Electronic assessment of disease activity and functioning in patients with axial spondyloarthritis: challenges and unmet needs

U. Kiltz[1], A. Boonen[2], J. Braun[1], J.G. Richter[3]

[1]*Rheumazentrum Ruhrgebiet, Herne, Germany;*
[2]*Division of Rheumatology, Department of Internal Medicine, Maastricht University Medical Center, the Netherlands;*
[3]*Policlinic for Rheumatology and Hiller Research Centre for Rheumatology, Medical Faculty, Heinrich-Heine-University Düsseldorf, Germany.*

Uta Kiltz, MD
Annelies Boonen, MD
Jürgen Braun, MD
Jutta G. Richter, MD

Please address correspondence to:
Dr Uta Kiltz,
Rheumazentrum Ruhrgebiet,
Claudiusstr. 45,
44649 Herne, Germany.
E-mail: uta.kiltz@elisabethgruppe.de

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ABSTRACT

The dynamic clinical course of rheumatic conditions indicates a need for regular collection of information on health status to monitor disease activity and functional status. Patient-reported outcomes measures (PROMs) are playing a key role in the evaluation of symptoms and functioning and health, and are crucial in the initiation of treatment in those patients. In recent years, electronic assessments of PROMs (so called ePROMs) have been introduced. This report summarises some of the rationale, opportunities, and results using ePROMs in patients with spondyloarthritis (SpA).

Introduction

In patients with inflammatory arthritides, the course of disease is heterogeneous, with considerable variability between patients as well as within patients over time. Therefore, regular collection of information is needed to monitor disease activity and functional status. Laboratory test results are often weakly related to clinical status and use of radiographic scores and joint counts are poorly reproducible. Thus, these traditional measures do have limitations in daily clinical care. The process of clinical decision making in rheumatology is influenced by subjective patients complaints about pain, stiffness and function which can be assessed by using patient-reported outcomes (PROs). PROs are playing a key role in the evaluation of symptoms and of functioning and health, as well as in treatment decisions in patients with spondyloarthritis (SpA).

Assessment of physical function, spinal pain, stiffness and fatigue as part of clinical record keeping or to evaluate pharmacological or non-pharmacological interventions is recommended by Assessment of Spondyloarthritis international Society (ASAS) and are usually assessed using patient-reported outcomes measures (PROMs) (1). Further, assessment of disease activity is one of the cornerstones in the ASAS/EULAR management recommendations (2). Most of the measures that are recommended concern single item global measures, either as a visual analogue scale (VAS) or a numeric rating scale (NRS). The multi-item Bath Ankylosing Functional Index (BASFI) has been developed to measure physical function in patients with SpA (3). Disease activity may be measured in patients with SpA either by the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) or by using the Ankylosing Spondylitis Disease Activity Score (ASDAS) (4, 5). In addition, to capture the broad spectrum of domains to measure severity and impact of axSpA, the ASAS Health Index (ASAS HI) was developed (6).

The PROMs to assess patients with SpA comprehensively have been tested and validated using paper-administered questionnaires and have gained widespread use in randomised controlled trials. However, these measures are not used in the majority of routine care settings, in part because paper-based forms are resource demanding in terms of distribution, score calculation and transfer of data into patients' records. Moreover, current PRO`s have been mainly validated for use in groups of patients instead of evaluating them in individual patients, hampering interpretation of scores for individual treatment decisions in individuals patients. Finally, sometimes complex scores (such as for ASDAS) and fast decision-making in daily clinical care exclude each other so that use of paper-based formats is limited too. Thus, paper-based PROMS have been regarded as costly and inefficient (7).

In the last decades technological capacities have been developed so that electronic assessments of PROMs (so called ePROMs) could be realised. The term ePROM is addressing different aspects of capturing electronic patient information:

- Standardised self-assessment of patients in daily routine care by documenting results in electronic medical records
- Standardised self-assessment of patients in pragmatic clinical trials and/or registries
- Self-monitoring by patients
- Remote ePROM documentation via Apps
- Telemedicine, telemonitoring.

