

## Original article

# Tele-rheumatology for overcoming socioeconomic barriers to healthcare in resource constrained settings: lessons from COVID-19 pandemic

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## Abstract

**Objectives.** To assess acceptability of teleconsultation among the socioeconomically marginalized sections of patients with rheumatic and musculoskeletal diseases (RMDs), to identify the socioeconomic barriers in continuing rheumatology care during the COVID-19 crisis and to identify patients who could benefit by shifting to tele-rheumatology consultations.

**Methods.** This was a cross sectional analytical study done at a tertiary care teaching hospital in India including patients with RMDs who were not on biological diseases modifying agents. Assessment of disease status, socioeconomic status and economic impact of COVID-19 was done via tele-consultation.

**Results.** Out of the 680 patients satisfying inclusion criteria, 373 completed the study. The format was found easy by 334 (89.6%) of them and 284 (76.1%) considered tele-rheumatology better than in-person consultation. During the pre-COVID months, the median monthly per capita income of the families of our patients and cost of illness was Indian rupees (INR) 2000 (US\$ 26) and INR 1685 (US\$ 21.91), respectively. Families whose financial needs were met (OR = 0.38, 95% CI: 0.239, 0.598) or those with schooling upto at least secondary school (OR = 0.442, 95% CI: 0.260, 0.752) ( $P = 0.002$ ) were less likely to stop prescription drugs. In a hypothetical model, 289 (77.4%) could be successfully switched to tele-rheumatology follow-up.

**Conclusion.** The acceptability of tele-rheumatology among socioeconomically marginalized patients with RMDs is good. During times of crisis, patients from poorer strata of society and lower educational background are likely to abruptly stop medications. Switching to a telemedicine-based hybrid model is likely to improve drug adherence with substantial savings on loss of pay and out of pocket expenditure.

**Key words:** Tele-rheumatology, economic impact, rheumatic and musculoskeletal diseases, socioeconomic status, COVID-19

### Rheumatology key messages

- Patients with RMDs from poorer strata of society abruptly stopped medications during the COVID-19 pandemic.
- Patients with low disease activity and on a stable DMARD dose will benefit from switching to tele-rheumatology.
- A hybrid model comprising of onsite nurse-based assessment along with tele-rheumatology can help decongest specialty clinics.

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Submitted 16 September 2020; accepted 3 November 2020

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## Introduction

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection has spread to >210 countries infecting >60 000 234 people [1]. Besides the direct health implications due to this viral infection, the prevailing circumstance has significantly modified lifestyle, travel and healthcare-seeking behaviours [2, 3] of people across the globe. In addition to the personal measures to mitigate infection, several stringent measures by governments across the world to contain the spread of Novel Coronavirus Disease (COVID-19) have adversely impacted people's lives. These changes have resulted in several improvisations and innovations with an aim to deliver effective healthcare using existing resources. Telemedicine is one such method that has come in handy for allowing an effective physician-patient interaction while maintaining the norms of the containment measures. To regulate the surge in the use of telemedicine in India, the Medical Council of India and the Ministry of Health and Family Welfare has come out with detailed guidelines for its implementation [4].

Rheumatic musculoskeletal diseases (RMDs) like most chronic diseases [5] require continuity of care for better disease outcome. Individuals with RMDs have unique challenges in the form of the need for adequate and regular monitoring of disease activity and adjustment of drug dosage by trained physicians. The use of telemedicine in rheumatology (tele-rheumatology), though shown to be effective in delivering healthcare, is still not widely adopted [6]. The challenges due to COVID-19 have resulted in an accelerated implementation of tele-rheumatology services helping rheumatology practitioners to partly ensure continuity of care. Although preliminary studies have shown good patient acceptability of tele-rheumatology, using new technology in socioeconomically backward sections of society may be a challenge. Moreover, the physicians via tele-rheumatology will encourage patients to acquire prescription drugs from a local pharmacist, thus obviating the need of travelling to a hospital. This sudden change may have major financial implications on the patients and their families. Insurance coverage for health expenditure is still in a nascent stage and out of pocket expenditure (OOPE) is the only means by which the majority of people in India afford health care [7]. This study was conducted in a state-run tertiary care teaching hospital in southern India. The institute serves as a single tertiary care hospital for a population of over 8 000 000 from five districts. The hospital provides consultation, treatment and investigation free of charge to a majority of patients. Most patients including those with RMDs visit the study centre once a month for consultation and prescription refills. With the enforcement of nationwide lockdown from 24 March 2020, in India none of the patients could come for their scheduled follow-up, forcing the doctors to implement teleconsultation. Hence, as we further strengthen and optimize telemedicine facilities, it is important to identify and address the societal and

economic barriers in accessing healthcare and identify the group of patients with RMD who will benefit from teleconsultation. In this study, we aimed to look at the feasibility of having teleconsultation among the socioeconomically marginalized sections of the society and to record the direct non-medical and indirect cost among patients with RMDs prior to the period of COVID lockdown. We then identified the predictors of abruptly discontinuing prescription medications and also the patients who could benefit from shifting to tele-rheumatology consultations.

