

# Mobile Health Applications to Optimize Chronic Disease Management and Outcomes: Rheumatoid Arthritis

## Background

Mobile health applications (mHealth apps) are defined by the FDA as ‘programs that run on smartphones and other mobile devices that can be used to manage [their] own health and wellness’<sup>1</sup>. According to a 2012 mobile health study, 19% of smartphone owners have downloaded an app specifically to track or manage health<sup>2</sup>. MHealth apps represent a growing modality to enable patients to take ownership of tracking and managing their chronic disease states, such as rheumatoid arthritis (RA).

With less than 20% of RA patients achieving clinical remission, there is an unmet need for new approaches to empower patients to self-manage their rheumatoid arthritis<sup>3</sup>. Patient tracking of symptoms and standardized measures of disease activity allows for better communication with health care providers and the opportunity to utilize a treat-to-target strategy. With functions such as disease activity tracking, medication reminders, and export to email, mHealth apps for rheumatoid arthritis have the potential to lead to improved clinical outcomes.

## Objective

To identify, categorize, and rank the variety of current mobile health applications (mHealth apps) available in rheumatoid arthritis (RA) with a focus on disease activity tracking, patient self-management, and the potential to improve disease outcomes.

## Methods

A search of mHealth apps was completed for both the iPhone and Android devices, the two leading smartphone operating systems, in November 2013 – February 2014. The search term “*rheumatoid arthritis*” resulted in n=32 iPhone apps from iTunes and n=198 Android apps from Google Play. Apps were excluded if not in English or did not track RA disease activity. Based on the criteria, a total of 7 apps were selected for inclusion in this research (n=4 Apple only, n=0 Android only, n=3 Apple and Android).

A qualitative and quantitative ranking tool was developed to evaluate the utility of these apps in helping patients self-manage rheumatoid arthritis. This ranking tool assessed the overall usability (1-5 star scale) of the mHealth apps based on two separate categories: Useful/Relevant (1-3 scale) and Interface/Navigation (1-3 scale).

### Definition of Useful/Relevant Scores (1-3)<sup>4</sup>

1. Standardized descriptive/numeric measures OR Composite Indexes OR Classification of Disease Activity
2. (Standardized descriptive/numeric measures OR Composite Indexes) AND (Classification of Disease Activity OR Functional Status Assessment OR Disease Prognosis Assessment)
3. (Standardized descriptive/numeric measures OR Composite Indexes) AND (Classification of Disease Activity OR Functional Status Assessment OR Disease Prognosis Assessment) AND (Relevant Additional Features)

### Definition of Interface/Navigation Scores (1-3)<sup>5</sup>

1. Confusing/messy/cluttered screen design; Complex data input process; information poorly presented and subject to misinterpretation; extensive training required; intrusive advertisements.
2. Average screen design; Average data input process; information adequately presented; minimal training required; subtle advertisements.
3. Clear/clean/uncluttered screen design; Intuitive data input process; information well presented and easy to understand; no training required; free of advertisements.