Due to the rise in connectivity and applicable devices, the range of time and locations at which patients may complete assessments *(e.g.* at home, waiting room or drug store/pharmacy kiosks, or use of their smartphone/tablet) has been enlarged considerably (8). There are different electronic devices that can assist gathering ePROMs: traditional computers, tablet PCs, smartphones and online platforms. (9, 10). These mobile devices are nowadays widespread and offer the opportunity of bringing medical applications as *e.g.* electronic diaries, into real-life context (11).

In addition, ePROMs have been incorporated in computer applications that gather data for registries (12, 13). Since the US Food and Drug Administration (FDA) and European Medical Agency (EMA) have required use PROMs as primary outcome measures, initiatives have been developed (such as within ISPOR) to guide collection of PRO data using electronic data capture modes of administration (14). Various computerised data capture tools designed to collect self-administered patient health status information are now available for routine care. This development took place especially in oncology but progress has been made in rheumatology during recent years as well (7, 15).

Electronic collection of ePROMs in clinical practice can serve several goals: 1. to support professional to monitor the patients, adjust treatment and share this information with team members; 2. to assess effectiveness and safety of drugs and medical care in real life; 3. to gain insight in practice variation and detect reasons for differences; 4. to allow patient to self-monitor his disease; and 5. to inform patients about course of disease and needs for treatment changes.

Regardless of the discipline, the type of application and device used measurement equivalence between ePRO and their paper originals should be documented. Importantly, measures should show validity not only at the group level, but also at the patient level. Campbell *et al.* published a review that summarises 55 studies investigating 79 instruments. It provides a good overview for Rheumatology and other disciplines (16). The authors stated that paper-based and electronic formats are usually rated to be equivalent at the group level, and that most study participants prefer electronic assessments – despite the fact that some patients prefer to use the paper format. However, they recommend further validations of electronic versions (14, 16).

Examples of use of ePROMs in rheumatic diseases

Most of the studies investigating electronic devices and systems in rheumatology care have been tested for use in patients with rheumatoid arthritis (RA) (17-19). However, testing of technological devices designed to collect self-administered patient health status information has been recommended by OMERACT for all patients with rheumatic diseases (20). Current use of such systems is limited as development occurred only sporadically over the last 10 years.

Involvement of patients is highly desirable since active involvement in their care has led to better treatment and outcomes (21). It is believed that electronic assessment of outcomes might improve tight control concepts emphasising the need for regular assessments including patients' active involvement by self-monitoring. Especially, inclusion of remote ePROM documentation via Apps into care management concepts might help to better integrate treat-to-target strategies in daily care. The authors of a systematic review on 8 reports describing 5 Apps targeting common psychiatric diseases concluded that significant reductions in depression, stress, and substance use were seen when using Apps compared to a control group (22). Notwithstanding, they discussed that it was difficult to determine whether the beneficial effects of Apps were attributable to the App itself, a function of natural remission or regression to the mean, or due to the face-to-face interaction of participants and physicians in conjunction with the App.

Electronic assessment systems simplify data acquisition, and information transfer between patients and physicians can be accelerated, facilitating better clinical decisions and improved efficiency of clinical workflow (23-25). Real-time flagging of important, clinically relevant symptoms becomes possible (available in some specific systems which support features of real-time flagging. Frequent monitoring and reviewing of patient-centered issues and needs offer an ability to enhance clinical care and quality assurance (25). One recent randomised-controlled study from UK demonstrates patients' self-monitoring of DMARD therapy can lead to significant reductions in healthcare utilisation. In this study with 100 RA and PsA patients, self-monitoring service was associated with 54.6% fewer visits to the clinical nurse specialist ($p<0.0001$), 6.8% fewer visits to the rheumatologist ($p=0.23$) and 38.8% fewer visits to the general practitioner ($p=0.07$), compared with control participants (19). However, in another study the willingness of the patients to self-monitor their disease was limited in a RA cohort who was followed in France and Netherlands (26).

