ORIGINAL ARTICLE

RAPID3 (Routine Assessment of Patient Index Data) on an MDHAQ (Multidimensional Health Assessment Questionnaire): Agreement With DAS28 (Disease Activity Score) and CDAI (Clinical Disease Activity Index) Activity Categories, Scored in Five Versus More Than Ninety Seconds

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Objective. To compare the Routine Assessment of Patient Index Data 3 (RAPID3) on a Multidimensional Health Assessment Questionnaire (MDHAQ) with the Disease Activity Score (DAS28), Clinical Disease Activity Index (CDAI), and individual core data set measures for correlations, agreement of activity levels, and time to score.

Methods. Four rheumatologists each assessed 50 patients with rheumatoid arthritis in "real-time" clinical care. Patients completed an MDHAQ. The rheumatologist then calculated RAPID3 (physical function, pain, patient global estimate), performed a 28-joint count, assigned a physician global estimate, and scored a CDAI, each timed by an observer. Erythrocyte sedimentation rate (ESR) was tested on the same date, and the DAS28-ESR was computed later, again timed by an observer. Spearman's rank-order correlations and comparisons of patients classified as high activity, moderate activity, low activity, and remission according to the DAS28, CDAI, and RAPID3 were computed and compared with kappa statistics. A second study of 25 "paper patients" was also performed to compare time to score the DAS28, CDAI, and RAPID3 on a 0–10 versus 0–30 scale. Mean and median times to score each index were computed.

Results. The 3 indices were correlated significantly, including agreement for >80% of patients for high/moderate activity. The mean time to perform a 28-joint count was 94 seconds, and the mean times to score the DAS28, CDAI, RAPID3 on a 0–10 scale, and RAPID3 on a 0–30 scale were 114, 106, 9.6, and 4.6 seconds, respectively.

Conclusion. RAPID3 scores provide similar quantitative information to DAS28 and CDAI, while calculated on a 0–30 scale in about 5% of the time.

INTRODUCTION

Quantitative assessment of patients with rheumatoid arthritis (RA) has been extensively advanced over the last 3 decades (1), primarily in clinical trials and clinical research. The only quantitative data collected at most usual

care visits are laboratory tests, because other quantitative RA core data set measures (2–4) of formal joint counts (5) or patient questionnaire scores (6) are not included. Most routine rheumatology care has not changed over many years, with decisions largely based on nonquantitative impressions, despite evidence of the value of quantitative measures to recognize poor long-term outcomes (7–9) and use of the Disease Activity Score (DAS28) to improve outcomes in RA clinical trials (10–18).

No single measure can serve as a gold standard to assess and monitor all of the individual patients with RA, and pooled indices (19) such as the DAS28 (20,21) and Clinical Disease Activity Index (CDAI) (22) are used. An index of only the 3 patient self-report RA core data set measures, the Routine Assessment of Patient Index Data 3 (RAPID3) without joint counts, is correlated significantly with the DAS28 and CDAI in clinical trials (23) and in clinical settings (24,25). RAPID3 distinguishes active from control treatments at levels similar to the DAS28 and CDAI in clinical trials of leflunomide (26,27), methotrexate (26,27), adalimumab (28), and abatacept (23). RAPID3 on a Multidimensional Health Assessment Questionnaire (MDHAQ) (see Supplementary Appendix A, available in the online version of this article at http://www3.interscience.wiley.com/journal/77005015/home) is scored in approximately 10 seconds (29), whereas a 28-joint count, required for the DAS or CDAI, involves approximately 90 seconds (29).

Previous studies of RAPID3 did not include analyses of the time to score the DAS28 and CDAI, and were performed by 3 rheumatologists who had considerable experience with quantitative measurement (25,29). In the present report, 4 additional rheumatologists who had not participated in prior research on RA indices analyzed correlations of RAPID3 with the DAS28 and CDAI, and the time to score these indices.

