period would create the greatest disruption in rheumatology care, we focused on that 6-week interval. Because we observed that telehealth services were minimally deployed for new patients, we compared the characteristics of established rheumatology patients who received in-person care, who received telehealth care, or who canceled any/all scheduled rheumatology visits with their clinician. Categories were mutually exclusive and applied in a hierarchical fashion such that someone who (for example) had a visit canceled but rescheduled it and received both in-person and telehealth care during the 6 weeks period would be counted only in the in-person care category. We compared demographics, main rheumatology diagnosis, and measures of social determinants of health, as described above. Standardized mean differences were used to compare these 3 groups, with values >0.10 indicative of potentially important differences (21).

We used multivariable logistic regression models to identify factors associated with canceled versus any completed visits (i.e.,

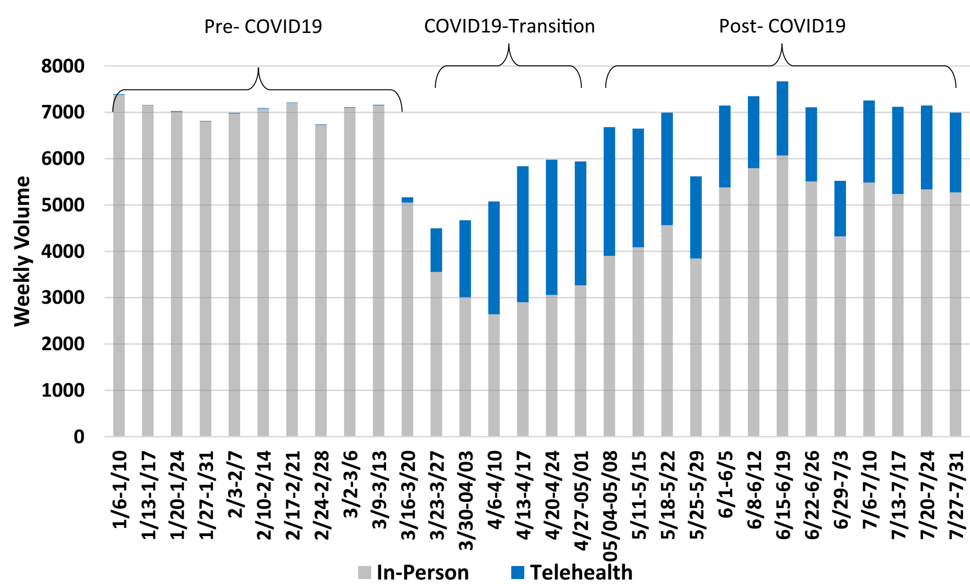

Figure 1. Weekly volume of follow-up clinician visits in the pre–COVID-19, COVID-19 transition, and post–COVID-19 periods. Visits include all evaluation and management clinician visit types other than new patient encounters and consultations. The decrease shown in the final week of May and the first week of July reflect the influence of national US holidays. The national state of emergency was declared on March 13, 2020; that week (full week 11 in 2020) was not included in either the pre–COVID-19 or the COVID-19 transition period, given the state of flux during that week. Color figure can be viewed in the online issue, which is available at http://onlinelibrary.wiley.com/doi/10.1002/acr.24626/abstract.

telehealth or in-person visits). In separate models we compared those who underwent a telehealth versus an in-person visit during the COVID-19 transition period. The main independent variables of interest were the social determinants of health described above. Because some factors related to geography were modestly correlated with one another, not all could be examined in multivariable models; factors of highest interest were retained. Given the clustered nature of the data (patients nested within physician practices), alternating logistic regression was used to adjust for and estimate the effects of practice-level effects. The proportion of all visits conducted as a telehealth visit, rather than an in-person visit, was quantified for each physician practice. To evaluate the hypothesis that greater telehealth volume might somewhat offset reduced total visit volume during the COVID-19 transition period, we plotted the proportion of visits conducted as telehealth, ranging from 0%, reflecting no use of telehealth, to 100%, indicating that all visits during this interval were conducted using telehealth. This proportion was plotted as a function of the mean weekly visit volume during the COVID-19 transition period compared to the pre–COVID-19 period and plotted as a ratio. A ratio close to 1 would indicate that for any given office, visit volume during the COVID-19 transition period was the same as during the pre–COVID-19 interval.