The COMEDRA trial in patients with RA assessed whether close monitoring of disease activity is associated with a better outcome by using a nurse-led programme compared to a patient self-assessment group (17). DMARD therapy was changed more frequently in the self-assessment group compared to the nurse-led group (17.2% *vs.* 10.9% (OR=1.70 (1.17; 2.49), $p=0.006$). Visual feedback for patients with early RA (integrated into the 'Electronic Record-

Table I. Advantages (PROs) and disadvantages (CONs) for ePROMS.

PROs	CONs
Real-time assessments with immediate access to the data and scoring	Need for IT system that might be costly
Rapid, time-saving	Validation studies necessary
Facilitate the immediate patient-physician-communication	Integration in workflow need effort
Data entry by the patients themselves	Necessity of training of clinical staff and patients
Improved data quality by prevention of data entry errors	Technical problems might lead to loss of data
View of long-term follow up data at a glance	Linkage to electronic health records might need programming
Link to electronic health records / patient documentation systems allowed	Users' resistance to "new" technology
Cost efficiently in the long-term	Regular adoptions to software updates necessary
Automated alerts when problems are identified	
PROs can be tailored to patients' specific needs	

adapted from (33, 34).

ing of Outcome Measures for Inflammatory arthritis and AS-EROMIA' system) had a positive and significant impact on the disease activity control (27). Recently, a strong correlation (weighted Pearson's correlation coefficient 0.60, p=0.0001) was reported between the use of a software application ('Rheum-PACER') and disease control in patients with RA (28). The investigators showed that chart review and documentation time trended downward, and productivity of the physician increased by 26% in this US cohort. Moreover, a relative increase in patients with low disease activity of 3% per quarter was noted.

ePROMs provide an opportunity to obtain a broadened view of disease course and patterns also to empowered patients, who may proactively participate in the management of the course of their disease. Stone et al. showed that compliance for documenting daily pain level into electronic health diaries is far more better compared to paper diaries in patients with chronic pain (29). In contrast to initial expectations, most patients have a positive attitude towards the use of PROMs in computerised systems (25). As the public and thereby the patients become more experienced and familiar in the use of new technologies, ePROMs gain higher acceptability and are commonly preferred by most patients over paper-based versions (16, 25, 30). However, recently active ePROM use in a webportal was performed by fewer than half of the patients with RA (26).

What do we know in SpA?

In SpA, studies on ePROMs are limited to comparative validity of electronic opposed to paper versions of the questionnaires. Several studies addressed the validity of a tablet PC for completion of BASDAI, BASFI, Health Assessment Questionnaire (HAQ), Short-Form (SF)-36 or ASDAS (25, 30-32). Richter *et al*. published data on evaluation of the feasibility of electronic data capture of Hannover Functional Ability Questionnaire (FFbH)/HAQ, BASDAI, and SF-36 using a Tablet PC connected to a patient documentation system (25). The study showed no significant differences between the electronic and the paper-based assessments. In a Danish study, self-explanatory touch screens based on the nationwide Danish DANIBO open source system generated valid results in patients with AS on completion of BASDAI, BASFI, HAQ and visual analogue scores (VAS) for pain, fatigue and global health when compared with the traditional paper form (32). The authors conclude that implementation of touch screens in clinical practice is feasible and patients need no instruction.

Evaluations by Bent *et al*. showed a high degree of agreement between paper and computer-administered versions of the Quebec Scale, the BASDAI, the BASFI, and the Bath AS Patient Global Score (BAS-G) on a computerised touchscreen system but also noticed that the computer score was lower than the paper score on average for the Quebec Scale and in the BAS-G results (30).

