

FINAL PROGRESS REPORT

Title: Evaluation of the Impact of Telemedicine on Management of Rheumatoid Arthritis

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Organization: Alaska Native Tribal Health Consortium

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1. Structured Abstract:

Purpose: The objective of this study was to assess outcomes and quality of care for rheumatoid arthritis (RA) in the setting of telemedicine use.

Scope: RA is a chronic disease with increased prevalence in American Indian/Alaska Native (AI/AN) populations. Management of RA requires frequent visits to a rheumatologist, but there is a shortage of rheumatologists in the US. Alaska has been a leader in telemedicine innovation. Utilization of this technology could improve access to care and outcomes of RA. This study evaluated the impact of telemedicine on outcomes and quality of care for RA in Alaska Native people.

Methods: Participants with RA were recruited when seeing a rheumatologist, either in-person or by telemedicine, both of which were available as part of usual care. Participants completed the RAPID3 (a patient-reported disease activity score) and a telemedicine survey and agreed to medical record review at baseline and 12 months, as well as follow-up contact at 6 and 12 months.

Results: Of 122 participants enrolled, 56 (46%) ever used telemedicine. At baseline, factors associated with telemedicine use included a higher number of rheumatologist visits in the past year, higher RAPID3 score, more positive perceptions of telemedicine, and seeing a physician who used telemedicine more often. The change in disease activity over 12 months was no different in the telemedicine vs. in-person group. Measures of quality of care did not differ by group. These findings suggest that telemedicine can be an effective tool in managing RA that is not inferior to usual in-person care.

Keywords: rheumatoid arthritis, telemedicine

2. Purpose:

The overall goal of the study was to evaluate the impact of telemedicine rheumatology follow-up as part of usual care on outcomes and quality of care in RA.

The specific aims of this study were to:

- 1) Determine the impact of telemedicine on disease activity, a patient-centered outcome measure of quality of care for RA (RAPID3).
- 2) Investigate the impact of telemedicine on process measures of quality of care for RA.

3. Scope:

RA is a chronic autoimmune disease predominantly affecting joints, leading to high rates of disability and increased mortality. The prevalence of RA is high in American Indian/Alaska Native (AI/AN) populations. The guidelines for RA require frequent visits to a rheumatologist, which have been associated with improved outcomes and quality of care. However, there is a shortage of rheumatologists in the United States, and this disproportionately affects minority and rural populations. Given this context, there is a need for improved access to rheumatologists for AI/AN and other rural populations.

Alaska has been a leader in telemedicine innovation, more recently with dramatically improved video teleconference (VTC) capability in multiple rural clinics. This VTC technology is expected to improve access to care for rural patients and to improve quality of care, given that quality of care for RA depends on access to rheumatologists. Although the uptake of telemedicine is increasing in many specialties worldwide, there are limited data on clinical outcomes associated with the implementation of telemedicine VTC follow-up.

This study evaluated the impact of telemedicine on outcomes and quality of care for RA in Alaska Native people.

4. Methods:

The study design was observational, with enrollment of a prospective cohort of RA patients. Telemedicine had already been implemented as part of usual care in this population. Thus, randomization of participants to a telemedicine intervention was not feasible. Participants with RA were recruited when seeing a rheumatologist at the Alaska Native Medical Center, either in-person or by telemedicine. At the study visit, participants completed the RAPID3 (a patient-reported disease activity score) and a telemedicine perception survey and agreed to medical record review (for demographics, disease characteristics, and quality of care) at baseline and 12 months, as well as to follow-up contact by telephone at 6 and 12 months. The RAPID3 was repeated at the 6- and 12-month telephone follow-up, and the telemedicine perception survey was repeated at 12 months. Follow-up was completed in March 2019. Medical record abstraction was completed for quality measures in all participants, but there was some loss to follow-up for the 6- and 12-month self-reported measures (RAPID3 and telemedicine perception

survey). This limited the power to detect changes in disease activity over time (Aim 1), but did not affect the analysis for Aim 2. In addition, because of the nature of the R21 grant funding, this study was designed with a short duration of follow-up. It would be useful to follow outcomes and perceptions of telemedicine in the longer term. We received a grant from AHRQ to evaluate telemedicine outcomes and costs in a broad set of chronic diseases over the next 5 years (1R01HS026208-01A1), which will include RA and other conditions.