## Results

TABLE 1. SUMMARY OF MHEALTH APPS FOR RHEUMATOID ARTHRITIS SELF-MANAGEMENT

General App Information							
App Name	MyRA	RAVE mobile	ArthritisID	R. Arthritis	RheumaTrack RA	RA Helper	RheumaHelper
Manufacturer	Crescendo Bioscience, Inc	DKBmed LLC	ACE Planning and Consulting Inc.	Frank Seubert	Mutterelbe medical UG	Modra Jagoda	Modra Jagoda
Version	1.6 (Updated Sep 16, 2013)	2.0.0 (Updated Oct 19, 2013)	1.0.4 (Updated Jan 24, 2012)	1.0 (Released Apr 26, 2013)	2.0 (Updated Feb 17, 2014)	1.0.1 (Updated Oct 27, 2013)	1.2 (Updated Oct 23, 2013)
Star Rating	4.5	N/A	N/A	N/A	4.1	5.0	4.5
Number of Reviews	38	N/A	N/A	N/A	259 Android / 20 Apple	3 Android	45 Android
Price / Device Compatibility	Free / Apple	Free / Apple	Free / Apple	Free / Apple	Free / Android and Apple	Free / Android and Apple	Free / Android and Apple
Overall Usability							
Author's Ranking (★ to ★★★★★)	★★★★	★★★★★	★★	★★	★★★★★	★	★★★★
Useful/Relevant (0-3)	2	3	1	1	2	1	2
Interface/Navigation (0-3)	3	3	2	1	3	1	2
Disease Activity Assessment							
Standardized descriptive/numeric measures							
Joint Symptoms	X	X	X	None	X	None	None
Morning Stiffness	X	None	X	None	X	None	None
Fatigue	X	None	X	None	None	None	None
Composite Indexes	None	X	None	X	None	X	X
Classification of Disease Activity	None	X	None	None	None	None	X
Functional Status Assessment							
Activities of Daily Living							
Standardized descriptive or numeric scale	X	None	None	None	X	None	None
Disease Prognosis Assessment							
Clinically Important Markers of Poor Prognosis	X	None	None	None	None	None	X
Classification of Disease Prognosis	None	None	None	None	None	None	None
Additional Features							
Trend Charts/Health Status Summary	X	X	None	None	X	X	None
Medication List / Alarm	X	None	None	None	X	X	None
Acute Phase Reactant Tracking	X	X	None	X	None	X	None
Note Taking	X	None	None	X	X	None	None
Export Function	X	X	None	None	X	None	None
Social Media	X	None	None	None	None	None	None
Disease Awareness & Education	X	X	X	X	None	None	None
Links to external resources	X	X	X	X	X	None	X

FIGURE 1. USEFUL/RELEVANT SCORE



Definition of Useful/Relevant Scores (1-3)

1. Standardized descriptive/numeric measures OR Composite Indexes OR Classification of Disease Activity
2. (Standardized descriptive/numeric measures OR Composite Indexes) AND (Classification of Disease Activity OR Functional Status Assessment OR Disease Prognosis Assessment)
3. (Standardized descriptive/numeric measures OR Composite Indexes) AND (Classification of Disease Activity OR Functional Status Assessment OR Disease Prognosis Assessment) AND (Relevant Additional Features)

FIGURE 2. INTERFACE/NAVIGATION SCORE



Definition of Interface/Navigation Scores (1-3)

1. Confusing/messy/cluttered screen design; Complex data input process; information poorly presented and subject to misinterpretation; extensive training required; intrusive advertisements.
2. Average screen design; Average data input process; information adequately presented; minimal training required; subtle advertisements.
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TABLE 2. VALIDATED RHEUMATOID ARTHRITIS DISEASE ACTIVITY MEASURES

MyRA	None Available					
RAVE mobile	DAS 28 (CRP and ESR)	CDAI	SDAI			
ArthritisID	None Available					
Rheumatoid Arthritis Diagnosis and Management	DAS 28 (ESR)	CDAI	SDAI	RAPID 3	PAS	
RheumaTrack RA	None Available					
RA Helper	DAS 28	CDAI	SDAI			
RheumaHelper	DAS 28 (ESR)	CDAI	SDAI			

TABLE 3. INNOVATIVE FEATURES

	# APPS WITH FEATURE	APPS WITH BEST EXAMPLE OF FEATURE
Camera Capture of Joint Symptoms	1	MyRA
Audio Recording of Patient-Reported Symptoms	1	MyRA
Tapping on Figure to Indicate Joint Involvement	3	RheumaTrack RA
Option to Set Disease Activity Goal	1	RA Helper
Option to Add Customized Daily Functionality Activity	1	MyRA
Youtube Instructions on App Functionality	2	ArthritisID
Facebook page for app	1	MyRA
Twitter account for app	1	MyRA
Personal Data Protected by Password	2	RheumaTrack RA
Font Size Adjustment	1	R. Arthritis
iCloud Backup of /Notes and Data	1	R. Arthritis

TABLE 4. SELECTED USER REPORTED APP LIMITATIONS

No option to track fatigue-related functional limitations
Lack comprehensive instructions or “help area”
Need more joint pain selection spots to cover back of the body (spine, neck, etc)
Lack comprehensive report view for emailing to HCP or for printing purposes
Lack ability to delete irrelevant activities
Lack ability to modify entered activities with typos
No iPad version of app available
Data entry on iPhone is difficult with pain in the fingers
Pain spots in the feet and hand are not immediately available to rate
Lack ability to delete medications that are discontinued
The color orange is undesirable as it reminds patient of inflammation