Recently, again BASFI, BASDAI and ASDAS assessment in a touch-screen system was found to be feasible, well accepted by patients, and good data quality, reliability and score agreement were demonstrated (31). Intra-class correlation coefficients (ICCs) between data generated by touch-screen system or paper-based format ranged from 0.90 to 0.96. Additionally, the test-retest study showed a very good agreement between the scores for the two administration modes (ICC ≥0.90). Age, computer experience and education level had no significant impact on the results. In all trials equivalence between ePRO and their paper originals have been confirmed on the group level. The authors stated that usage of ePROs are less time-consuming for most patients, and provide immediate access to scores (31). Further overarching pros and cons are listed in Table I.

What would we like to know?

- Despite some initial promising data on the systematic use of ePROMs in rheumatic diseases and agreement between electronic and paper score for PROMs in SpA, several issues have not been addressed adequately to provide evidence whether and in which setting ePROMs can improve outcome patients with SpA in daily care. Use of ePROMs in daily care should influence the decision process in respect to treatment adaptations in a timely manner. It has to be shown that using ePROMs help to reduce the time on inadequate treatment options.
- The possible influence of the use of ePROMs on other outcomes such as efficiency of patient-physician communication, patients' confidence or anxiety about management, or treat-

ment adherence should be analysed.

- When ePROMs are used for patient self-monitoring, further information concerning whether patients interpret results correctly and did not draw incorrect conclusions must be studied.
- When ePROMs are used for patient self-monitoring, several measures should be additionally validated to provide physicians guidance how to interpret the scores on the individual patient level.
- Patient education is necessary on ePROM use apart from the clinic.
- Studies on the influence of use of ePROMs on compliance are indicated.
- Track systems are needed to ensure ePROMs are reviewed by physicians or other staff members in a timely manner in the caring and monitoring process.
- Further studies are needed concerning whether ePROMs can overcome the problem of standardised distribution of PROMs in daily clinical care.
- Qualitative research is needed to address concerns and possible anxieties of worries of patients which might occur in respect to use ePROMs, particularly outside of clinical settings.
- While patients might be involved more extensively in treatment decisions when using ePROMs, further information is needed concerning the relevance of involvement by patients.
- It should be recognised that some patients are not willing to engage in e-health initiatives, so that these patients are identified to ensure that they will not receive less optimal care and that inequity based on digital literacy can be avoided.

Investigators should focus on assessing the advantage of using ePROMs for individual patients especially in the context of daily care. Knowledge about "flares" is an important issue in patients with rheumatic diseases, but different variables might be assessed by patients and by physicians differently, so criteria for adjustment of treatment might be clarified. By Contrast, patients with continuous low disease activity might postpone their doctor's visit and just check laboratory tests and continue medication.

Conclusion

There is growing evidence that usage of ePROMs is feasible, that such systems are preferred by many patients, and that outcomes of patients are improved. Over the last decade, the evolution of computer software and technology has improved the ability to satisfy the clinical requirements of PROMs. Systems must be user-friendly and sensitive, and should pose minimal burden on the patients and the rheumatology staff to reach successful integration and sustained use, especially in routine care. The use of mobile electronic devices might simplify data acquisition at the time and location of clinical decision making. However, data on SpA patients are scarce and almost no real-life data have been published whether systems in which ePROMS are part of the management of patients, improve outcomes at acceptable (or reduced) costs and minimal side effects for patients with SpA.