5. Results:

Principal Findings and Outcomes:

At baseline, we recruited 122 participants for the study. Of those, 89 (73%) completed the 6 month follow-up RAPID3 and 74 (61%) completed the 12 month follow-up RAPID3 and telemedicine perception survey. All participants had the baseline and 12 month medical record abstractions completed. Baseline data analysis is complete and a manuscript has been recommended for publication in the journal *Arthritis Care and Research* contingent on minor revisions, which have been completed and submitted.

At baseline, the demographic and disease-related characteristics of patients ever seen by telemedicine for RA were similar to those seen in-person only (presented in Table 1 below). Differences between groups at baseline included a higher RAPID3 score (indicating higher disease activity) for those seen by telemedicine, higher number of visits in the past year, higher likelihood of seeing a rheumatologist who uses telemedicine more frequently, and more positive perceptions of telemedicine. On multivariate analysis of factors associated with telemedicine use in RA, these factors all remained significant (presented in Table 2 below).

Perceptions of telemedicine were an important factor associated with the choice to be seen by telemedicine for RA follow-up. The results of the telemedicine perception survey are presented in detail in Figure 1 below. Individuals seen by telemedicine still expressed a preference to be seen by the specialist in-person (61%), but those seen by telemedicine were more likely to feel that the care given in video visits was as good as the care given in in-person visits. Both groups felt that technical difficulties were a limitation in some cases.

Table 1: Characteristics of Patients with RA seen by Telemedicine vs. In-Person Only

Characteristic	Telemedicine (n=56)	In-person only (n=66)	p-value
Age, year, mean (SD)	52.2 (12.2)	52.2 (13.9)	0.971
Female, n (%)	45 (80%)	57 (86%)	0.372
RA disease duration, years, mean (SD)	10.0 (8.8)	10.2 (10.9)	0.421
Anti-CCP antibody positive, n (%)	48 (87%)	61 (92%)	0.35
RF positive, n (%)	48 (87%)	59 (89%)	0.54
Erosions of hands or feet on plain films, n (%)	15 (30%)	15 (25%)	0.56
Current smoking, n (%)	28 (50%)	30 (45%)	0.46
Rheumatic disease comorbidity index, mean (SD)	1.1 (1.1)	0.73 (1.2)	0.06
RAPID3 score (0-30 scale), mean (SD)	12.63 (5.4)	10.43 (5.5)	0.037*
Number of rheumatology visits in past year, mean (SD)	2.95 (1.35)	2.39 (1.32)	0.011*
DMARD** prescribed in the past year, n (%)	55 (98%)	64 (97%)	0.66
Distance to rheumatologist, miles, mean (SD)	130.2 (248.7)	169.7 (234.2)	0.116
Rheumatologist telemedicine rate, mean (SD)	0.196 (0.064)	0.115 (0.094)	<0.001*
Telemedicine survey score (possible range -2 to +2), mean (SD)	0.547 (0.625)	0.238 (0.597)	0.001*
Ever seen by telemedicine by another provider (non-rheumatology), n (%)	9 (16%)	4 (6%)	0.074

*p<0.05

**DMARD: Disease-modifying anti-rheumatic drug

Table 2: Factors Associated with Telemedicine by Multivariate Logistic Regression

