



Contents lists available at ScienceDirect

Journal of Hand Therapy

journal homepage: www.elsevier.com/locate/jht

Research Paper

The online version of an evidence-based hand exercise programme for people with rheumatoid arthritis: An effectiveness-implementation study

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ARTICLE INFO

Article history:

Received 11 March 2024

Revised 4 November 2024

Accepted 7 November 2024

Available online xxx

Keywords:

Rheumatoid arthritis

Pain

Hand function

Online program

Implementation

ABSTRACT

Background: The Strengthening and Stretching for Rheumatoid Arthritis of the Hand (SARAH) program is an evidence-based exercise program for adults with hand function difficulties due to rheumatoid arthritis. A self-guided online version of the program has been developed for direct access by patients.

Purpose: To evaluate the delivery of the online program in routine therapy care and its impact on clinical outcomes, before making it widely available.

Study Design: An effectiveness-implementation study.

Methods: Volunteer patients were identified from National Health Service (NHS) hand therapy departments in the United Kingdom. Patients were given access to the 4-week program, delivered via text, videos, polls, and social discussion forums. Self-reported pain and hand function were collected at baseline, discharge, and telephone follow-up at 4 months. Delivery of baseline and discharge sessions, acceptability, and patient engagement and experience were also explored.

Results: A total of 78 patients were enrolled from 18 therapy departments in 15 NHS trusts in England, Scotland, and Wales. Sixty-five patients took part, of whom 46 (71%) registered with the online SARAH program. The majority of baseline and discharge sessions were delivered face-to-face. Pain improved at discharge and was stable at follow-up. Hand function significantly improved with medium effect sizes of Cohen's *d* of 0.6 and 0.52 respectively. The majority of patients rated themselves as improved and were continuing the SARAH exercises at discharge and 4 months. No related adverse effects were reported. Patient engagement was high during the first week of the program but gradually declined. Most patients were satisfied and found the program useful.

Conclusions: The online SARAH program delivered in routine therapy care was acceptable and beneficial to patients. Improvements in clinical outcomes were similar to the SARAH clinical trial and our previous implementation work.

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Introduction

Rheumatoid arthritis (RA) is a chronic inflammatory autoimmune disorder affecting the synovial joints and multiple organ systems such as heart and lungs.¹ As per the 2021 Global Burden of Diseases, Injuries, and Risk Factors Study, about 17.6 million people were living with RA in 2020. By 2050, 31.7 million people are expected to be living with RA.² The prevalence in the United Kingdom (UK) is about 1% of the

population. RA can affect anyone but women are 2 to 3 times more likely to be affected. RA commonly affects the small joints of the hands and wrists, particularly the metacarpophalangeal and proximal interphalangeal joints. If left untreated, it causes pain, swelling, morning stiffness, and hand and wrist deformities, leading to chronic disability and restricted participation.² The condition is treated by a multi-disciplinary approach including exercises to the affected joints and surrounding muscles, to reduce disability and improve functioning.³

The SARAH program (Strengthening And Stretching for Rheumatoid Arthritis of the Hand) is a progressive and tailored hand and arm exercise program^{4,5} for people with RA affecting the hands and wrists. The program consists of seven flexibility and four strength exercises

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supplemented with behavioral strategies such as self-monitoring, goal setting, and action planning to encourage long-term exercise adherence.

The SARAH program was compared to best practice usual care in a randomized controlled trial with 490 patients in England.⁶ Patients who received the SARAH program attended an initial face-to-face assessment and five supervised exercise training/review sessions with their therapists over a 12-week period to ensure progression of exercises and adherence to home exercise. The primary outcome was the hand function subscale of the Michigan Hand Outcome Questionnaire at 12 months (10 questions scored from 0 to 100; higher scores mean better hand function). The mean change (95% confidence interval, [CI]) from baseline to 4 months in the usual care group was 4.04 (2.17–5.91), while in the SARAH group, it was 8.73 (6.83–10.64) ($N = 449$). The mean change (95% CI) at 12 months was 3.56 (1.45–5.68) in the usual care group and 7.93 (5.98–9.88) in the SARAH group ($N = 438$). This indicates that the improvements in hand function were double in the SARAH group compared to usual care. Pain remained stable, and no adverse effects were reported related to the SARAH program. It also demonstrated to be a cost-effective intervention.⁶ These findings provided high-quality evidence on the prescription of hand exercises and led to an update of the National Institute for Health and Care Excellence (NICE) guidelines of managing RA in adults.⁷ The SARAH program is recommended for adults having difficulties with hand function due to RA and on a stable drug treatment for at least 3 months or on no drugs.^{4–6}