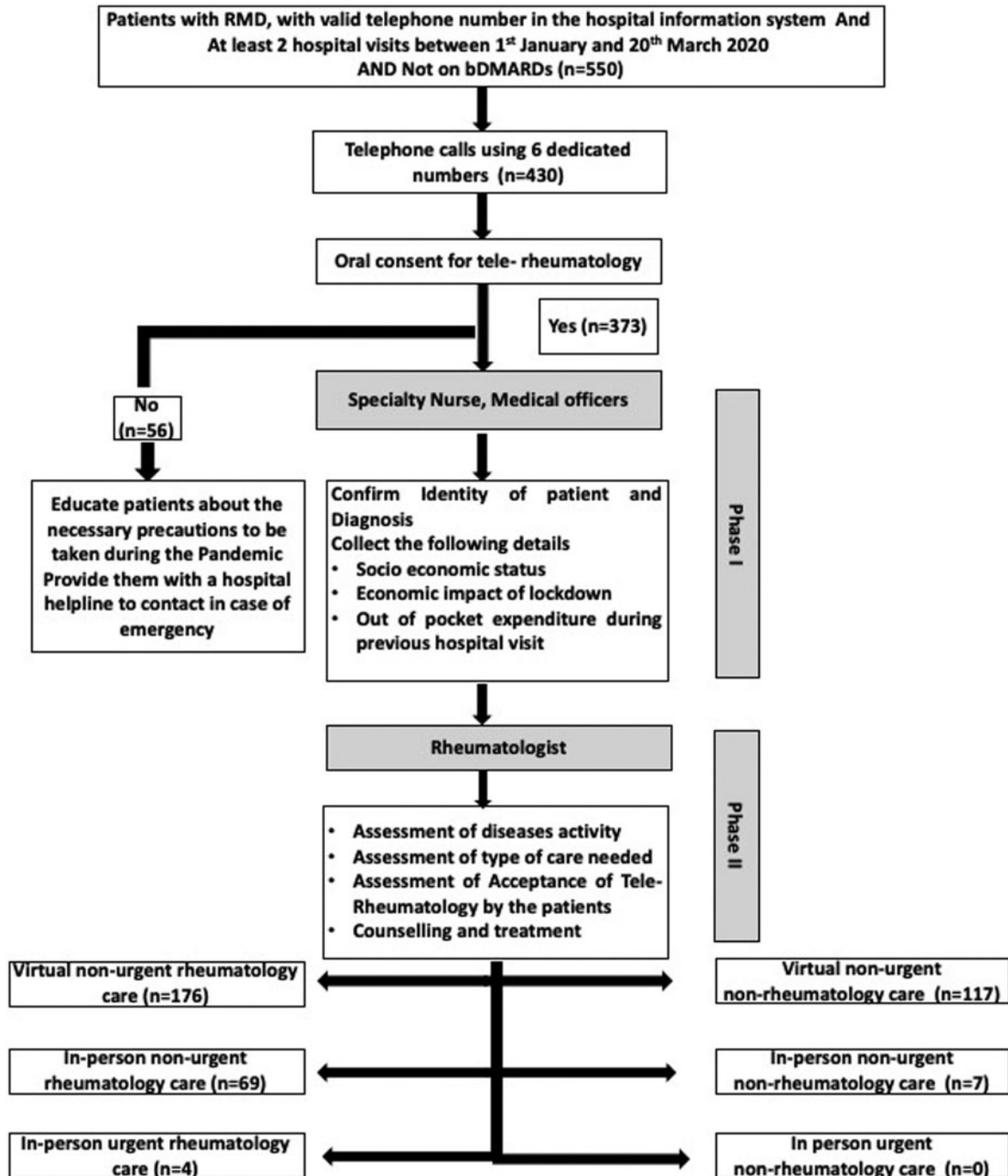
## Methodology

This was a hospital-based cross-sectional analytical study conducted during the month of April 2020. The data collection has been approved by the Institute Ethics Committee for Observational Studies, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India. Contact details of the patients who used the rheumatology outpatient service or were undergoing inpatient care in the three months preceding the start of COVID-19 containment measures in India were collected from the department database. A total of 4268 contact details were available on the hospital information system. Those on regular follow-up (i.e. at least two registered visits between 1 January and 30 March 2020) and not on biological diseases modifying anti-rheumatic drugs (bDMARDs) were selected for the study.

A team comprising of two rheumatology consultants, six rheumatology fellows, two medical officers and two specialty nurses was formed. The teleconsultations were limited to telephone calls and WhatsApp-based sharing of photographs. Patients were also invited to upload self-captured photographs of suspected active physical manifestations, reports of investigations and prescription medications via WhatsApp. The calls were conducted between 15 and 30 April 2020. Data was captured using a predesigned form (Supplement 1, available at *Rheumatology* online). The details of the team and the method of teleconsultation is elaborated in the Supplement 2, available at *Rheumatology* online. The workflow is represented in Fig. 1.