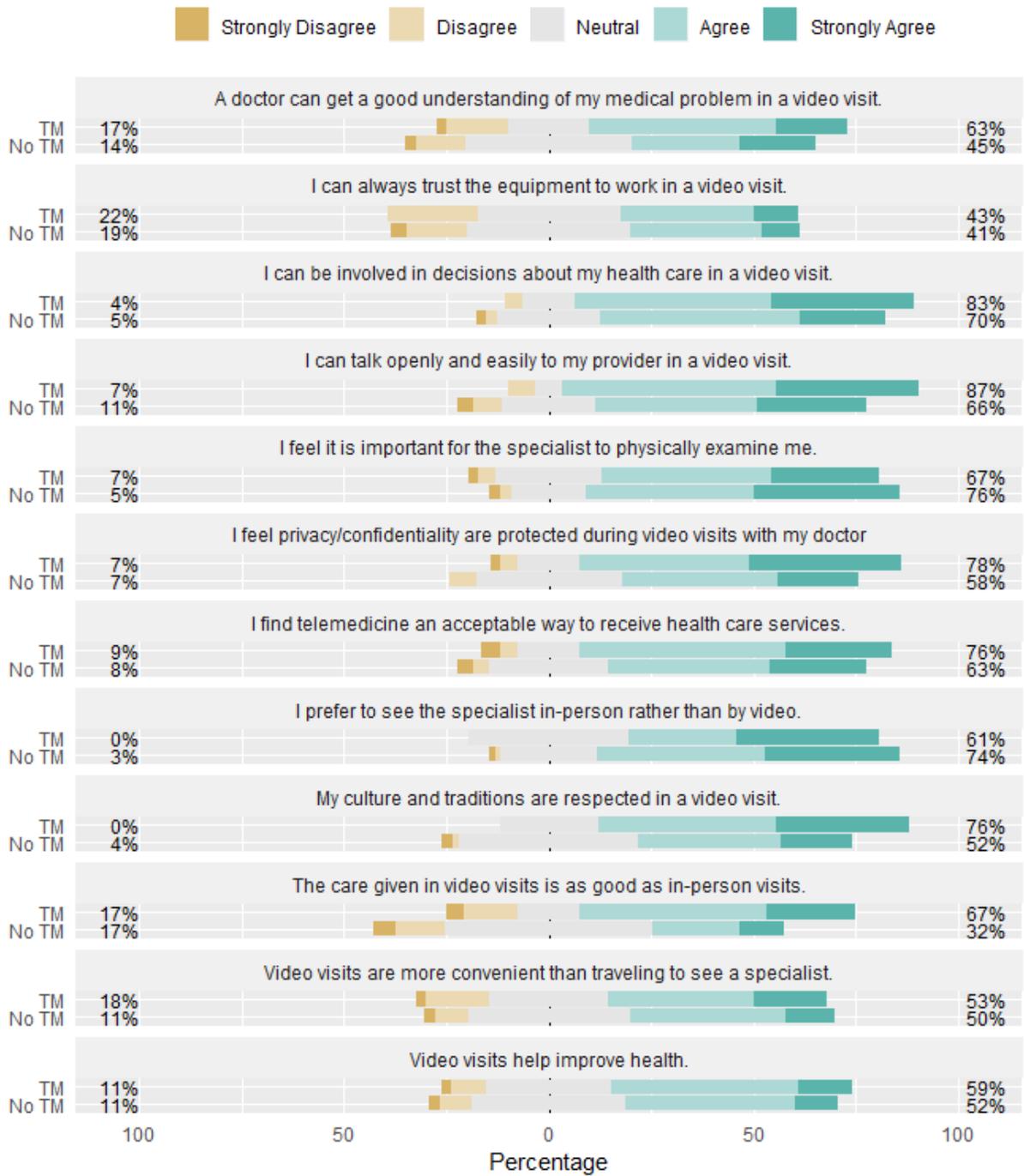
Characteristic	Odds ratio	95% Confidence Interval	p-value
Age less than 50	2.16	0.81, 6.14	0.13
Male sex	2.88	0.83, 10.80	0.10
Number of visits in past year	1.51	1.07, 2.16	0.02*
RAPID3 score	1.16	1.05, 1.29	<0.01*
Telemedicine survey score	2.76	1.32, 6.18	<0.01*
Telemedicine visit ever by any provider	0.88	0.18, 4.61	0.87
Mean rheumatologist telemedicine rate	4.14	2.35, 8.00	<0.01*

*p<0.05

Figure 1 Legend: Perceptions of Telemedicine in Participants with RA Ever Seen by Telemedicine compared to In-Person Only

Twelve questions about perceptions of telemedicine were asked on a Likert scale, with the results summarized in this figure. Positive responses (agree or strongly agree) are presented in blue, with negative responses (disagree or strongly disagree) in beige. The percent with positive response is shown for each group on the right of the figure, with percent negative response on the left. The neutral category was removed when calculating percentages. The telemedicine group responses are presented on the top of each question (as “TM”) and the in-person only group on the bottom (as “no TM”).

Figure 1:



Preliminary follow-up data were presented at the American College of Rheumatology annual meeting in October 2018. Follow-up data analysis has now been completed, and a manuscript is in draft format. The manuscript will be submitted to a journal as soon as tribal review is complete (required for all publications according to the policy of tribal health organizations in Alaska). Follow-up data are summarized by Aim below.