PATIENTS AND METHODS

Patients and rheumatologists. Patients were seen in usual care by 4 rheumatologists (CLC, ATK, AMK, ELS) at 3 private practice settings. Each rheumatologist assessed 50 patients with RA. None of these rheumatologists had participated in previous studies of correlations of indices (25) or time to perform joint counts and score RAPID3 (29). Patients signed consent for the results to be sent anonymously to a data center. The study was approved by local Institutional Review Boards for the Protection of Human Subjects.

MDHAQ and RAPID3 scores. The MDHAQ (30,31) (see Supplementary Appendix A, available in the online version of this article at http://www3.interscience.wiley.com/journal/77005015/home) includes, on page 1, the 3 self-report RA core data set scores for physical function, pain, and patient global estimate. A template to convert 0–3 scores for 10 individual physical function items to a 0–10 composite score is found in the column on the right side of page 1 (see Supplementary Appendix A, available in the online version of this article at http://www3.interscience.wiley.com/journal/77005015/home). The pain and global estimate visual analog scales (VAS) are in 21 numbered circles rather than a 10-cm line format (32) to facilitate scoring. A template to convert RAPID3 scores from 0–30 to 0–10 has been included in many versions of the MDHAQ. Page 1 (see Supplementary Appendix A, available in the online version of this article at http://www3.interscience.wiley.com/journal/77005015/home) also includes a Rheumatoid Arthritis Disease Activity Index (RADAI) self-report joint count (33). Page 2 of the MDHAQ (see Supplementary Appendix A, available in the online version of this article at http://www3.interscience.wiley.com/journal/77005015/home) includes a review of systems, recent medical history, fatigue VAS, queries about exercise and change in status, and demographic measures.

First study protocol: "real-time" comparisons of DAS28, CDAI, and RAPID3 scores. The receptionist presented an MDHAQ to all patients upon registration for a visit. Each patient completed the MDHAQ while waiting to see the rheumatologist. The rheumatologist calculated a RAPID3 score from the MDHAQ before or while seeing the patient, and entered the score on the MDHAQ. An assistant using a stopwatch recorded the number of seconds to score RAPID3 on a "time to score" data sheet, and recorded the assigned scores for individual measures and RAPID3 on a separate "measures and indices scores" data sheet.

The rheumatologist performed a standard 28 swollen and tender joint count (34), scored on a joint count form at a usual point in the visit. The joint count was again timed by the assistant with a stopwatch, and recorded on the time to score data sheet. The swollen and tender joint count scores were entered on the measures and indices scores data sheet. The rheumatologist assigned a physician global estimate of status on a 0–10 scale (where 0 = best status and 10 = poorest status) on the measures and indices scores data sheet, while the timer did not stop the stopwatch, and then scored a CDAI (swollen joint count [0–28 scale], tender joint count [0–28 scale], patient global estimate [0–10 scale], physician global estimate [0–10 scale]; total CDAI: 0–76 scale) (22). The time in seconds to score the CDAI was recorded by the assistant and entered on the time to score data sheet, and the CDAI was recorded on the measures and indices scores data sheet.

An erythrocyte sedimentation rate (ESR) was ordered. At a later time, a DAS28-ESR (35) was calculated from the swollen joint count, tender joint count, ESR, and patient global estimate using the DAS Web site calculator (online at: www.das-score.nl), timed by the observer and recorded

on the time to score data sheet, with the DAS28-ESR recorded on the measures and indices scores data sheet.

Second study protocol: time to score DAS28, CDAI, and RAPID3 as 0–30 and 0–10 scores in "paper patients." After the rheumatologists had enrolled 50 patients each in the study, a second simpler study was conducted of the time to score indices of 25 paper patients randomly selected from the 200 in the real-time study. In this second study, individual index component measures were listed in columns on a separate page for each of the 4 indices for 25 patients in groups of 5, with a space to enter the index score. The 4 indices were scored in order: RAPID3 on a 0–30 scale, without conversion of a 0–30 score to 0–10, CDAI, DAS28, and RAPID3 as a 0–10 score, with conversion from a 0–30 scale using a scoring template identical to that found on the MDHAQ.