In the first phase of the call, after confirming the patient's identity and diagnosis, the nurse or the medical officers collected demographic details, socioeconomic status [updated modified Kuppuswamy socioeconomic scale (SES)] [8], direct and indirect expenditure during their previous follow up visits and the economic impact of the pandemic. In the second phase, the rheumatologist assessed the diseases status and classified each patient as requiring one of the following: (i) virtual non-urgent rheumatology care; (ii) in-person non-urgent rheumatology care; (iii) in-person urgent rheumatology care; (iv) virtual non-urgent non-rheumatology care; (v) in-person non-urgent non-rheumatology care; or (vi) in-person urgent non-rheumatology care (Supplement 3, available at *Rheumatology* online).

Fig. 1 Schematic representation of the process of tele-rheumatology consultation



### Cost calculation

Costs were calculated from the patient's perspective using a bottom-up costing approach from the expenditure incurred during the last hospital visit. The direct non-medical cost incurred by each patient was calculated by adding the OOPE for travel, stay and food for the patient and an accompanying person.

The indirect cost was calculated as described below. The loss of pay incurred by the patient and accompanying person due to the hospital visit was calculated as per the information provided by the patient. If the patient or the accompanying individual was a homemaker, replacement cost was calculated at a rate of Indian rupees (INR) 46 (US\$ 0.598) per h of work lost, which is

the compensation fixed by the government of India for unskilled workers [9]. The direct medication cost was calculated with an assumption that the patients would buy the drugs from a pharmacy close to their locality. The medication cost was calculated by adding the average of maximum retail prices (MRP) per drug, from five leading pharmaceutical manufacturers in India.

### Statistics

Sample size was calculated with an assumed acceptance rate of 70% and an error margin of 5%. The estimated sample size was 322 at 5% level of significance. Allowing a 15% non-response rate, the final sample size was 378. We called a total of 550 patients out of which 430 answered the phone. The data was analysed using IBM SPSS Statistics 19 software. Continuous variables like age, disease duration, family income, direct/indirect non-medical and medical costs, distance from the hospital were represented as mean (s.d.) or median and interquartile range (IQR) or range, as appropriate. The Kolmogorov–Smirnov test was used to check the normality of the quantitative data. Categorical variables like gender, educational and economic status, disease status, presence of comorbidities, compliance and availability of drugs, COVID-19-related symptoms and knowledge of precautions, a questionnaire assessing physical and mental health as well as acceptability of telemedicine were described as frequencies and proportions. Variables determining abrupt stoppage of prescription drugs were compared using  $\chi^2$  or Mann–Whitney *U* test. A *P*-value of <0.05 was considered statistically significant.

## Results

### Demography and acceptance of tele-rheumatology:

Out of the 550 calls made, 430 (78.2%) answered the call, of which 373 patients consented and completed teleconsultation. The demographic variables are represented in Table 1. The median age of the patients was 35 (25–44) years. A majority of the patients had a diagnosis of SLE *n* = 198 (53.1%) followed by inflammatory arthritis *n* = 81 (21.7%). Out of the 373 patients, 334 (89.6%) found tele-rheumatology consultation easy to follow, 284 (76.1%) considered that tele-rheumatology was better than in-person consultation in circumstances like the current one. Fifty-nine patients (15.8%) felt that tele-rheumatology was not as good as in-person consultation (Fig. 2).

### Socioeconomic status of participants and economic impact of COVID-19

Three hundred and forty-eight (93%) patients were from sections that were below the lower middle socioeconomic class with a monthly median family income amounting to less than INR 14 000 (US\$ 182). The median income of the study population was INR 7000 (US\$

91) (range, INR 1000–70 000) (US\$ 13–910) with the median per capita income being INR 2000 (US\$ 26) (range, 200–23 334) (US\$ 2.6–303.3) per month. With the enforcement of lockdown measures, 271 (72.7%) families experienced a loss of income, 99 (26.5%) had no change in their income status, and three (0.8%) had an increase in income. The median loss in monthly family income among the 271 patients was INR 5000 (US\$ 65) (500–35 000) (US\$ 6.5–455). Overall, 187 (47.5%) families were pushed to a lower SES as a result of the stringent lockdown measures. Out of the patients interviewed, 122 (32.7%) reported that their families could not adequately meet their daily financial needs.

### Economic burden of RMD and distance from health care

The median non-medical cost (direct non-medical cost + indirect cost) was INR 752 (US\$ 9.78) (IQR 497–1347) (US\$ 6.46–17.51), INR 742 (US\$ 9.65) (IQR 483–1298) (US\$ 6.28–16.87) and INR 954 (US\$ 12.40) (IQR 592–1687) (US\$ 7.70–21.93) among patients with inflammatory arthritis, SLE and non-SLE CTDs respectively. The direct cost of medication was approximately INR 369 (US\$ 4.80) (IQR 345–827) (US\$ 4.49–10.75), INR 836 (US\$ 10.87) (IQR 402–1183) (US\$ 5.22–15.38) and INR 562.9 (US\$ 7.32) (IQR 331–1092) (US\$ 4.30–14.20) in inflammatory arthritis, SLE and non-SLE connective tissue diseases respectively. The overall calculated cost of illness in our cohort with various RMDs was INR 1685 (US\$ 21.91) (IQR 256–12 738) (US\$ 3.33–165.59) (Table 2). In order to access rheumatology consultation, the patients had to travel a median of 82 km (1.6–504) even though the closest health care facility was at a median distance of 5 km (0.1–50) (Table 1).