The within-person changes in CDAI scores in the pre–COVID-19 and post–COVID-19 transition periods were evaluated with paired t-tests. Logistic regression was used to model the likelihood of treatment initiation in the COVID-19 transition period versus the corresponding interval in 2019, controlling for practice-level clustering as described above. The study received institutional review board approval and patient consent was waived. All data analyses were conducted in SAS 9.4 and R 4.0.3.

RESULTS

A total of 126,550 patients contributed 303,037 unique visit days in which 1 or more encounters occurred in 2020. In the first 10 full weeks of 2020 (pre-COVID), the mean ± SD number of weekly visits across all visit types (e.g., in person, laboratory testing appointments, infusions) in the provider network was 10,806 ± 280, occurring among 73,976 unique rheumatology patients. Restricting to only follow-up visits with clinicians, the mean ± SD weekly visit volume was 7,075 ± 184 visits in the pre–COVID-19 interval,

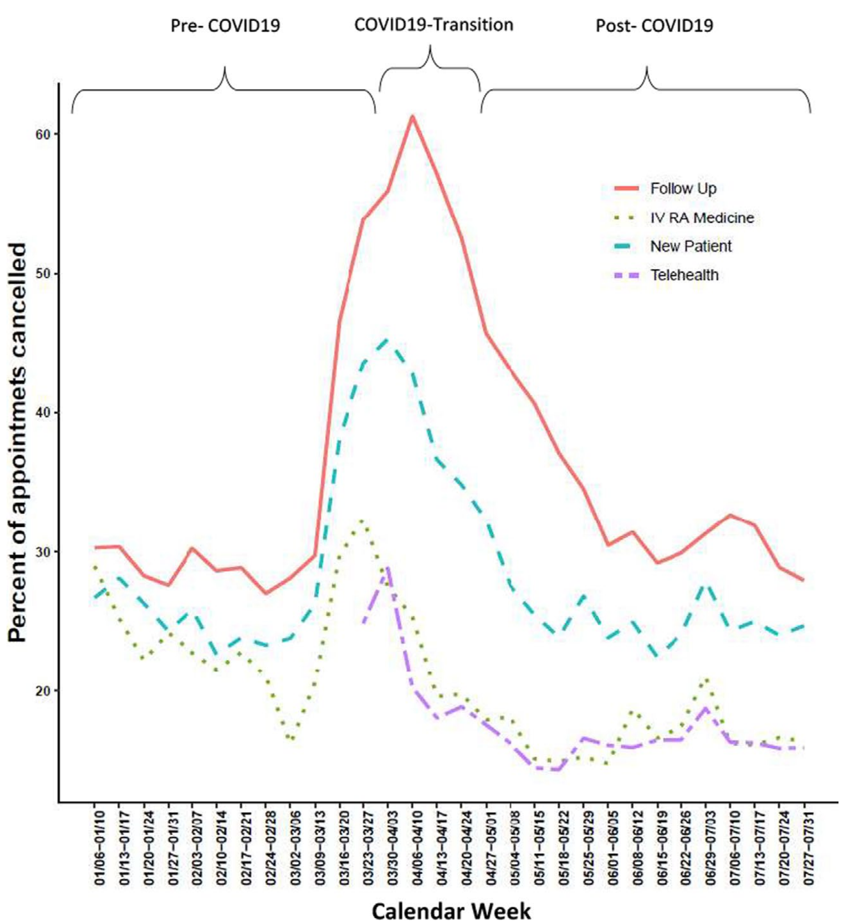

Figure 2. Canceled appointments for new patient visits, follow-up visits, telehealth, and intravenous infusions for rheumatoid arthritis (RA) treatments during 2020. IV = intravenous.