TABLE 5. SELECTED USER REPORTED APP ADVANTAGES

Great tracking record and perfect for showing doctors
Effective monitoring tool that records ups and downs
Tracks medications and improve medication compliance
Chart view demonstrates correlation of medication compliance and overall well-being
User friendly and concise
Comprehensive rheumatology calculator and set of diagnostic criteria
Links to RA resources are helpful
App design is simple, beautiful, and formatted to the needs of an RA patient

## Discussion

- The 7 mHealth apps selected for inclusion in this research represented a variety of user functionalities available for patients to self-manage their rheumatoid arthritis.
- All 7 apps tracked ‘disease activity assessment’ with a standardized descriptive numeric scale (joint symptoms, morning stiffness, fatigue) and/or a composite index (DAS28, SDAI, CDAI, RAPID, PAS). Only 2 of the 7 apps categorized disease activity as low, moderate, or high.
- ‘Assessment of functional status’ and ‘assessment of disease prognosis’ were each only found in 2 of 7 apps and should be considered as an essential feature for future apps.
- Some of the apps offered additional features such as disease activity trend charts, medication reminder, note taking, and exportation of data to email which can improve patient compliance, and facilitate the communication of disease activity status to health care providers.
- Innovative and customizable features have the potential to increase patient interactivity and loyalty to an app. Notable features include camera capture of joint symptoms (MyRA), tapping to record joint involvement (RheumaTrack RA), and customization of daily functionality entries.
- RheumaTrack RA had the most number of reviewer ratings (259 Android / 20 Apple). App users cited the medication reminder, ability to track flares, and option to share disease activity trends with health care providers as the most useful features. Areas of improvement cited by app users include lack of option to track fatigue and daily functionalities such as working and exercising.
- One app (Rheumatoid Arthritis Diagnosis and Management) directly cited the 2012 American College of Rheumatology Guidelines and effectively integrated composite index score correlation with disease activity into the app.
- In the research, the authors found mHealth apps that contained unfounded claims to relieving RA associated pain and methods to curing RA. Health care providers have a role in recommending a mHealth app and educating patients on what constitutes a medically accurate and useful app.

## Limitations

- The rank tool for overall usability was not validated.
- Authors’ Ranking was calculated giving equal weight to ‘Useful/Relevant’ and ‘Interface/Navigation’ scores. In actuality, patients preference may follow other criteria.
- While some apps may have been designed for use by the physician for diagnosis and classification of RA severity, the research was focused on the disease activity tracking and self-management of RA by the patient.

## Conclusion

Currently available mHealth apps offer a variety of user functions for rheumatoid arthritis patients to track disease activity and manage symptom flares. MHealth apps have proven to be a very accessible and patient-friendly tool to track real-time RA symptoms and generate disease activity scores. However, there is a need for apps to capture functional status and disease prognosis to provide a more complete picture of the RA patient experience. Furthermore, apps could be improved by better integration with clinical practice guidelines and other evidence-based practices. Additional studies are necessary to determine the content components and design parameters that will enable optimal use of mHealth apps by the RA community.

## References

1. Mobile Medical Applications. Available at: <http://www.fda.gov/medicaldevices/productsandmedicalprocedures/connectedhealth/mobilemedicalapplications/default.htm>. Accessed February 28, 2014.
2. Mobile Health 2012. Pew Research Internet Project. Available at: <http://www.pewinternet.org/2012/11/08/mobile-health-2012/>. Accessed March 1, 2014.
3. Gibofsky, A. Overview of Epidemiology, Pathophysiology, and Diagnosis of Rheumatoid Arthritis. American Journal of Managed Care. 2012. Available at: [http://www.ajmc.com/publications/supplement/2012/ace006\\_12dec\\_gibofsky\\_s295to302/48tshash\\_v08huxf2.dpuf](http://www.ajmc.com/publications/supplement/2012/ace006_12dec_gibofsky_s295to302/48tshash_v08huxf2.dpuf). Accessed March 1, 2014.
4. 2014 PQRS Measure Groups Specification Manual. American Medical Association. Available at: <http://cms.gov/Medicare/quality-initiatives-patient-assessment-instruments/PQRS/MeasuresCodes.html>. Accessed February 27, 2014.
5. Selecting a Mobile App: Evaluating the Usability of Medical Applications. mHIMSS App Usability Work Group. Available at: <http://www.mhimss.org/sites/default/files/resource-media/pdf/HIMSSguidetoappusability1mHIMSS.pdf>. Accessed February 27, 2014.