Following the clinical trial, we undertook an implementation study demonstrating similar patient outcomes when the SARAH face to face program was delivered by therapists as part of routine National Health Service (NHS) care.^{8,9} However, some therapists struggled to provide the recommended number of SARAH sessions, delivering only one or two sessions which was inadequate for exercise progression needed to ensure hand muscle strength gains for the success of the program.¹⁰ We also found that in some countries, the therapy infrastructure to provide the SARAH program was not available.¹¹

Therefore, we developed an online SARAH program for direct access by patients, following a needs assessment; review by patient contributors; and usability evaluation in patients ($n = 9$).¹² It was a self-guided program with six online sessions that had the same format and materials from the face-to-face SARAH program. A concept development study was conducted in another sample ($n = 8$),¹³ where patients were observed navigating four key sessions of the program at their homes or research center. This preliminary investigation indicated that the online SARAH program was feasible, acceptable, and beneficial, and that the program could be reduced to a 4-week online version. However, further evaluation was needed before making the online SARAH program widely available in NHS therapy settings.

Purpose

We aimed to, 1) evaluate its delivery in routine NHS therapy settings and clinical impact on patient outcomes, 2) determine if the online program is acceptable to patients, 3) explore patient engagement and experiences with the program, and 4) update the program, if needed.

Methods

Study design

We used the effectiveness-hybrid implementation type 2 design.¹⁴ This allowed a dual evaluation of the clinical intervention (SARAH program) on patient-level outcomes (pre-post), and adoption of the implementation intervention (the online SARAH program) in routine settings.

Participants

We advertised the online SARAH evaluation through our research team's contacts from our previous SARAH work and the British Association of Hand Therapists e-bulletin. Occupational therapists and physiotherapists from NHS settings in the UK who were regularly prescribing the SARAH program to their patients were invited to take part. Therapists who expressed interest in participating in the online SARAH program evaluation were provided with implementation packs containing patient agreement forms, baseline and discharge questionnaire booklets, and treatment logs.

Therapists were asked to identify and invite potential patients (aged 18 or older, with stable rheumatoid arthritis) to participate in the evaluation. Additionally, patients needed to have access to a computer or mobile device with internet connection and agree to provide their contact details to the SARAH research team at the University of Exeter to complete follow-up assessments through telephone or postal questionnaires. Those who were willing and provided signed agreement were recruited by the therapists at the participating sites.

We set a pragmatic target of 50 patients, based on 20% attrition rate ($n = 62$) and limited funding resources and time period for a large sample or conducting follow-up assessments. A sample size of 40 or above may mean the data is normally distributed and sufficient for one-sample student t-test analysis.¹⁵

Procedure

At baseline session, patients provided their informed written consent after which they underwent a routine clinical assessment and completed a baseline questionnaire (Table 1). We used the hand function subscale of the Michigan Hand Outcomes Questionnaire¹⁶ (the primary outcome of SARAH clinical trial) to allow comparison to the original trial⁶ and implementation study.^{9,13}

Patients were provided with a unique link to register with the online SARAH program on FutureLearn, a massive open online learning platform on a wide range of subjects available at <https://www.futurelearn.com>. Therapists either showed them how to register or emailed the link. Patients were advised to start the program as soon as possible and contact their therapists if they had any issues. Some sites provided Therabands and/or putty to do the strengthening exercises and some asked the patients to purchase their own.

Upon registration, patients had access to 4 weekly sessions: 1) Getting started, 2) SARAH strength exercises, 3) Adjusting the SARAH exercises and 4) Doing the exercises long-term. There were 46 learning activities in the form of text, instructional and exercise videos, polls, and social discussion forums (Appendix 1). Within the program, patients self-rated their hand and wrist pain, hand function and confidence in doing the program in Likert scale polls (Table 1). Each activity step had a comments section where patients can post their comments relating to the program. They also commented in social discussion forums that had pre-defined questions (Appendix 1) to share their experiences with other patients. Two authors (EW and CS) moderated the comments to address any queries. Patients could also download the exercise guide, exercise planner, and exercise diary.

Approximately 6 weeks from baseline, patients attended another appointment with their therapist to provide discharge data (Table 1). This allowed adequate time for patients to use the online resource and provide clinical outcomes. However, this 6-week window was intended as guidance only, as discharge appointment time points varied widely across the participating sites. Four months later, the SARAH research team contacted the patients by telephone to complete the 4-month follow-up questionnaire (Table 1). When patients were not reached by phone, postal questionnaires were sent.