contributed by 60,002 unique patients (Figure 1). Overall follow-up visit volume decreased by 24.6% in the COVID-19 transition period but rebounded within a few months to pre–COVID-19 levels. Telehealth visits pre–COVID-19 were nearly nonexistent and increased to 41.4% and 27.7%, respectively, of all follow-up clinician visits in the COVID-19 transition period and post–COVID-19 period (Figure 1, blue bars). The vast majority of telehealth visits were video-based (91%); the remainder were phone (7%) or digital visits (2%).

Among all follow-up visits and depending on the calendar week, up to 60% of visits were canceled (Figure 2, red line), higher than for new patients and for IV RA medications. In the COVID-19 transition and post–COVID-19 transition periods, telehealth visits (purple broken line) were less likely to be canceled than in-person follow-up (solid red line) or new patient visits (blue broken line).

Table 1 shows characteristics of the 50,988 established rheumatology patients who canceled, had in-person visits, or had telehealth visits during the COVID-19 transition interval. Older patients were more likely to cancel visits and less likely to have telehealth-only care. Non-White race, lower socioeconomic status proxied by the ADI, US region, and greater COVID-19 activity in the patient's county of residence were associated with canceling and having in-person visits rather than telehealth care alone.

Table 1. Characteristics of rheumatology patients with canceled, in-person, and telehealth return visits during the 6-week COVID-19 transition period (n = 50,988 visits)*

Characteristic	Canceled	In-Person†	Telehealth	SMD
Visits, no.	22,237	16,510	12,241	–
Age, mean ± SD years	62.1 ± 15.3	58.8 ± 15.4	57.2 ± 14.9	0.21
Age <65, no. (%)	12,661 (59)	9,960 ± 60.4	8,389 ± 64.4	0.07
Age ≥65, no. (%)	8,803 (41)	6,540 ± 39.6	4,635 ± 35.6	–
Sex				0.07
Female	15,178 (78.4)	12,464 (75.5)	9,757 (79.7)	–
Race‡				0.23
White	14,290 (64.3)	12,612 (76.4)	9,070 (74.1)	–
Black	2,050 (9.2)	1,728 (10.5)	1,192 (9.7)	–
Hispanic	2,539 (13.1)	1,968 (11.9)	1,649 (13.5)	0.05
Area Deprivation Index, national rank				0.10
Quintile 1 (most affluent)	2,473 (12.7)	1,982 (12.0)	1,884 (15.4)	–
Quintile 2	5,370 (27.7)	4,437 (26.9)	3,628 (29.6)	–
Quintile 3	4,842 (25.0)	4,224 (25.6)	3,053 (24.9)	–
Quintile 4	3,946 (20.3)	3,528 (21.4)	2,208 (18.0)	–
Quintile 5 (least affluent)	2,766 (14.3)	2,338 (14.2)	1,468 (12.0)	–
Driving distance, mean ± SD kilometers	25.1 ± 41.6	26.2 ± 50.8	29.3 ± 75.8	0.05
Rural residence	1,612 (8.3)	1,331 (8.1)	676 (5.5)	0.09
Primary rheumatology diagnosis				–
RA	5,765 (29.7)	5,281 (32.0)	4,165 (34.0)	0.06
Osteoarthritis	2,908 (15.0)	2,157 (13.1)	1,493 (12.2)	0.05
PsA/AS/SpA	1,734 (8.9)	1,784 (10.8)	1,584 (12.9)	0.09
Osteoporosis	1,324 (6.8)	888 (5.4)	561 (4.6)	0.06
Systemic lupus erythematosus	1,144 (5.9)	1,196 (7.2)	1,151 (9.4)	0.09
Gout	555 (2.9)	442 (2.7)	240 (2.0)	0.04
Region				0.36
South Atlantic	11,685 (60.2)	8,515 (51.6)	6,934 (56.6)	–
West South Central	2,024 (10.4)	2,144 (13.0)	1,472 (12.0)	–
East North Central	1,648 (8.5)	1,393 (8.4)	1,309 (10.7)	–
Pacific	1,613 (8.3)	1,152 (7.0)	1,323 (10.8)	–
Mountain	1,000 (5.2)	2,048 (12.4)	446 (3.6)	–
East South Central	696 (3.6)	708 (4.3)	151 (1.2)	–
Mid-Atlantic	514 (2.6)	255 (1.5)	427 (3.5)	–
West North Central	82 (0.4)	268 (1.6)	30 (0.2)	–
New England	20 (0.1)	9 (0.1)	134 (1.1)	–
Not available	115 (0.6)	17 (0.1)	15 (0.1)	–
Cases of COVID-19 per capita§				0.18
Lowest tertile	5,625 (29.0)	5,196 (31.5)	3,062 (25.0)	–
Middle tertile	6,601 (34.0)	6,866 (41.6)	4,912 (40.1)	–
Highest tertile	6,964 (35.9)	4,319 (26.2)	4,107 (33.6)	–