Aim 1 (Disease Activity): Determine the impact of telemedicine on disease activity, a patient-centered outcome measure of quality of care for RA (RAPID3). For this aim, the primary analysis determined the change in patient-reported disease activity (RAPID3 score) over one year in patients having at least one telemedicine visit compared to controls with no telemedicine visits. Secondary analyses included change in functional status at one year and the proportion of patients with low disease activity or remission.

As mentioned above, the RAPID3 score was higher at baseline in patients seen by telemedicine compared to in-person only. RAPID3 was measured at 6 and 12 months. The change in RAPID3 was no different in the telemedicine vs. in-person group at either 6 months or one year (see Table 3 below). There was no difference in functional status or the proportion of low disease activity or remission by group over the study period.

Table 3: Disease Activity and Functional Status over Time in Patients with RA seen by Telemedicine vs. In-Person Only

	Telemedicine			In-Person Only		
	Baseline (n=57)	6 months (n=44)	12 months (n=35)	Baseline (n=65)	6 months (n=45)	12 months (n=39)
RAPID3, Mean (SD)	12.5 (5.4)	11.8 (5.0)	12.3 (5.9)	10.5 (5.5)	9.6 (4.6)	10.3 (5.3)
Low disease activity or Remission, n (%)	10 (18)	8 (18)	7 (21)	18 (28)	12 (27)	12 (31)
Functional Status Score, mean (SD)	2.9 (2.0)	2.5 (1.7)	2.4 (1.8)	2.0 (1.8)	2.1 (2.0)	1.9 (1.3)

Repeated linear measures mixed models were used to evaluate factors associated with RAPID3 score and functional status score over time, accounting for covariates. Factors associated with RAPID3 score over time included age and being in the in-person group (lower score at all time points). Factors associated with functional status over time also included age and being in the in-person group (lower score at all time points). General estimating equations were used to account for correlation between data from the same patient during multiple rounds of follow-up for the categorical outcome (proportion in low disease activity or remission). In this model, age and female sex were associated with proportion in low disease activity or remission. None of the models found an association with group (telemedicine vs. in-person) and any measures of disease activity over time.

Aim 2 (Quality of Care): Investigate the impact of telemedicine on process measures of quality of care for RA. For this aim, we specifically included access to care (number of rheumatology visits per year), quality of assessment (proportion of visits in which disease activity measurement documented) and quality of management (proportion of visits with moderate or high disease activity documented in which a change in medications is prescribed). We included some additional measures of quality of care for RA endorsed by the American College of Rheumatology (proportion of visits in which functional status assessment is documented, and proportion of patients prescribed a disease-modifying anti-rheumatic drug (DMARD) in the past year).

We found no statistically significant difference in the number of visits over the one-year study period in patients seen by telemedicine vs. in-person only. This is despite our baseline findings described above that patients seen by telemedicine had a higher number of visits in the year prior to study enrollment. The proportion of visits in which disease activity was documented and the proportion of visits with moderate or high disease activity in which a change in medications was prescribed were no different by group. There was also no difference in the proportion of visits in which a functional status assessment was documented or in the proportion of patients prescribed a DMARD in the past year. These results are presented in Table 4 below.

Table 4: Quality Measures from Medical Record Abstraction at 12 Months

Characteristic	Telemedicine (n=57 patients with 93 visits)	In-Person Only (n=65 patients with 121 visits)	p-value
Number of rheumatologist visits in year after study enrollment, mean (SD)	1.6 (1.1)	1.9 (1.4)	0.32
Proportion of visits in which disease activity is documented (% of visits)	26	32	0.3
Proportion of visits with moderate or high disease activity documented in which a change in medications is prescribed (% of visits)	86	67	0.21
Proportion of visits in which functional status assessment is documented (% of visits)	27	23	0.46
DMARD prescribed in past year (% of patients)	86	75	0.14

Multivariate analyses were conducted for quality measures. When including covariates, we found that the only factor associated with the number of visits in the year of the study was the number of visits in the preceding year. In multivariate analysis of functional status assessment, both the number of visits during the study period and being in the telemedicine group were associated with increased likelihood of documenting a functional status assessment. The number of visits was strongly associated with increased likelihood of DMARD prescription in the past year.