References

1. VAN DER HEIJDE D, VAN DER LINDEN S, DOUGADOS M, BELLAMY N, RUSSELL AS, EDMONDS J: Ankylosing spondylitis: plenary discussion and results of voting on selection of domains and some specific instruments. *J Rheumatol* 1999; 26: 1003-5.
2. BRAUN J, VAN DEN BERG R, BARALIAKOS X *et al*.: 2010 update of the ASAS/EULAR recommendations for the management of ankylosing spondylitis. *Ann Rheum Dis* 2011; 70: 896-904.
3. CALIN A, GARRETT S, WHITELOCK H *et al*.: A new approach to defining functional ability in ankylosing spondylitis: the development of the Bath Ankylosing Spondylitis Functional Index. *J Rheumatol* 1994; 21: 2281-5.
4. GARRETT S, JENKINSON T, KENNEDY LG, WHITELOCK H, GAISFORD P, CALIN A: A new approach to defining disease status in ankylosing spondylitis: the Bath Ankylosing Spondylitis Disease Activity Index. *J Rheumatol* 1994; 21: 2286-91.
5. VAN DER HEIJDE D, LIE E, KVIEN TK *et al*.: ASDAS, a highly discriminatory ASAS-endorsed disease activity score in patients with ankylosing spondylitis. *Ann Rheum Dis* 2009; 68: 1811-8.
6. KILTZ U, VAN DER HEIJDE D, BOONEN A *et al*.: Development of a health index in patients with ankylosing spondylitis (ASAS HI): final result of a global initiative based on the ICF guided by ASAS. *Ann Rheum Dis* 2015; 74: 830-5.
7. SMITH SK, ROWE K, ABERNETHY AP: Use of an electronic patient-reported outcome measurement system to improve distress management in oncology. *Palliat Support Care* 2014; 12: 69-73.
8. JENSEN RE, ROTHROCK NE, DEWITT EM *et al*.: The role of technical advances in the adoption and integration of patient-reported outcomes in clinical care. *Med Care* 2015; 53: 153-9.
9. BUXTON J, WHITE M, OSOBA D: Patients' experiences using a computerized program with a touch-sensitive video monitor for the assessment of health-related quality of life. *Qual Life Res* 1998; 7: 513-9.
10. AZEVEDO AR, DE SOUSA HM, MONTEIRO JA, LIMA AR: Future perspectives of Smartphone applications for rheumatic diseases self-management. *Rheumatol Int* 2015; 35: 419-31.
11. DENNISON L, MORRISON L, CONWAY G, YARDLEY L: Opportunities and challenges for smartphone applications in supporting health behavior change: qualitative study. *J Med Internet Res* 2013; 15: e86.
12. HETLAND ML: DANBIO--powerful research database and electronic patient record. *Rheumatology* (Oxford) 2011; 50: 69-77.
13. OVRETVEIT J, KELLER C, HVITFELDT FORSBERG H, ESSÉN A, LINDBLAD S, BROMMELS M: Continuous innovation: developing and using a clinical database with new technology for patient-centred care--the case of the Swedish quality register for arthritis. *Int J Qual Health Care* 2013; 25: 118-24.
14. COONS SJ, GWALTNEY CJ, HAYS RD *et al*.: Recommendations on evidence needed to support measurement equivalence between electronic and paper-based patient-reported outcome (PRO) measures: ISPOR ePRO Good Research Practices Task Force report. *Value Health* 2009; 12: 419-29.
15. JENSEN RE, SNYDER CF, ABERNETHY AP *et al*.: Review of electronic patient-reported outcomes systems used in cancer clinical care. *J Oncol Pract* 2014; 10: e215-22.
16. CAMPBELL N, ALI F, FINLAY AY, SALEK SS: Equivalence of electronic and paper-based patient-reported outcome measures. *Qual Life Res* 2015; 24: 1949-61.
17. DOUGADOS M, SOUBRIER M, PERRODEAU E *et al*.: Impact of a nurse-led programme on comorbidity management and impact of a patient self-assessment of disease activity on the management of rheumatoid arthritis: results of a prospective, multicentre, randomised, controlled trial (COMEDRA). *Ann Rheum Dis* 2015; 74: 1725-33.
18. SARGIOUS A, LEE SJ: Remote collection of questionnaires. *Clin Exp Rheumatol* 2014; 32 (Suppl. 85): S168-72.
19. MCBAIN H, SHIPLEY M, OLALEYE A, MOORE S, NEWMAN S: A patient-initiated DMARD self-monitoring service for people with rheumatoid or psoriatic arthritis on methotrexate: a randomised controlled trial. *Ann Rheum Dis* 2016; 75: 1343-9.
20. KIRWAN JR, AHLMÉN M, DE WIT M *et al*.: Progress since OMERACT 6 on including patient perspective in rheumatoid arthritis outcome assessment. *J Rheumatol* 2005; 32: 2246-9.
21. SMOLEN JS: Treat-to-target: rationale and strategies. *Clin Exp Rheumatol* 2012; 30 (Suppl. 73): S2-6.
22. DONKER T, PETRIE K, PROUDFOOT J, CLARKE J, BIRCH MR, CHRISTENSEN H:

Smartphones for smarter delivery of mental health programs: a systematic review. *J Med Internet Res* 2013; 15: p. e247.

23. CHUNG AE, BASCH EM: Incorporating the patient's voice into electronic health records through patient-reported outcomes as the "review of systems". *J Am Med Inform Assoc* 2015; 22: 914-6.
24. GREENWOOD MC, HAKIM AJ, CARSON E, DOYLE DV: Touch-screen computer systems in the rheumatology clinic offer a reliable and user-friendly means of collecting quality-of-life and outcome data from patients with rheumatoid arthritis. *Rheumatology* (Oxford) 2006; 45: 66-71.
25. RICHTER JG, BECKER A, KOCH T *et al*.: Self-assessments of patients via Tablet PC in routine patient care: comparison with standardised paper questionnaires. *Ann Rheum Dis* 2008; 67: 1739-41.
26. KOEVOETS R, DE GLAS NA, LE BOURLOUT C *et al*.: Autonomous online health assessment questionnaire registry in daily clinical practice. *Rheumatology* (Oxford) 2013; 52: 883-7.
27. EL MIEDANY Y, EL GAAFARY M, PALMER D: Assessment of the utility of visual feedback in the treatment of early rheumatoid arthritis patients: a pilot study. *Rheumatol Int* 201; 32: 3061-8.
28. NEWMAN ED, LERCH V, BILLET J, BERGER A, KIRCHNER HL: Improving the quality of care of patients with rheumatic disease using patient-centric electronic redesign software. *Arthritis Care Res* 2015; 67: p. 546-53.
29. STONE AA, SHIFFMAN S, SCHWARTZ JE, BRODERICK JE, HUFFORD MR: Patient compliance with paper and electronic diaries. *Control Clin Trials* 2003; 24: 182-99.
30. BENT H, RATZLAFF CR, GOLIGHER EC, KOPEC JA, GILLIES JH: Computer-administered bath ankylosing spondylitis and Quebec Scale outcome questionnaires for low back pain: agreement with traditional paper format. *J Rheumatol* 2005; 32: 669-72.
31. SALAFFI F, GASPARINI S, CIAPETTI A, GUTIERREZ M, GRASSI W: Usability of an innovative and interactive electronic system for collection of patient-reported data in axial spondyloarthritis: comparison with the traditional paper-administered format. *Rheumatology* (Oxford) 2013; 52: 2062-70.
32. SCHEFTE DB, HETLAND ML: An open-source, self-explanatory touch screen in routine care. Validity of filling in the Bath measures on Ankylosing Spondylitis Disease Activity Index, Function Index, the Health Assessment Questionnaire and Visual Analogue Scales in comparison with paper versions. *Rheumatology* (Oxford) 2010; 49: 99-104.
33. SCHICK-MAKAROFF K, MOLZAHN A: Strategies to use tablet computers for collection of electronic patient-reported outcomes. *Health Qual Life Outcomes* 2015; 13: p. 2.
34. RICHTER J, KAMPLING C, SCHNEIDER M: Electronic patient reported outcome measures (e-PROMS) in Rheumatology, in Patient Reported Outcome Measures in Rheumatic Diseases. *In*: MIEDANY YE (Ed.) Springer, 2016, p. 773.