Table 1
Data collection and assessment schedule for the online SARA-SE

Data	Time points
<i>Outcomes collected via questionnaire booklets [Baseline and Discharge] and telephone [follow-up]:</i>	
Demographics – age, gender, ethnic origin, employment status, hand dominance, and disease duration	Baseline
Self-reported hand and wrist pain intensity [5-point Likert scale, Very mild to Very severe]	Baseline Discharge 4-mo follow-up
Self-reported hand function [Hand function sub-scale of Michigan Hand Outcomes Questionnaire, 0 to 100- higher scores mean better hand function]	Baseline Discharge 4-mo follow-up
Self-reported recovery [7-point Likert scale, Completely recovered to Vastly worsened]	Discharge 4-mo follow-up
Patient satisfaction with the SARA-SE program [5-point Likert scale, Very dissatisfied to Very satisfied]	Discharge
Patient perceived usefulness of the SARA-SE program [5-point Likert scale, Not at all useful to Extremely useful]	Discharge
Self-reported adherence to SARA-SE exercises at home [Yes/No]	Discharge 4-mo follow-up
Self-reported home exercise frequency [Daily/3–4 times per week/1–2 times per week/Other]	Discharge 4-mo follow-up
Informal feedback on online SARA-SE program	4-mo follow-up
<i>Treatment logs completed by therapists in the questionnaire booklets:</i>	
Mode of delivery [face-to-face/telephone/videoconference]	Baseline Discharge
Guidance on online SARA-SE registration and provision of link	Baseline
Provision of exercise equipment – putty, exercise bands	Baseline
Any issues experienced by patients when doing the online SARA-SE program	Time period between baseline and discharge
Patient-reported number of weekly online sessions completed	Discharge
Evaluation of exercise performance [3-point Likert scale: 1-Correct Demonstration; 2- Incorrect and required Assistance; 3-Incorrect after being assisted]	Discharge
Patient attendance	Baseline Discharge
<i>Information collected within the online SARA-SE program:</i>	
Number of patients registered	Weekly reports until the program was closed.
Step activity metrics – number of visits made to each step of the program	
Self-reported hand and wrist pain intensity [5-point Likert scale, Very mild to Very severe]	Week 1 and Week 4
Self-reported difficulty in doing usual activities. [5-point Likert scale, No difficulty to Unable to do]	Week 1 and Week 4
Self-reported confidence in doing the program. [5-point Likert scale, Not confident at all to Very confident]	Week 1 and Week 4
Self-reported recovery [7-point Likert scale, Completely recovered to Vastly worsened]	Week 4
Patient feedback from discussion forums – individual comments by users	Weeks 1 to 4

SARA-SE = strengthening and stretching for rheumatoid arthritis of the hand.

Data analysis

We summarized the demographic information and clinical outcomes and estimated the changes in hand function and pain as mean or median difference using paired student *t*-test or Wilcoxon signed-rank test, as appropriate. We also calculated Cohen's *d* for hand function that was interpreted as small (0.2 to 0.5), medium (0.5 to 0.8) and large (greater than 0.8) treatment effect sizes.¹⁷ Missingness varied among outcomes and we used all the available data for reporting. Data were analysed using SPSS Version 29,¹⁸ with two-sided significance set at 0.05.

We presented the number of patients in each response category for self-reported recovery, usefulness and treatment satisfaction, and home exercise adherence. We summarized the informal feedback collected during follow-up. We undertook content analysis of individual patients' comments from the forums to describe their overall experience.¹⁹ This process involved reading and coding each comment, and allocating similar codes into categories and labeling them.

Ethics

The University of Exeter classified this project as service evaluation not requiring approval. As per the UK's Health Research Authority guidelines,²⁰ service evaluation refers to projects that

evaluate current service without reference to a standard and involving an intervention only.

Results

Recruitment and baseline characteristics

Between May 30, 2022 and May 20, 2023, 18 therapy departments from 15 NHS trusts in England, Scotland, and Wales participated. Sixteen occupational therapists and one physiotherapist led the evaluation from the participating sites. Figure 1 shows the flowchart of patients through the online SARA-SE evaluation. Five sites did not recruit any participants.

In total, 78 patients agreed to participate. However, 13 patients (13/78, 17%) withdrew for the following reasons: i) chose not to participate or no reason given ($n = 5$); ii) lack of time ($n = 2$); iii) had difficulties using the website or viewing the exercises on the phone and preferred face-to-face sessions ($n = 3$); and iv) could not participate due to other health reasons ($n = 3$).