### Disease assessment and continuity of care

Based on the tele-rheumatology assessment of current diseases status, 80 (21.4%) patients were classified as requiring either urgent or non-urgent in-person care and the remaining 293 (78.5%) patients required only virtual consultation. During the first month of nationwide lockdown, 256 (68.6%) patients continued the drugs based on previous prescriptions, and 117 (31.4%) stopped them abruptly.

### Factors responsible for discontinuation of prescription drugs

We analysed the reasons for discontinuation of prescription drugs to identify barriers in obtaining healthcare consultation (Table 3). The majority (88%) of them attributed not taking drugs to the combination of the worsened financial condition of their families and lack of public transport. It was found that the patients with lower monthly income prior to lockdown (INR 6000 vs INR 8000, *P* <0.05) (US\$ 78 vs 104) were more likely to discontinue drugs. The individuals whose financial needs were adequately met had a lower odds of discontinuing drugs as compared with those whose financial needs

TABLE 1 Baseline characteristics

Number of patients	<i>n</i> = 373
Age in years, median (IQR)	35 (25-44)
Gender <i>n</i> (%)	
Male	40 (10.7)
Female	331 (88.7)
Others	2 (0.4)
Disease subtype <i>n</i> (%)	
Inflammatory arthritis	93 (24.9)
SLE	198 (53.1)
Other CTDs (IIM, MCTD, SSc)	82 (22.0)
Socio-economic class (modified Kuppuswamy's class) <i>n</i> (%)	
Upper	01 (0.3)
Upper middle	24 (6.4)
Lower middle	63 (16.9)
Upper lower	221 (59.2)
Lower	64 (17.2)
Educational status <i>n</i> (%)	
Up to middle school	155 (41.6)
High and intermediate/secondary	108 (29)
Graduate and above	110 (29.5)
Distance needed to travel to access healthcare (median, range)	
Distance between residence and the study centre in kilometres	82 (1.6–504)
Distance between residence and the nearest state-run secondary health care centre in kilometers	5 (0.1–50)
Continued prescription rheumatology drugs? <i>n</i> (%)	
Yes	256 (68.6)
No	117 (31.4)
Form of health care needed as assessed by the rheumatologist <i>n</i> (%)	
Virtual non-urgent rheumatology care	176 (47.2)
In-person non-urgent rheumatology care	69 (18.5)
In-person urgent rheumatology care	04 (1.1)
Virtual non-urgent non rheumatology care	117 (31.4)
In-person non-urgent non rheumatology care	07 (1.9)
In-person urgent non rheumatology care	00

CTDs: connective tissue diseases; IIM: idiopathic immune mediated myositis; MCTD: mixed connective tissue disease; SSc: systemic sclerosis.

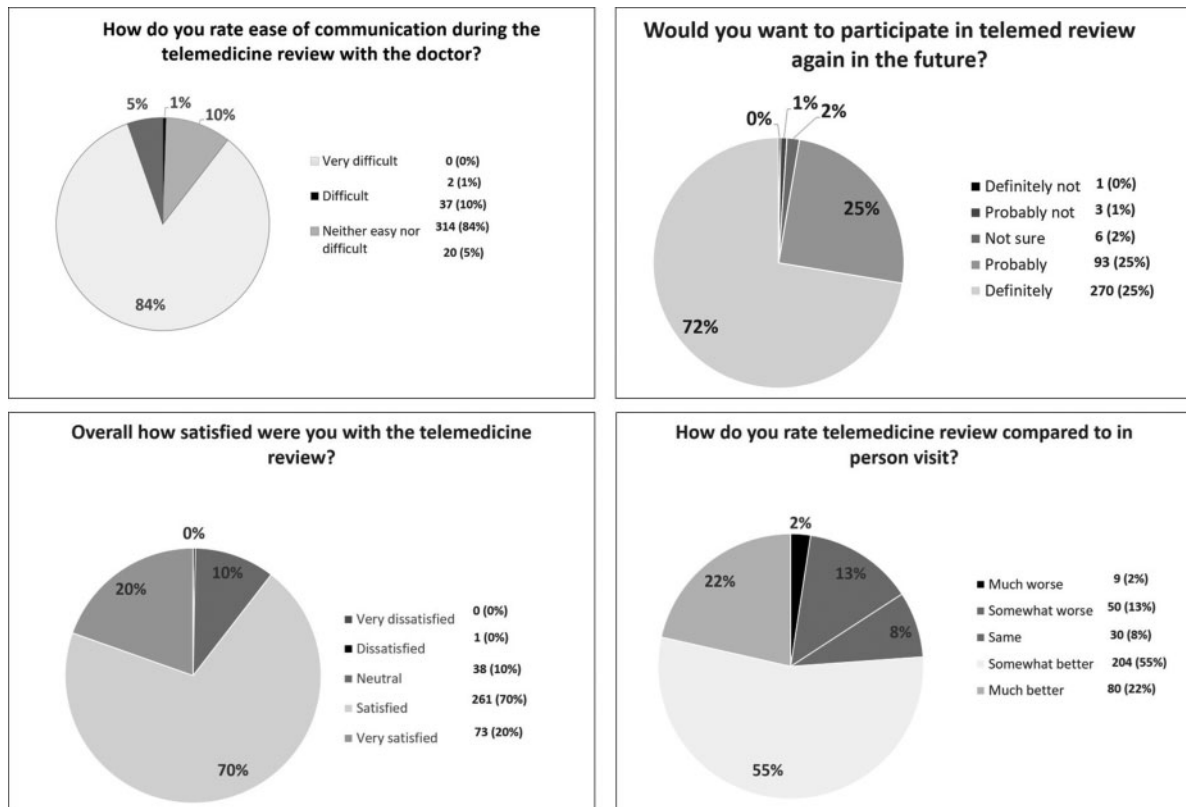
were not adequately met (OR 0.38, 95% CI: 0.239, 0.598). The education status of the patients also determined drug compliance. Patients educated to secondary school level or above were at lower odds of abruptly stopping prescription drugs as opposed to those educated to a lower level. Interestingly, we found that patients with inflammatory arthritis had a higher chance of stopping treatment abruptly (43%) as compared with those with SLE (31.3%), inflammatory myositis or scleroderma (13.3%) ( $P < 0.05$ ). There was no difference in distance of residence from the study centre and OOP between the patients who stopped medications and those who continued ( $P > 0.05$ ). The effect of stopping medications was reflected in a worsening of disease activity in these patients. As compared with the previous hospital visit where only 10 (2.6%) patients reported bad or worse symptoms, 42 patients (11.2%) had such symptoms at the time of the teleconsultation (Fig. 3).