* Values are the number (%) unless indicated otherwise. AS = ankylosing spondylitis; PsA = psoriatic arthritis; RA = rheumatoid arthritis; SMD = standardized mean difference (differences >0.10 are considered potentially clinically relevant); SpA = spondyloarthritis.
† May also include telehealth visits.
‡ Other category not shown, includes Asian, Native American, and missing race.
§ County-level data linked to the patient through 5-digit zip code; as of May 1, 2020.

Table 2. Factors associated with canceling visits and use of telehealth (versus in-person visits) during the 6-week COVID-19 transition period*

Factor	Canceled all visits versus having in-person or telehealth care (n = 50,988 visits)	Telehealth versus in-person care (n = 28,785 visits)
Age, 5-year interval	1.09 (1.09–1.10)†	0.97 (0.96–0.98)†
Male	0.91 (0.87–0.96)†	0.79 (0.74–0.83)†
Black (versus White)	1.17 (1.10–1.24)†	0.98 (0.90–1.06)
Hispanic ethnicity	1.16 (1.10–1.23)†	1.18 (1.10–1.28)†
Area Deprivation Index (reference to quintile 1, most affluent)		
Quintile 2	1.08 (1.01–1.14)†	0.83 (0.77–0.90)†
Quintile 3	1.09 (1.02–1.16)†	0.74 (0.68–0.80)†
Quintile 4	1.10 (1.03–1.18)†	0.65 (0.60–0.70)†
Quintile 5 (least affluent)	1.12 (1.04–1.20)†	0.66 (0.60–0.72)†
Driving distance from patient's residence to rheumatologist office, per 30-km increment	0.96 (0.93–0.98)†	1.03 (1.01–1.06)†
Rural	1.27 (1.19–1.37)†	0.78 (0.70–0.80)†
Primary diagnosis (reference to RA)‡		
PsA/AS/SpA	0.99 (0.92–1.06)	1.03 (0.89–1.20)
Systemic lupus erythematosus	0.96 (0.89–1.04)	1.03 (0.89–1.19)
Gout	1.39 (1.23–1.57)†	0.88 (0.72–1.07)
Osteoarthritis	1.18 (1.11–1.26)†	0.94 (0.82–1.08)
Osteoporosis	1.32 (1.21–1.43)†	0.83 (0.69–1.08)

* Values are the odds ratio (95% confidence interval). AS = ankylosing spondylitis; PsA = psoriatic arthritis; RA = rheumatoid arthritis; SpA = spondyloarthritis.
† Statistically significant.
‡ County-level data linked to the patient through 5-digit zip code.