Within the questionnaire booklets, baseline data were available for 94% of patients (61/65). The majority were women, white British, employed (full-time/part-time/self-employed) and right-handed (Table 2). Discharge data was available for 65% of patients (42/65). Four-month follow-up assessments were completed in 46/65 (71%)

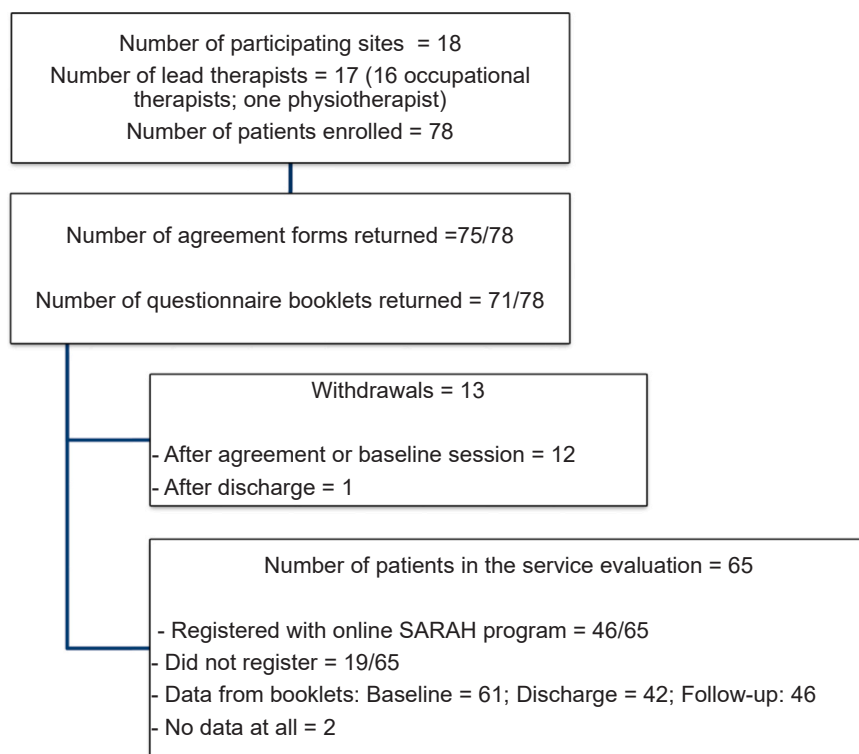


Fig. 1. Online SARAH evaluation flow diagram. SARAH = strengthening and stretching for rheumatoid arthritis of the hand.

Table 2
Demographic characteristics of patients in the online SARAH service evaluation

Demographics	All patients N=65	Those who registered N=46	Those who didn't register N=19
Gender [n, %]	Female: 52 [87%] Male: 8	Female: 38 [86%] Male: 6	Female: 14 [87.5%] Male: 2
Mean age [SD] in years	54.3 [13.4]	54.6 [13.7]	53.6 [13]
Mean RA duration [SD] in years	12.7 [11]	13 [11.5]	11.9 [9.9]
Ethnicity	White: 56 [93%] Mixed: 1 Other: 3	White: 43 [98%] Other: 1	White: 13 [81%] Mixed: 1 Other: 2 [Mexican: 1; Black Caribbean: 1]
Handedness	Right: 46 Left: 5	Right: 33 Left: 4	Right: 13 Left: 1
Employment	Employed: 34 [57%] Not working/Retired: 26	Employed: 24 [54.5%] Not working/Retired: 20	Employed: 10 [62.5%] Not working/Retired: 6
Mean Hand function [SD] [0-100]	52.9 [16.2]	51.7 [16.7]	55.8 [14.4]
Median pain [Interquartile range] [1-5]	3 [2 to 3.75]	3 [2.25 to 4]	3 [2 to 3]

SD = standard deviation; SARAH = strengthening and stretching for rheumatoid arthritis of the hand.

patients (telephone: 40; postal questionnaires: 6). Full datasets were available from 52% patients (34/65). Data was unavailable from four patients (no data = 2, and only follow-up data = 2; 6%) and hence excluded from the analyses.

The majority of baseline sessions were conducted face to face (53/60; 1 missing) and seven via telephone. During this session, 51 patients were shown how to register with the online program. Five patients were not shown due to lack of time or the link was emailed: 4; One patient was instructed over the telephone. Exercise equipment (Thera band, Theraputty or both) were provided to 49 patients. Three patients purchased on their own. Some sites also provided printed exercise sheets to their patients.

Forty-three patients attended the discharge session with 26 attending in person, 12 were by phone, one via video conference and there was no information for four patients. Four-month follow-up was completed in 46 patients (telephone: 40; postal questionnaires:

6). The average duration between baseline and discharge appointments completed across the participating sites was 70 days, and baseline and follow-up was 130 days.

Not all the patients who signed up and were given access to the online SARAH program went onto register for the program. Of the 65 participating patients, 46/65 (71%) registered with the online SARAH program and 19/65 (29%) did not.

Those who did not register were slightly younger and had lived with RA for less time with higher baseline hand function than those who did register (Table 2). Reasons collected during 4-month telephone follow-up for not registering with the online SARAH program included not being computer savvy ($n=1$), issues with logging in or Internet connectivity ($n=3$), other health problems ($n=1$), couldn't find time ($n=1$), felt the online program was too much and preferred face-to-face sessions with therapist ($n=1$). Seven patients also reported getting printed exercise sheets and exercise equipment from their therapists.