This simpler exercise included rheumatologists A, B, C, and D, who each had studied 50 of their own patients in the real-time study described above, as well as 2 additional rheumatologists E and F (MJB, YY), who had participated in previous studies (25,29). An assistant timed and recorded the number of seconds to score each index by the rheumatologist, in groups of 5. The mean and median of the total of 25 scores were then designated as the time to score a single measure.

Statistical analyses. Demographic data, RA core data set measures, and indices of 50 patients of each of the 4 rheumatologists were summarized and compared using analysis of variance for continuous data and chi-square tests for categorical data. Spearman's rank-order correlation coefficients were computed to compare individual core data set measures, duration of disease, and DAS28, CDAI, and RAPID3 scores.

Cross-tabulations were computed to compare the number and proportion of patients classified in the 4 DAS28 and CDAI categories of high disease activity (DAS28: >5.1, CDAI: >22), moderate disease activity (DAS28: 3.21–5.1, CDAI: 10.1–22), low disease activity (DAS28: 2.61–3.2, CDAI: 2.81–10), and remission (DAS28: 0–2.6, CDAI: 0–2.8) with the 4 proposed RAPID3 categories, measured on a 0–30 scale of high severity (12.1–30), moderate severity (6.1–12.0), low severity (3.1–6.0), and remission (0–3.0). The term "severity" rather than "activity" is used to describe RAPID3 categories because a self-report index may reflect joint damage as well as disease activity. Statistical significance of the level of agreement of the different scales was evaluated using chi-square, kappa, and weighted kappa statistics (36). Additional analyses were performed for each index in 2 groups, high/moderate compared with low/remission, because the cut points of 3.2 for DAS28, 10 for CDAI, and 6 for RAPID3 appear to provide critical levels for rheumatologists to recognize incomplete responses and strongly consider a change in therapy.

The times to score each measure and index in the first real-time protocol in 50 patients were summarized for each rheumatologist and for the entire group. The times to score the 25 paper patients in a controlled setting were estimated by dividing each group of 5 observations by 5 and subsequently calculating the mean of these estimated

times by each of the 6 rheumatologists and the entire group. All analyses were conducted using Stata statistical software, version 9.2 (StataCorp, College Station, TX).

RESULTS

Patients. The mean age of the patients was 53.4 years, the mean duration of disease was 11.6 years, and 81% were women (Table 1). Mean values for RA core data set measures were 4.8 swollen joints on a 28 swollen joint count, 7.1 tender joints on a 28 tender joint count, physician global estimate of 3.5 (0–10 scale), ESR of 24.5 mm/hour, physical function of 2.2 (on a 0–10 MDHAQ scale; 0.67 on a 0–3 scale), pain of 4.3 (0–10 scale), and patient global estimate of 3.7 (0–10 scale). The mean DAS28 level (0–10 scale) was 3.7, the mean CDAI (0–76 scale) was 19.2, the mean RAPID3 on a 0–30 scale was 10.3, and the mean RAPID3 on a 0–10 scale was 3.4.

Variation among patients of the 4 rheumatologists was seen. Patients of rheumatologists A and D were younger (these rheumatologists were younger) and had shorter duration of disease. The patients of rheumatologist B had significantly higher swollen and tender joint counts, ESR, and therefore DAS28 and CDAI, than the other 3 rheumatologists, although self-report questionnaire responses of the patients did not differ significantly. Overall, the patients appear to be a typical group of patients with RA.

Correlations and severity categories of DAS28, CDAI, and RAPID3. DAS28 versus RAPID3 scores were significantly correlated (Spearman's $\rho = 0.43$, range 0.36–0.61; $P < 0.001$), and CDAI versus RAPID3 scores were significantly correlated at higher levels ($\rho = 0.61$, range 0.54–0.77; $P < 0.001$) (Table 2). High activity according to the DAS28 (>5.1) was seen in 17% of the patients; 65% of those patients also had high severity according to RAPID3 (>12), and 82% had high/moderate severity according to RAPID3 (>6) (Table 3). Overall, 22% of the patients met the criteria for DAS28 remission (≤2.6); 41% of those patients met RAPID3 near-remission criteria (≤3), and 59% had low severity or remission (≤6) (Table 3). The kappa value was 0.16 (range 0.12–0.20) and the weighted kappa value was 0.27 (range 0.13–0.33) for DAS28 versus RAPID3, indicating fair agreement (Tables 2 and 3).