After multivariable adjustment, the factors independently associated with canceling all return visits in the COVID-19 transition period (Table 2, left column) included older age, female sex, Black race, Hispanic ethnicity, lower socioeconomic status, and rural residence. Compared to patients with RA, patients with gout, osteoarthritis, and osteoporosis were more likely to cancel all visits and not reschedule them. Most but not all these same factors were associated with lesser use of telehealth compared to having an in-person visit (Table 2, right column, Figure 3). Factors associated with a lower likelihood to have a telehealth visit included older age, male sex, lower socioeconomic status, and rural residence. Greater driving distance from the rheumatologists' office was associated with a greater likelihood to have a telehealth visit.

The proportion of all visits delivered via telehealth was highly variable across different rheumatology practices (Figure 4). In some offices, telehealth comprised almost 100% of visits during the COVID-19 transition period (i.e., the highest points on the

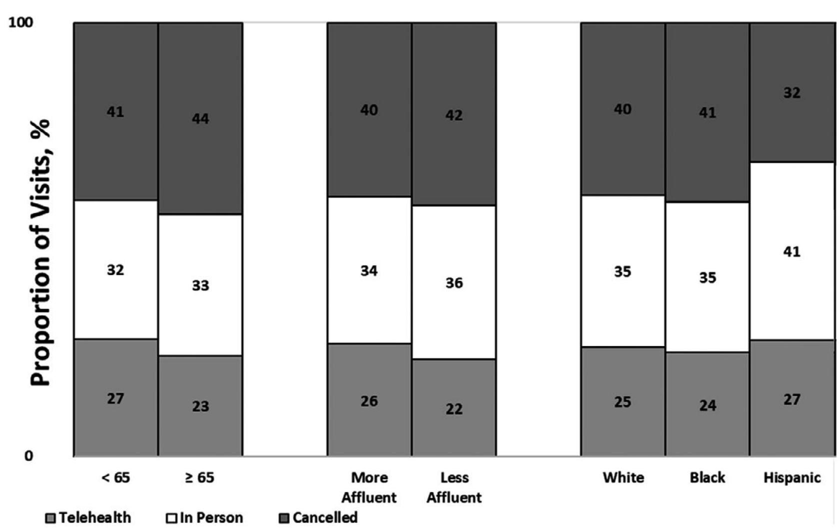

Figure 3. Proportion of telehealth, in-person, and canceled visits by age, Area Deprivation Index score, and race/ethnicity. More affluence is represented by an Area Deprivation Index score ≤80 (i.e., upper 4 quartiles); less affluence is represented by an Area Deprivation Index score >80 (i.e., lowest quartile).

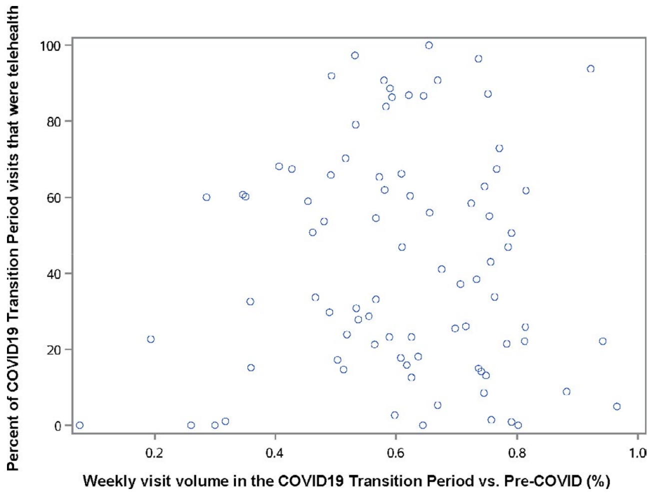

Figure 4. Practice-level variability in the proportion of visits conducted as telehealth visits (rather than in-person follow-up visits) in the COVID-19 transition period (y axis), plotted against the ratio of visit volume in the COVID-19 transition period divided by the pre–COVID-19 period (x axis) (n = 12,241). Every data point represents a unique American Arthritis and Rheumatology Associates rheumatology office (n = 89 offices). Three offices with ratios >1 were omitted for visual consistency. Color figure can be viewed in the online issue, which is available at http://onlinelibrary.wiley.com/doi/10.1002/acr.24626/abstract.