Table 3
Clinical outcomes for patients who registered for the course

Outcomes	Baseline all patients		Baseline [patients providing discharge data]		Discharge		Baseline [patients providing follow-up data]		Follow-up		p*			
	Mean [SD] or median [IQR]	N	Mean [SD] or median [IQR]	N	Mean [SD] or median [IQR]	N	Mean [SD] or median [IQR]	N	Mean change [95% CI] or median change [IQR]	Mean [SD] or median [IQR]		N		
Hand function [0–100]	44	51.7 [16.7]	32	51.8 [15.8]	32	62.3 [21]	53	18.1	33	61.9 [18]	33	8.9 [2.8 to 14.9]†	0.005	
Hand/wrist pain [1–5]	44	3 [2.25 to 4]	32	3 [2 to 4]	31	2 [2 to 3]	10.5 [3.9 to 17.2]‡	3	[2 to 4]	33	3 [2 to 3]	0 [0 to -1]	<0.001	0.008

SD = standard deviation; CI = confidence interval; IQR = interquartile range.

* Two-sided p value.

† Cohen's *d* 0.6 [95% CI, 0.2 to 0.95].

‡ Cohen's *d* 0.52 [95% CI, 0.2 to 0.9].

Clinical outcomes

Self-reported hand and wrist pain intensity and hand function in patients who registered with the online program are presented in Table 3. Wilcoxon-signed rank test showed that pain significantly reduced at discharge and remained stable at follow-up. Paired sample student *t* test indicated significant improvements in hand function at discharge and follow-up with medium treatment effect sizes of Cohen's *d* = 0.6 and 0.52 respectively (Table 3).

Figure 2a presents the number of patients who self-reported their recovery at discharge and follow-up. The majority of patients rated themselves as improved (much improved or slightly improved) at discharge (87%, 26/30) and follow-up (79%, 26/33). At discharge and follow-up, 91% of patients reported continuing the SARAH exercises (Fig. 2b). Around 50% and 40% were exercising daily and 17% and 33% were doing 3–4 times/wk, respectively (Fig. 2c).

During the discharge session, therapists conducted and reported 262 observations in 24 patients performing the 11 SARAH exercises. Overall, the majority of the patients demonstrated all the exercises correctly (207/262, success rate 79%). Twenty-eight out of the 262 observations (11%) were incorrect in the first attempt and required therapist guidance. The exercises that were most challenging were the wrist backward bends ($n=8/24$) and knuckle bends ($n=3/24$). Three patients had difficulty demonstrating the exercises correctly, even after therapist guidance.

No adverse effects such as severe pain or stiffness related to the SARAH exercises were reported.

Acceptability

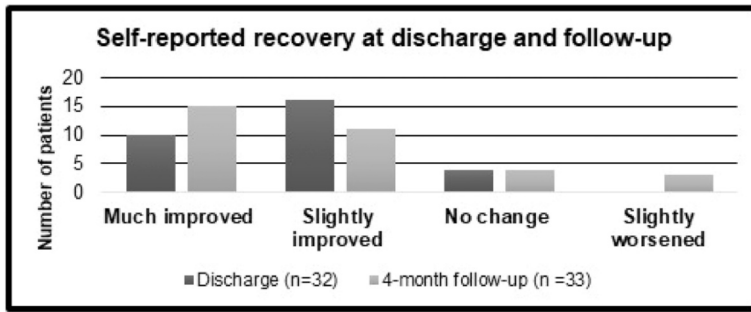
Figures 2d and 2e present self-reported usefulness and treatment satisfaction by those who registered with the program. Most patients were satisfied (87%, 26/30) and found the program as useful (90%, 27/30). Feedback collected during follow-up also indicated that most patients perceived the program as useful and easy to follow. One patient commented that the exercise illustrations had a poor color background and exercise videos were not relatable with a white person demonstrating hand and wrist movements difficult to do.

Patient engagement

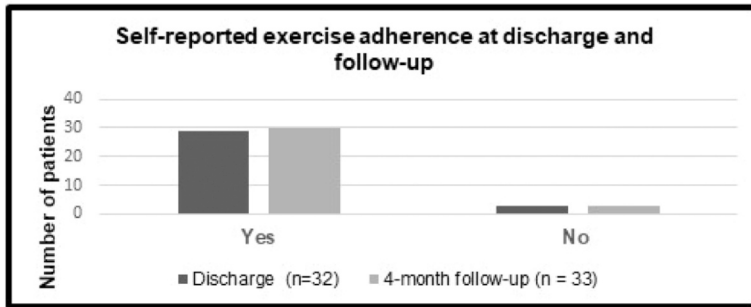
In those registered, self-reports on the number of weekly online SARAH sessions completed were available from 25/33 patients at discharge. Eighteen patients said they completed all 4 weeks; two reported completing 3 weeks; four completed 2 weeks and one patient completed the first week.