High activity according to the CDAI (>22) was seen in 33% of the patients; 68% of those patients had RAPID3 high severity (>12) and 88% had RAPID3 high/moderate severity (>6) (Table 3). Only 8% of the patients met the criteria for CDAI remission (≤2.8); 75% of those patients were also in RAPID3 remission (≤3) (Table 3). The kappa value was 0.27 (range 0.22–0.37) and the weighted kappa value was 0.44 (range 0.26–0.58) for CDAI versus RAPID3, again indicating fair agreement of the indices (Tables 2 and 3).

Patients were analyzed in 2 rather than 4 categories, according to high/moderate activity or low activity/remission (Table 2), as the most important clinical level to identify incomplete responses in patients with RA. Among patients with high or moderate DAS28 activity (>3.2), 80% (range 61–97%) also had high or moderate RAPID3

Table 1. Demographic characteristics, RA core data set measures, and clinical indices in 200 patients seen by 4 rheumatologists*

	A (n = 50)	B (n = 51)	C (n = 50)	D (n = 49)	Total (n = 200)	P
Age, years	52.7 ± 14.1	58.9 ± 17.3	58.8 ± 12.5	43.0 ± 15.5	53.4 ± 16.2	< 0.0001†
Duration, years	5.6 ± 7.6	13.4 ± 9.1	14.9 ± 11.7	12.5 ± 12.3	11.6 ± 10.8	0.0001†
Education, years	13.7 ± 2.4	13.8 ± 2.8	13.1 ± 2.6	13.9 ± 2.9	13.6 ± 2.7	0.4601†
Women, no. (%)	38 (76.0)	42 (82.4)	41 (82.0)	41 (83.7)	162 (81.0)	0.5940‡
Race, no. (%)						
Non-Hispanic white	49 (98.0)	46 (90.2)	48 (96.0)	43 (87.7)	186 (93.0)	0.0340‡
African American	1 (2.0)	0	2 (4.0)	2 (4.1)	5 (2.5)	
Hispanic	0	5 (9.8)	0	2 (4.1)	7 (3.5)	
Asian	0	0	0	2 (4.1)	2 (4.1)	
RA core data set measures						
Physician/assessor measures						
Swollen 28-joint count	2.8 ± 3.8	10.1 ± 6.6	3.3 ± 3.7	2.9 ± 2.6	4.8 ± 5.4	< 0.0001†
Tender 28-joint count	7.2 ± 6.9	14.6 ± 7.5	4.0 ± 4.5	2.5 ± 3.3	7.1 ± 7.5	< 0.0001†
Physician global estimate VAS	4.0 ± 2.2	4.3 ± 2.5	3.1 ± 1.6	2.8 ± 2.2	3.5 ± 2.2	0.0009†
Laboratory measure						
ESR, mm/hour	20.1 ± 17.1	35.6 ± 22.0	22.1 ± 20.5	20.1 ± 18.1	24.5 ± 20.5	0.0001†
Patient measures						
Function	2.4 ± 1.9	2.4 ± 1.8	2.4 ± 2.0	1.7 ± 1.8	2.2 ± 1.9	0.1191†
Pain VAS	5.2 ± 2.6	4.6 ± 3.3	4.5 ± 2.8	3.1 ± 2.9	4.3 ± 3.0	0.0036†
Patient global estimate VAS	4.2 ± 2.7	4.1 ± 2.9	4.0 ± 2.9	2.7 ± 2.7	3.7 ± 2.8	0.0312†
Clinical indices						
DAS28	3.4 ± 1.4	5.3 ± 1.0	3.2 ± 1.2	3.0 ± 1.0	3.7 ± 1.5	< 0.0001†
CDAI	18.1 ± 12.0	33.0 ± 14.8	14.3 ± 9.9	10.9 ± 7.9	19.2 ± 14.2	< 0.0001†
RAPID3	11.7 ± 6.2	11.0 ± 7.3	10.8 ± 7.0	7.5 ± 6.9	10.3 ± 7.0	0.0106†