#### Effect of tele-rheumatology consultation on healthcare costs

Because the study centre is a government-run tertiary care hospital that covers the costs of medications and investigations for the majority, direct non-medical healthcare-related costs are the main expenditure incurred by the patients (Table 2). The median direct non-medical and indirect cost expenditure for the patients per hospital visit was INR 796 (US\$ 10.35) (Range, 0–6724) (US\$ 0–87.41). The median direct medical cost, if they were to buy the drugs at their local pharmacy, would be INR 654 (US\$ 8.502) (range 24–7904) (US\$ 0.31–102.75). The patients who could potentially save money by purchasing medications locally and avoiding hospital visits were labelled 'potential savers' ( $n = 222$ ) and the rest as 'non-savers'. Comparing the factors between potential savers vs non-savers, we found that the distance from the study centre and the



Fig. 2 Patient perspective of adequacy and efficacy of teleconsultation in rheumatic diseases



medication cost were the key determinants of healthcare expenditure. People from distant places with a median distance of 105 km (IQR 40–154) could potentially save by purchasing prescription drugs from their locality as compared with non-savers who resided closer to the study centre (39.9 km, 13–105) ( $P < 0.01$ ) (Supplement 4, available at *Rheumatology* online). The projected cost of drugs if the patient had to buy from the locality is shown in Table 2. Patients with SLE, IIM and SSc would have a higher OOPE as compared with inflammatory arthritis ( $P < 0.05$ ).

Finally, we tried to identify the patients who could be shifted to tele-rheumatology with drugs purchased from the local pharmacy. For this, the patients in remission or low disease activity taking a stable dose of DMARDs since the last three visits ( $n = 289$ ) were analysed. It was found that 176 (47.2%) patients could be classified as 'potential savers'. If the drugs were to be made available at the closest state-run secondary care government hospital (median 5 km, range 0.1–50), all 289 (77.4%) could be successfully switched to tele-rheumatology follow-up.

## Discussion

This study was designed as a part of the accelerated induction of teleconsultation service during the initial

months of the COVID-19 pandemic in India. Besides the feasibility of implementing tele-rheumatology, the study specifically aimed at understanding the challenges faced by the patients with RMDs in continuing treatment due to the containment measures and to identify the characteristics of patients who could be shifted to tele-rheumatology consultations. The acceptance of tele-rheumatology was good. Pre-COVID financial status of the family and education status of the patients determined if they continued prescription drugs during the lockdown. Switching to tele-rheumatology and ensuring availability of drugs closer to their residence would benefit >77% of patients with RMDs.

Most (93.2%) of our patients were from economically poorer sections of society, which is the scenario faced in the majority of the state-run institutes in India [10]. We observed a high rate of acceptance of tele-rheumatology services, with over three-quarters of them preferring tele-rheumatology over in-person consultation. Similar patient acceptability rates were also seen in different telemedicine studies [11, 12]. The high acceptance rates may also be a result of the apprehension about contracting COVID infection during hospital visits and the lack of public transportation and needs validation in the post-COVID-19 era. The pandemic has had massive economic implications on the families of patients suffering from rheumatic diseases. Numerous

**TABLE 2** Family income, economic burden of rheumatic diseases and the economic impact of COVID-19 pandemic on patients with RMDs