y axis), whereas at other offices, there was no telehealth use. There was no association between the use of telehealth and the reduction in visit volume in the COVID-19 transition period compared to pre–COVID-19 levels (Figure 4, x axis). Likewise, there was no association between use of telehealth and practice size (not shown). After multivariable adjustment for demographics, social determinants of health, and primary rheumatologic diagnosis, patients receiving care at offices with greater telehealth use were 4.32-fold more likely to receive telehealth than at offices with lesser use of telehealth services (see Supplementary Table 1, available on the *Arthritis Care & Research* website at http://onlinelibrary.wiley.com/doi/10.1002/acr.24626/abstract). This practice-level effect was larger in magnitude than all other demographic and social determinants of health-related factors that we studied, although most of these remained significant. Practice site likewise was associated with a greater likelihood that patients canceled visits (adjusted odds ratio [OR] 1.54 [95% confidence interval (95% CI) 1.18–2.02]).

Among people who had both a CDAI score in the pre–COVID-19 and post–COVID-19 transition period (n = 2,741, baseline mean CDAI score = 13.8), the mean within-person change in the CDAI score was <1 unit, reflecting no meaningful change. Related to medication initiation in the COVID-19 transition period, and after controlling for practice-level clustering, the odds of starting a new biologic or JAK inhibitor therapy for an RA patient was substantially lower (adjusted OR 0.55 [95% CI 0.50–0.61]) compared to the corresponding 6-week period of time in 2019.

DISCUSSION

In this analysis of telehealth use in a large, multistate, US community practice–based rheumatology network, we found that telehealth care was essentially nonexistent in the pre–COVID-19 era, grew rapidly to comprise almost half of all follow-up clinic visits as the COVID-19 pandemic evolved, and later stabilized to comprise approximately one-fourth of all follow-up visits. Telehealth appeared to be a substitute for in-person visits, and one of the drivers of more visit cancellations was lower use of telehealth. Of major concern, several important social determinants of health (older age, lower socioeconomic status, and rural residence) were associated with a lower likelihood of having telehealth visits and a greater likelihood of canceling all visits. Further driving distance from the rheumatology office was associated with greater telehealth use, presumably related to the convenience of telehealth for patients with longer driving distances. In this context, the reduced use of telehealth among patients from rural areas is particularly striking and highlights the complex social and socioeconomic factors contributing to inequities among patients in rural areas.

We also identified other factors associated with telehealth use. Patients with certain autoimmune rheumatic diseases (e.g., RA, psoriatic arthritis, systemic lupus erythematosus) were less likely to cancel visits during the COVID-19 transition period compared to patients with gout, osteoarthritis, and osteoporosis, perhaps reflecting the need for close follow-up or medication monitoring among patients with autoimmune conditions. Individual office practice in delivering telehealth also had a large effect on whether patients received these services, suggesting that some rheumatology practices were able to convert and adapt their practices to deliver care via telehealth, while others made minimal use of it. While reasons for this high practice-level variability are unclear, the ratio of office staff to patients, access to telehealth technology within each provider's office and comfort with its use, and the case mix of individual physician practices may all be influential.