The user activity data from FutureLearn indicated a total of 1032 steps visited by 49 patients. The average number of steps visited was 21, ranging from 1 to 41. Table 4 lists the number of visits to steps that covered the core content of the online program. Engagement intensity was relatively high at Week 1 and declined reaching up to 27% by Week 4. With comments on activities and discussion forums, individual participation and interactions peaked at Week 1 that declined to 49%, 41.5% and 48% in the subsequent 3 weeks.

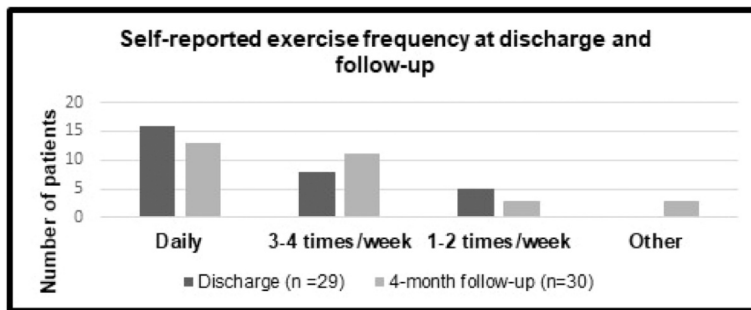
During the telephone follow-up, a few of the registered patients discussed why they couldn't continue the online program. Five patients were using printed exercise sheets and one of them felt the registration process and setting up the password with FutureLearn was too much effort. Two patients reported having difficulty operating the computer keyboard. Another had wrist pain after doing wrist backward bends at higher loads and was advised by the therapist to reduce the load. Another had personal issues and three others reported difficulty doing specific exercises (wrist backward bends or putty exercises).



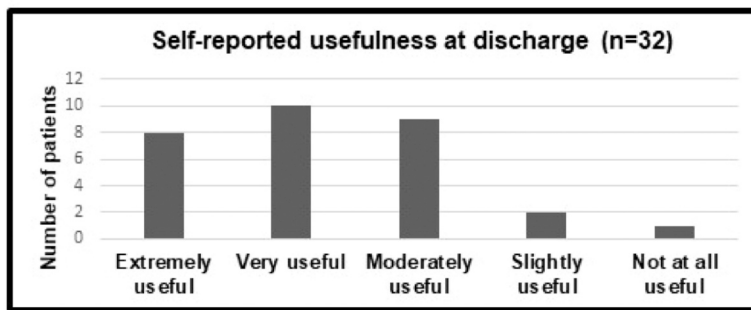
a. Self-reported recovery



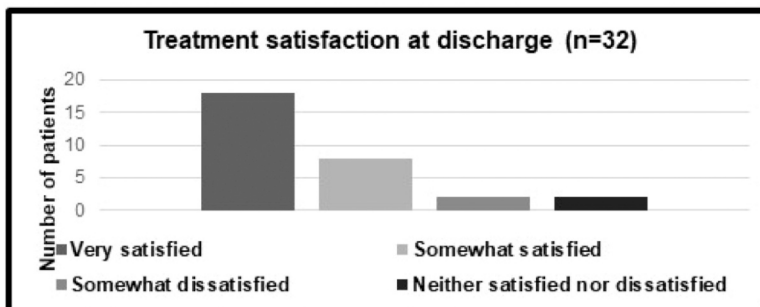
b. Self-reported exercise adherence



c. Self-reported exercise frequency



d. Self-reported usefulness



e. Self-reported satisfaction

Fig. 2. Self-reported recovery, usefulness, treatment satisfaction and home exercise adherence at discharge and follow-up.

Table 4
Number of visits to steps that covered the core content of the online SARAH program

Weeks	Step number, topic, delivery format	Number of visits
Week 1	Step 1.1	
Total 14 steps	Course essentials – Text	41
	Step 1.7	
	• Flexibility exercise videos – Knuckle bends, Finger bends, Finger walking	40
	Step 1.8	
	• Flexibility exercise videos – Wrist circles, Spread fingers, Hand behind head, Hand behind back	37
Week 2	Steps 2.3 to 2.6 Strengthening exercise videos	
Total 9 steps	• Hand squeeze	26
	• Squeeze fingers	24
	• Finger pinch	23
	• Wrist backward bends	24
Week 3	Step 3.1	17
Total 9 steps	Overview of Week 3 – Text	
Week 4	Step 4.1	24
Total 14 steps	Overview of Week 4 – Text	
	Step 4.14	11
	End of course reflections – Discussion	

SARAH = strengthening and stretching for rheumatoid arthritis of the hand.