	Before lockdown	One month after lockdown	P-value
Family income, INR	7000 (1000–70 000)	–2000 (0–70 000)	<0.01
Median (range)	US\$ 91 (13–910)	US\$ 26 (0–910)	
Per capita income, INR	2000 (200–23 334)	667 (0–23 334)	<0.01
Median (range)	US\$ 26 (2.6–303.3)	US\$ 8.67 (0–303.3)	
Change in family income due to the lockdown, median (range)		–3000 (–6000–35 000) US\$ –39(–78–455)	
Were you able to meet your financial needs after lockdown? <i>n</i> (%)			
Not at all		30 (8.0)	
A little		92 (24.7)	
Moderately		156 (41.8)	
Mostly		91 (24.4)	
Completely		04 (1.1)	
Non-medical costs incurred during previous visits, INR		796 (0–6724) US\$ 10.35 (0–87.41)	NA
Median (range)			
Calculated direct cost of drugs, INR		654 (24–7904) US\$ 8.50 (0.3–102.76)	NA
Median (range)			
Overall calculated cost of illness, INR		1685 (256–12 738) US\$ 21.91 (3.33–165.59)	NA
Median (range)			
Calculated monthly expenditure: group-wise breakdown			
	Direct medical cost	Non-medical cost	Total cost of illness
Inflammatory arthritis (RA, SpA and JIA), INR Median (range)	369 (24–2064) US\$ 4.80 (0.31–26.83)	752 (60–3992) US\$ 9.78 (0.78–51.90)	1495 (372–4696) US\$ 19.44 (4.84–61.05)
SLE, INR	836 (24–7904)	742 (62–3410)	1759.5 (274–10 182)
Median (range)	US\$ 10.87 (0.31–102.75)	US\$ 9.65 (0.81–44.33)	US\$ 22.87 (3.56–132.37)
Non SLE CTDs (IIM, MCTD and SSc), INR	562.9 (24–7822) US\$ 7.32 (0.31–101.69)	954 (0–6724) US\$ 12.40 (0–87.41)	1920 (256–12 738) US\$ 24.96 (3.33–165.59)
Median (range)			

CTDs: connective tissue diseases; IIM: idiopathic immune mediated myositis; INR: Indian rupee; MCTD: mixed connective tissue disease; SSc: systemic sclerosis; SpA: spondyloarthritis.

(72.7%) families had a drop in their monthly income, which ranged from complete loss to at least 50% loss in the majority. This loss has affected close to 33% of the families in meeting their daily financial needs. Since the only means of obtaining health care for these patients during the nation-wide lockdown was by increasing their OOPE, around one-third of the patients abruptly discontinued their prescription drugs. These numbers are likely to worsen with continued lockdown across the country, which will lead to dwindling of savings amongst families, pushing them into poverty. Patients with SLE, inflammatory myositis and scleroderma were more likely to continue prescription DMARDs as compared with those with inflammatory arthritis. This could be a result of several research programs in SLE, IIM and SSc at our centre, resulting in a better understanding of the diseases among the patients. Lower education status, polypharmacy and depression are major predictors of medication non-adherence in SLE [13]. It is also well known that knowledge and understanding about the illness and treatment among patients is an important

determinant of medication adherence in chronic conditions [13]. An alternative explanation could be that patients with inflammatory arthritis do well in the short term with over-the-counter non-steroidal anti-inflammatory drugs, thus making it relatively easy to self-medicate for a short time and skip the costlier prescription drugs.

The data on the economic burden of rheumatic diseases in India is sparse, and the existing studies have concentrated on RA [14, 15]. While there is some evidence to show that the cost of health care utilization may be similar across various inflammatory arthritis diseases [16], there is clear evidence of higher economic burden among patients with SLE [17, 18]. Our study also found a higher direct medical cost in SLE and non-SLE connective tissue diseases with a median cost of INR 836 (US\$ 10.87) and INR 562.9 (US\$7.32), respectively. The direct non-medical and indirect OOPE was comparable across all the rheumatic diseases for each follow-up visit and mainly depended on the distance to be travelled to reach the study centre. The calculated

**TABLE 3** Factors determining drug discontinuation among patients with RMDs

Characteristic	Medications continued (n = 256)	Medications discontinued (n = 256)	P-value (OR, 95% CI)
Age in years (median, IQR)	34.00 (24–44)	35(26–45)	0.28
Family income before lockdown, INR (median, range)	8000 (1000–70 000) US\$ 104 (13–910)	6000 (2000–35 000) US\$ 78 (26–455)	0.009
Calculated direct medicine cost, INR (median, range)	620.6 (24–7904) US\$ 8.07 (0.31–102.75)	716 (24–7777) US\$ 9.31 (0.31–101.10)	0.48
Per capita income, INR (median, range)	2000 (200–23 333) US\$ 26 (2.6–303.33)	1500 (333–1 1667) US\$ 19.5 (4.33–303.33)	0.006
Income loss due to lockdown, INR (median, range)	3000 (–6000–30 000) US\$ 39 (–78–390)	4000(0–35 000) US\$ 52 (0–455)	0.22
Financial needs met during lockdown			
Inadequately, n (%)	66 (54.1)	56 (45.9)	P = 0.005
Adequately, n (%)	190 (75.7)	61 (24.3)	OR = 0.378 (0.239–0.598)
Distance of residence from the study centre (km) (median, range)	76 (2–427)	88 (2–504)	0.14
Distance of residence from the closest sec- ondary care centre (median, range)	5 (0.1–200)	5 (0.1–40)	0.18
Gender n (%)			
Male	24 (60%)	16 (40%)	0.30
Female	229 (69.4%)	101 (30.6%)	
Others	2 (100%)	0 0	
Disease group n (%)			
Inflammatory arthritis	53 (57%)	40 (43%)	0.002
SLE	136 (68.7%)	62 (31.3%)	
Non SLE CTD	67 (81.7%)	15 (18.3%)	
Disease group n (%)			
Inflammatory arthritis	53 (57%)	40 (43%)	OR = 0.503 (0.309–0.818) P = 0.005
Connective tissue diseases (SLE, IIM, MCTD, SSc)	203 (72.5%)	77 (27.5%)	
Education status of patient n (%)			
Up to secondary school	168 (63.9%)	95 (36.1%)	OR = 0.442 (0.260–0.752) P = 0.002
Higher secondary and above	88 (80.0%)	22 (20.0%)	
Kuppuswamy scale n (%)			
Higher income group (upper + upper middle)	20 (80%)	5 (20%)	0.21
Lower income group (lower middle + upper lower + lower)	236 (67.8)	112 (32.2)	
Disease status at last visit n (%)			
Good	249 (66.6)	113 (30.2)	0.56
Bad	6 (1.6)	4 (1.1)	
Current disease status n (%)			
Good	238(63.8)	93(24.9)	0.01
Bad	18(4.8)	24(6.4)	