Prior to COVID-19, the use of telehealth in rheumatology received limited attention and use was largely confined to highly selected settings such as the Alaska Tribal Health system (1). Since the pandemic began, however, the use of telehealth has emerged as a tool to help mitigate disruptions in health care, with a variety of applications across health care (3,22,23). Several reports have described the impact of the COVID-19 pandemic on patient behaviors and health care delivery. For example, surveys of patients with autoimmune RMDs have shown that approximately 10–15% stopped their rheumatology treatments during the pandemic, usually without the recommendation or knowledge of their rheumatology provider (4,24). At the height of the COVID-19 transition period, the proportion of patients skipping office visits and/or required laboratory monitoring tests was as high as 50% (24). Patients with noninflammatory

RMDs have also been affected by the pandemic, and appear to have similar levels of concern regarding COVID-19 as those with inflammatory and autoimmune RMDs (4). While telehealth has been an important tool in reducing health care disruptions during the pandemic, as shown in our study, it also is likely to serve an important purpose in health care delivery in the future.

How to best deliver telehealth care in outpatient rheumatology practices moving forward remains unclear. Several important features may facilitate best practices. Telehealth care pathways can be used to identify the most appropriate patients to receive telehealth instead of in-office care, identifying which diagnoses and visit reasons are most suitable for telehealth care, which patients are most comfortable and satisfied with telehealth, and screening for access to technology needed to deliver telehealth (25). New provider and patient education may be needed, teaching how to conduct a rheumatology examination over a live video feed and how to best instruct and assist patients in conducting their own standardized self-examination (e.g., a patient joint count for those with RA) (26). Collecting disease-specific and disease-agnostic electronic patient-reported outcomes using a digital platform via a smartphone app and/or passive monitoring (e.g., health tracker device such as a Fitbit or Apple watch) may also be useful complements to delivering high-quality remote patient care (12,27).

The results of this study highlight the importance of ensuring that telehealth does not exacerbate existing disparities in health care access. Recognizing that social determinants of health are associated with visit cancellations, practices should have processes to identify and contact patients with missed or canceled visits. Interventions to improve access to and/or assistance in using telehealth technology is particularly important for vulnerable populations. Additionally, incorporating patient preferences for telehealth versus office visits and providing alternatives for patients who are uncomfortable with standard telehealth visits will be important. Identifying barriers to effective telehealth use and strategies to overcome these barriers is a significant area of need.

Results from this analysis must be contextualized considering its setting. This study reflects the experience of rheumatology providers in this high-volume, community practice–based network of ~300 community rheumatology providers distributed among 92 offices. While diverse, these clinicians' practice characteristics and patterns may not generalize to other community settings, nor to academic medical centers, although our findings appear similar to early reports from smaller rheumatology provider networks (28). Measures of social determinants of health were inferred based on patients' residence using their 9-digit zip code, which maps to census block group. This approach is commonly used in health services research, because this information is often not available directly from patients. The potential biases inherent to collecting socioeconomic status data from individual patients, including the expected nonresponse bias, likely offsets this limitation.

Finally, as a nuance of the single-vendor EHR system used by these clinicians, the scheduling system allows a visit to be rescheduled by changing the date, but this change will not be recognized as a canceled visit. Thus, the actual cancellation rates may be higher than shown in Figure 2, although efforts are underway to remedy this limitation in the future. Finally, we note that telehealth services may be associated with greater (or worse) satisfaction according to patients and providers (11) and may or may not achieve comparable outcomes as in-person visits (29). These topics were out of scope for this analysis but will be fruitful as future directions.

In conclusion, we observed large disruptions in care during the COVID-19 pandemic, partially offset by telehealth use, with evidence that telehealth continues to be an important part of care delivery. Telehealth and other technology-focused tools facilitating remote patient care and monitoring may be valuable to optimize outcomes, but these approaches need to be made more accessible, irrespective of the important social determinants of health that impact access to technology-enabled care. The substantial disparities we found in access to care for rheumatology patients during the pandemic based on age, socioeconomic status, and rural residence should be a call to action for rheumatology providers. Vulnerable populations should be prioritized, with specific strategies developed to reduce disparities in access to rheumatology care and maximize health and quality of life for these patients.

AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Dr. Curtis had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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