Overall experience

Content analysis of patients' comments in the discussion forums revealed nine categories listed in Table 5. Twenty-nine patients (63% of those registered) commented at least once or more on the activity steps and discussion forums, out of which 11 contributed in Week 4.

Three categories emerged from Week 1. Patients shared personal stories of how RA symptoms and impairments (such as reduced

flexibility and strength) impacted their day-to-day function. The online program was recommended by their therapists. Patients expressed different treatment expectations in terms of improvements in pain, swelling, stiffness, flexibility, strength and/or ability to function in daily life. A few were having difficulty doing particular flexibility exercises, for example, knuckle bends and finger bends. The exercise guide and videos were perceived as useful resources.

Two categories emerged from Week 2 and 3 respectively. Majority of the patients felt challenged to do the strength exercises (particularly finger pinch and hand squeeze) due to pain, weakness, or previous surgery in the hand. They also shared how they kept going with the program, some starting off with strength exercises at low loads and gradually building-up.

By Week 3, patients started perceiving the benefits of exercises with reduction in pain and improvements in flexibility, dexterity and strength. They also felt empowered doing the program by adjusting the exercise plan and dosage on their own.

By Week 4, the majority of patients' treatment expectations were met as they perceived improvements in pain, swelling, stiffness, flexibility, strength and/or hand function.

Overall, patient experience with the online SARAH program was positive and encouraging.

Discussion

Our findings indicated that the online SARAH program when delivered by therapists in routine NHS settings was feasible to deliver, acceptable to patients and resulted in significant improvements in clinical outcomes.

In terms of recruitment and engagement, around 17% patients withdrew (13/78); one-third of patients who took part didn't register with the online program (19/65); and of those registered, a few

Table 5
Overall patient experience

Week	Categories	Quotes
Week 1	Impact of rheumatoid arthritis on day-to-day function	<i>I have suffered from RA for over 20 y but as I get older I have had to adapt some tasks are becoming more difficult as my hands have become weaker and more painful with less flexibility my occupational therapist recommended the SARAH program might be beneficial I am willing to try anything that might help improve quality of life. [Male, 60 y]</i>
89 comments	Therapists suggested the program	<i>The physiotherapist I am attending recommended I joined and sent me the link and printed the exercises for me also supplied the beige putty to get me started. [Female, 78 y]</i>
	Hoping to see benefits	<i>Looking forward to seeing how much my strength and grip improves. [Female, 61 y]</i> <i>I have recently been diagnosed with rheumatoid arthritis and I am looking forward to the course to see if it will help me with the pain. [Male, 68 y]</i>
	SARAH materials are useful	<i>I think these exercises will be really helpful. I can feel them stretching the joints in my hand and encouraging movement. [Female, 42 y]</i>
Week 2 44 comments	Strength exercises are challenging	<i>Useful video - helped me decide on my own, daily, achievable exercise plan. [Female, 59 y]</i> <i>Struggling with some but early days and others have become well not easy but I'm doing them and able to carry on. [Female, 62 y]</i>
	I would keep going	<i>Really hard, this one! Little finger and the one next to it on both sides are really weak and struggle to pinch the putty. Left had noticeably weaker than the right [I am right-handed]. [Female, 59 y]</i>
Week 3	Seeing the benefits	<i>I have been performing the exercises to the best of my ability and on the whole can manage to perform them given time to practice [Male, 60 y]</i>
37 comments	I am mastering the program!	<i>I am benefitting from the exercises. My fingers have more dexterity and I'm not experiencing pain. [Female, 61 y]</i> <i>I'm making the exercises part of daily life, finding ways to do them in all sorts of situations. [Female, 39 y]</i> <i>I am adjusting the plan, and which exercises I can do, mixing the sets and amount of seconds held to what I can comfortably do, without feeling pain the next morning. [Female, 59 y]</i>
Week 4	SARAH exercises have benefitted me	<i>I adjust the SARAH plan to accommodate what movement and strength I have in my hands at the time and to accommodate any pain limitation when doing them [Male, 60 y]</i> <i>I feel perfectly confident to do them on my own. [Female, 65 y]</i> <i>I wasn't able to close my hands before or flatten them out. they are not perfect but a big improvement. [Female, 78 y]</i>
43 comments		<i>Thanks to my OT and to you for your research and helpful tips. I have found the exercises extremely beneficial, my dexterity and strength has noticeably improved. I shall make a habit of continuing. [Female, 61 y]</i> <i>The flexibility and strengthening exercises are definitely helping. I will continue to do them regularly. [Female, 68 y]</i>

SARAH = strengthening and stretching for rheumatoid arthritis of the hand.