Discussion and Conclusions:

We found no difference in RAPID3 at 12 months after study enrollment and no difference in the change in RAPID3 over time when comparing patients ever seen by telemedicine vs. in-person only. These findings could indicate that telemedicine does not improve disease activity compared to in-person only care. For this first study Aim, we relied on self-reported data 12 months, and some participants were lost to follow-up. Therefore, this finding could also reflect lower statistical power for Aim 1 than Aim 2. Finally, the duration of this study was relatively

short, and the gains that may occur with telemedicine follow-up visits may require a longer duration of follow-up. Overall, our conclusion for Aim 1 is that there is no difference in disease activity for patients seen by telemedicine vs. in-person only. This indicates that telemedicine remains a reasonable option for follow-up of RA, and that further studies of longer duration are needed.

In our second aim, we compared measures of quality of care in the group seen by telemedicine vs. in-person only. Overall, we found no difference in the quality of care between groups. The only difference was that in multivariate analysis, functional status assessment documentation was more likely in the telemedicine group. We hypothesize that this could reflect the fact that there is more time for discussion and less time focused on physical examination during a telemedicine visit. Although we evaluated multiple quality measures available for RA, it is our suspicion that these do not adequately capture all aspects of a visit. For example, discussion of medication risks and benefits may be longer during a telemedicine visit than in-person, and our study did not measure this component of care. As in Aim 1, we believe that finding no difference between groups in the short study duration likely indicates that telemedicine is a viable option for follow-up of RA.

A limitation of this study is that participants were not randomized to telemedicine because this was already being offered as part of usual care for RA. Therefore, although we controlled for covariates when possible, we found that disease activity was higher in patients who were seen by telemedicine, which could lead to bias that cannot be fully accounted for in statistical analyses.

Significance and Implications:

This study provides preliminary data demonstrating the characteristics associated with choosing telemedicine when offered as an option for follow-up of RA, as well as the feasibility of this method of care. Although telemedicine did not improve RA disease activity or quality of care compared to in-person only visits for the measures in this study over a 12-month period, it was also not inferior to in-person care. These findings indicate that telemedicine can reasonably be offered as an option for RA follow-up and is at least as good as in-person care. Longer-term studies are needed to document the effectiveness of telemedicine in quality of care for RA and disease outcomes. This study did not address costs, but future studies should conduct cost

analyses. If the costs of telemedicine are much lower, with similar outcomes, this may lead to more widespread acceptance of telemedicine.

6. List of Publications and Products:

No manuscripts have been published yet, but one has been recommended for publication contingent on minor revisions (submitted 6/27/19) in the journal *Arthritis Care and Research*. A second manuscript is in draft format, to be submitted to a journal before the end of 2019.

Four abstracts have been presented at scientific meetings:

1. Ferucci E, Choromanski T, Day G, Freeman S. Telemedicine Impact on Rheumatoid Arthritis Care. Alaska Native Health Research Conference. Oral abstract presentation October 18, 2017. <https://www.regonline.com/custImages/390000/392531/FerucciETelemedicine.pdf> . Accessed July 19, 2019.
2. Ferucci E, Choromanski T, Day G, Freeman S. Telemedicine for Rheumatoid Arthritis in the Alaska Native Population [abstract]. *Arthritis Rheumatol*. 2017; 69(Suppl 10). <http://acrabstracts.org/abstract/telemedicine-for-rheumatoid-arthritis-in-the-alaska-native-population/>. Accessed July 19, 2019.
3. Ferucci E, Freeman S. Telemedicine for Rheumatoid Arthritis in Alaska Native People: Impact on Outcomes, Quality and Satisfaction. American Telemedicine Association 2018 Meeting, ePoster 118, presented 4/30/2018 at 4:45pm. <https://www.eventscribe.com/2018/ATA/agenda.asp?h=Full%20Schedule&BCFO=P|G>, accessed online July 20, 2018.
4. Ferucci E, Choromanski T, Day G, Freeman S. Outcomes of Telemedicine for Rheumatoid Arthritis in the Alaska Native Population [abstract]. *Arthritis Rheumatol* 2018; 70(Suppl 10). <https://acrabstracts.org/abstract/outcomes-of-telemedicine-for-rheumatoid-arthritis-in-the-alaska-native-population/>. Accessed July 19, 2019.