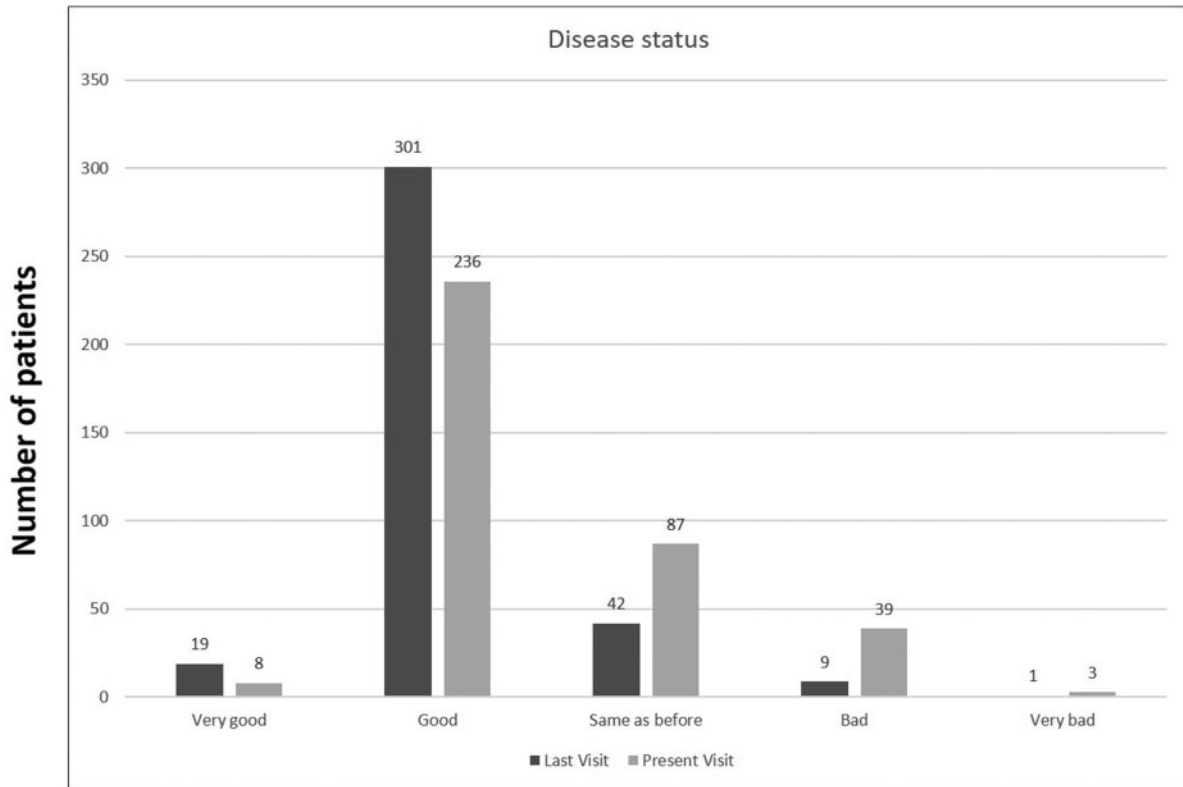
CTDs: connective tissue diseases; IIM: idiopathic immune mediated myositis; INR: Indian rupee; MCTD: mixed connective tissue disease; SSc: systemic sclerosis; SLE: systemic lupus erythematosus.

monthly economic burden of RMDs in our study was INR 1685 (US\$ 21.91) (INR 256–INR 12 738) (US\$ 3.33–165.59) despite not including the cost of investigations and hospitalization charges. The cost calculated in this study does not include the expenditure on bDMARDs and the treatment of refractory patients; both these factors are known to disproportionately increase the overall costs in RMDs [19]. Besides, the conservative cost estimate from our study is substantially higher than the overall economic burden in more common chronic

diseases like type 2 diabetes mellitus in India (INR 6000–20 000 per annum) (US\$ 78–260) [20, 21].