reported that they couldn't continue the program. The majority of these patients had common reasons such as lack of time, difficulties accessing the program due to pain, or difficulty with using computer keyboard and technical reasons, and a preference for face-to-face appointments and printed exercise sheets. These findings resonate with the frequently reported barriers that prevent people from participating in digital health interventions.^{21,22} Strategies such as knowing patients' expectations and barriers in using the online program, making the program accessible across devices, facilitating personal motivation with rewards, credit points or recognition from the treating healthcare professionals,²³ and providing audiovisual guidance on registration process could facilitate active involvement. From the outset, it is important that patients are made aware of their active role in managing RA.²⁴ Tailored solutions to minimize pain, stiffness and discomfort from using computers^{25–27} such as using soft gel keyboard pads, keyboard shortcuts to minimize usage of mouse, touch pad or text dictation options and a good sitting posture might be useful.

In terms of clinical impact, changes in pain and hand function and the proportion of patients who rated themselves as improved were similar to the original SARAH trial⁶ and our previous implementation work.^{9,13} Resonating with our previous evaluations,^{6,9,13} no adverse effects relating to the online SARAH program were reported. These findings indicate that the online SARAH program was beneficial and safe when delivered in routine care. Though the success rate of exercise performance was slightly lower compared to our previous work,¹³ the results are still encouraging as patients practised and progressed the exercises on their own.

Patients did not suggest any further modifications in the online SARAH program. Given the challenges experienced by a few patients with finger, knuckle, and wrist bend exercises, we will produce step-by-step demonstration videos for these exercises by involving a patient representative. The updated online SARAH program will be hosted from the University of Exeter, UK for wider and easy access by patients. A navigation video guide will be produced for patients to find and understand the registration process and features of the online SARAH program.

Limitations

This study has some limitations. Recruitment depended on therapists' selection of potential patients and those who were willing to do the online SARAH program. These factors may have contributed to selection bias. Though the patient samples were from diverse geographical locations, the majority of them were from white ethnic background (93%), females (87%) or employed (57%). We predominantly used patient-reported outcome measures and scales. We did not assess the fidelity of the first therapy session, patients' digital skills, or how they navigated the online SARAH program. Lack of control group and long-term follow-up, under representation of patients from non-white ethnic groups, and small sample size limit the generalizability of the findings.

Conclusions

This study has provided valuable insight into the real-world application of the online SARAH program in patients accessing NHS care. Positive clinical outcomes and patient feedback have further strengthened the evidence base on the usefulness, safety, and therapeutic benefits of the SARAH program. Patients learnt to tailor the SARAH exercises to their own needs and abilities and felt empowered mastering the program. Patients who did the program perceived it as a useful self-guided resource.

Our next steps will be to develop partnerships with national and international professional networks, hospitals and charities, and to widely disseminate the program to people with RA in need of hand exercises.

Author contributions

Esther Williamson: Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Conceptualization. **Sarah E Lamb:** Writing – review & editing, Writing – original draft, Resources, Methodology, Funding acquisition, Conceptualization. **Cynthia Srikesavan:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare no conflicts of interest with the research, authorship, and publication of this manuscript.

Acknowledgments

The project was based at the University of Exeter and University of Oxford and funded by the Mireille Gillings Foundation. It is a collaboration with the University of Exeter and supported by funding from the Oxford Thames Valley Applied Research Collaboration (ARC), and NIHR Exeter Biomedical Research Center and ARC. We would like to thank the patient participants and acknowledge the study sites that took part in this evaluation.

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- 1) Whytemans Brae Hospital, NHS Fife
 - 2) Royal United Hospitals Bath
 - 3) Royal Hampshire County Hospital
 - 4) Basingstoke and North Hampshire Hospital
 - 5) Castle Douglas Hospital, NHS Dumfries & Galloway
 - 6) Chelsea and Westminster Hospital NHS Foundation Trust
 - 7) James Paget University Hospitals NHS Foundation Trust
 - 8) St Woolos hospital, Aneurin Bevan University Health Board
 - 9) County hospital, Aneurin Bevan University Health Board
 - 10) Ysbyty Ystrad Fawr, Aneurin Bevan University Health Board
 - 11) Chepstow Community Hospital, Aneurin Bevan University Health Board
 - 12) University Hospitals Birmingham
 - 13) Northern Devon Healthcare NHS Trust
 - 14) Wansbeck General Hospital, Northumbria Healthcare NHS Foundation Trust
 - 15) Hexham Gen Hospital, Northumbria Healthcare NHS Foundation Trust
 - 16) Nuffield Orthopaedic Centre, Oxford University Hospitals
 - 17) University Hospital Southampton
 - 18) Leeds Teaching Hospitals NHS Trust
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Supporting material

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.jht.2024.11.001.

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