* Values are the mean ± SD unless otherwise indicated. *P* values <0.05 were considered significant. RA = rheumatoid arthritis; VAS = visual analog scale; ESR = erythrocyte sedimentation rate; DAS28 = Disease Activity Score; CDAI = Clinical Disease Activity Index; RAPID3 = Routine Assessment of Patient Index Data 3.
† Continuous variable; calculated by analysis of variance.
‡ Discontinuous variable; calculated by chi-square test.

severity (>6) (Table 2). Among patients with low activity or remission according to DAS28 (≤3.2), 53% (range 48–56%) also had low activity or remission according to RAPID3 (≤6) (Table 2). The kappa was 0.34 (range 0.05–0.48), indicating fair agreement.

Among patients with high or moderate CDAI activity (>10), 86% (range 73–97%) had high or moderate RAPID3 severity (>6) (Table 2). Among patients with low activity or remission according to CDAI (≤10), 69% (range 59–100%) had RAPID3 low activity/remission (≤6) (Table 2). The kappa was 0.55 (range 0.18–0.70), indicating moderate agreement.

Time to score indices in real-time clinical care. The mean time to score a 28-joint count in real-time clinical care was 94 seconds (range 54–120 seconds) (Figure 1A). The mean time to score a CDAI was 106 seconds (range 72–133 seconds). The mean time to score a DAS28 was 114 seconds (range 71–145 seconds). The mean time to score RAPID3 as a 0–10 scale (including conversion from a 0–30 score) was 9.5 seconds (range 8.3–12.5 seconds) (Figure 1A).

Time to score indices in paper patients. A second, simple study of time to score indices in paper patients (Figure 1B) indicated a mean time to score a RAPID3 on a 0–10 scale of 9.6 seconds (range 7.5–13.4 seconds), CDAI

5.2 seconds (range 3.4–6.8 seconds), DAS28 (at the Web site) 17.7 seconds (range 11.4–23.4 seconds), and RAPID3 on a 0–30 scale, without adjusting to a 0–10 scale, 4.6 seconds (range 3.6–5.9 seconds) (Figure 1B).

The mean time to score RAPID3 on a 0–10 scale was identical to real-time clinical data. However, the mean time to score a 0–30 scale was 5 seconds (range 2.0–6.2 seconds) less than on a 0–10 scale (Figure 1B). With inclusion of 94 seconds for a 28-joint count, the mean time to score a DAS28 was 111.7 seconds and the mean time to score a CDAI was 99.2 seconds, both similar to real-time clinical data.

DISCUSSION

Quantitative measurement has advanced treatment of many diseases, including RA, to recognize severe long-term outcomes (7–9) and to improve outcomes in clinical trials (10–18). However, most measures used in clinical trials and other research, such as formal joint counts (5) or patient questionnaires (6), have not been incorporated into routine care to help guide clinical decisions. Most rheumatology visits are conducted similarly to the 1970s, with laboratory tests as the only quantitative data.

A careful joint examination is required for a diagnosis of RA. A formal quantitative swollen and tender joint count and indices that include these measures, such as the

Table 2. Spearman's rank correlation coefficients, kappa, and weighted kappa coefficients for RAPID3 versus DAS28 and CDAI, and agreement between moderate/high severity or low severity/remission categories according to RAPID3 scores versus moderate/high activity or low activity/remission according to DAS28 and CDAI, in 200 patients seen by 4 rheumatologists*