In the natural course of RMDs, a patient requiring out-patient care will be in one of the three phases of diseases course: (i) the initial dose-escalation phase requiring frequent specialist care for diseases assessment and treatment response; (ii) the consolidation phase where the specialist has fixed the dose but will need to assess the efficacy and safety of the drug; and (iii) finally, there is the long-term maintenance phase



**Fig. 3** Change in patient reported diseases status as a result of stopping of drugs

where periodic assessments and investigations are required at intervals not earlier than once in three months. Patients falling under the latter two groups are the ideal candidates to be shifted to tele-rheumatology consultations. Randomized controlled trials among patients with low baseline disease activities have shown that tele-rheumatology was equivalent to in-person consultation in controlling diseases activity and identifying adverse drug events [22]. Another option is a hybrid model of combination of tele-rheumatology and specialist nurse-based assessment of patients with rheumatic diseases at the teleconsultation site. Our study has shown that shifting all the patients who require only virtual non-urgent rheumatology care to the closest secondary care hospital that was at a median distance of 5 km from their residence for prescription refills would result in more than three-quarters of the patients being switched to tele-rheumatology consultations. This would also probably ensure better medication adherence as observed in other chronic diseases like HIV [23]. The strategy to switch to tele-rheumatology would also benefit the patients and their families financially as the OOPE can be minimized. Such models can ensure optimum decentralized health-care delivery for majority of patients with chronic diseases and help decongest tertiary care centres [24], thus also maintaining the norms of physical distancing [25]. We found that the families

with a lower monthly family income [median of INR 6000 (US\$ 78)] are likely to default and attempts like tele-rheumatology can result in cutting down on the direct non-medical and indirect healthcare-related cost and job absenteeism. This financial benefit, accounting for about 5–10% of their monthly income, could motivate more patients to adhere to medications.

This study with its cross-sectional design is not optimum for the analysis of cost benefits of tele-rheumatology. Moreover, the social economic class that is studied using the Kuppuswamy scale takes into account the education qualification and occupation of the head of the family and may not be representative of the whole family. This limitation was to some extent overcome in our study by taking the overall income of the family and also analysis of the patients' occupation and education status. Because the study had very low numbers of patients with refractory RMDs and none on biological DMARDs, the costs projected may be an underestimation. The main strength of this study was that the teleconsultations were done without incurring any additional expenditure and within a time frame of 3 weeks after the lockdown was announced, reflecting the financial and logistic ease of implementation. The results of this study provide the basis for creating a tele-rheumatology-based cohort of patients with RMDs and to prospectively study the cost and other benefits of the model.

According to data from the World Bank, India is home to 24% of the world's poor people [26] and these people with RMDs are likely to be the most affected, as seen in our study. Though India has been successful in decreasing the number of people below the poverty line to 22%, the gains may quickly plummet during the course of the COVID-19 pandemic as the poorer sections with chronic diseases have lost their source of income. With the demand to increase their OOPE on drugs it is likely that their savings will dwindle. Thus, making provisions for follow-up through teleconsultations and drug distribution (door delivery or availability at a facility close to their residence) is likely to increase drug adherence among these patients and result in savings that can benefit their families to sustain their livelihood. In this direction, the federal agencies have been proactive in launching the tele-medicine guidelines for the benefit of millions of doctors and patients across India. The guidelines clearly define the legal aspects involved and define the variety of technology that can be used for providing teleconsultation. However, the guidelines do not allow dose escalation, addition of new drugs and prescription of conventional or biological DMARDs. These are essential parts of patient follow-up in rheumatology practice and are extremely safe when done by experts. With time and more experience in tele-medicine, these shortcomings are likely to be ironed out. In fact, the results of our study can be extrapolated for the management of most chronic diseases like diabetes and hypertension with the exception of malignant disorders. A hybrid long-term model as discussed above would be an ideal health care delivery model for developing countries. The government of India currently spends 20–25% of total health spending of the country on non-communicable diseases [27]. Increase in this spending by means of higher allocation of funds or by using public–private partnership models to strengthen resources at the secondary care centres or urban health centres are the need of the hour. Thus, with minimal added federal investment, we will be able to provide cheaper and state of the art health care at the patients' doorstep.

## Acknowledgements

V.S.N. and C.K. designed and coordinated the study. S.S., A.D. and D.B. designed the data collection form and trained the team. S.S.K. and K.R. designed the cost analysis components of the study. V.S.N., C.K., S.S., A.D., D.B., S.D., A.M., S.D., A.G. and K.R. recruited the patients, collected, organized and interpreted the data. C.K., D.B., A.M. and S.D. conducted the statistical analysis. C.K. and S.S. drafted the manuscript. V.S.N. and S.S.K. critically reviewed the manuscript. V.S.N. is the lead author and all the authors agree to the contents and are equally responsible for the contents of the manuscript.

**Funding:** No specific funding was received from any funding bodies in the public, commercial or not-for-profit sectors to carry out the work described in this manuscript.

**Disclosure statement:** All authors declare that there is no conflict of interest.

## Data availability statement

Data represented in this manuscript are available with the Corresponding Author and will be provided if necessary.

## Supplementary data

Supplementary data are available at *Rheumatology* online.

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