	A	B	C	D	Total
RAPID3 vs. DAS28					
Spearman's correlation coefficient	0.61	0.39	0.54	0.36	0.43
P	< 0.001	0.005	< 0.001	0.010	< 0.001
Kappa	0.13	0.12	0.20	0.12	0.16
P	0.022	0.090	0.002	0.050	< 0.001
Weighted kappa	0.29	0.13	0.33	0.16	0.27
P	< 0.001	0.050	< 0.001	0.43	< 0.001
RAPID3 vs. CDAI					
Spearman's correlation coefficient	0.66	0.54	0.77	0.70	0.61
P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Kappa	0.37	0.22	0.25	0.22	0.27
P	< 0.001	0.004	< 0.001	< 0.001	< 0.001
Weighted kappa	0.58	0.26	0.46	0.37	0.44
P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Agreement of RAPID3/DAS28 categories					
Moderate/high, no. (%)	28/29 (97)	35/49 (71)	23/25 (92)	11/18 (61)	97/121 (80)
Kappa	0.47	0.05	0.48	0.15	0.34
P	< 0.001	0.257	< 0.001	0.141	< 0.001
Low/remission, no. (%)	10/21 (48)	1/2 (50)	14/25 (56)	17/31 (55)	42/79 (53)
Kappa	–	–	–	–	–
P	–	–	–	–	–
Agreement of RAPID3/CDAI categories					
Moderate/high, no. (%)	32/33 (97)	36/49 (73)	28/29 (97)	17/21 (81)	113/132 (86)
Kappa	0.61	0.18	0.70	0.51	0.55
P	< 0.001	0.03	< 0.001	< 0.001	< 0.001
Low/remission, no. (%)	10/17 (59)	2/2 (100)	15/21 (71)	20/28 (71)	47/68 (69)
Kappa	–	–	–	–	–
P	–	–	–	–	–

* RAPID3 = Routine Assessment of Patient Index Data 3; DAS28 = Disease Activity Score; CDAI = Clinical Disease Activity Index.

DAS28 and CDAI, are the most specific measures of RA activity (37). However, the most specific measure is not necessarily the most sensitive to detect change. Relative efficiencies of patient questionnaire scores to detect differences between active and control treatments in clinical trials of methotrexate (38), leflunomide (38), anakinra (39),

Table 3. RAPID3 scores compared with DAS28 and CDAI in 200 patients by 4 rheumatologists*

	RAPID3 scores				
	High severity (12.1–30)	Moderate severity (6.1–12.0)	Low severity (3.1–6.0)	Near remission (0–3.0)	Total
DAS28 scores†					
High activity (>5.1)	22 (64.7)	6 (17.7)	4 (11.8)	2 (5.9)	34 (17.0)
Moderate activity (3.21–5.1)	44 (50.6)	25 (28.7)	5 (5.8)	13 (14.9)	87 (43.5)
Low activity (2.61–3.2)	9 (25.7)	10 (28.6)	9 (25.7)	7 (20.0)	35 (17.5)
Remission (0–2.6)	7 (15.9)	11 (25.0)	8 (18.2)	18 (40.9)	44 (22.0)
Total	82 (41.0)	52 (26.0)	26 (13.0)	40 (20.0)	200
CDAI scores‡					
High activity (>22)	45 (68.2)	13 (19.7)	4 (6.1)	4 (6.1)	66 (33.0)
Moderate activity (10.1–22.0)	31 (47.0)	24 (36.4)	5 (7.6)	6 (9.1)	66 (33.0)
Low activity (2.9–10)	6 (11.5)	15 (28.9)	13 (25.0)	18 (34.6)	52 (26.0)
Remission (0–2.8)	0 (0.0)	0 (0.0)	4 (25.0)	12 (75.0)	16 (8.0)
Total	82 (41.0)	52 (26.0)	26 (13.0)	40 (20.0)	200

* Values are the number (percentage). RAPID3 = Routine Assessment of Patient Index Data 3; DAS28 = Disease Activity Score; CDAI = Clinical Disease Activity Index.
† DAS28 scores vs. RAPID3 scores: $\kappa = 0.16$, weighted $\kappa = 0.27$.
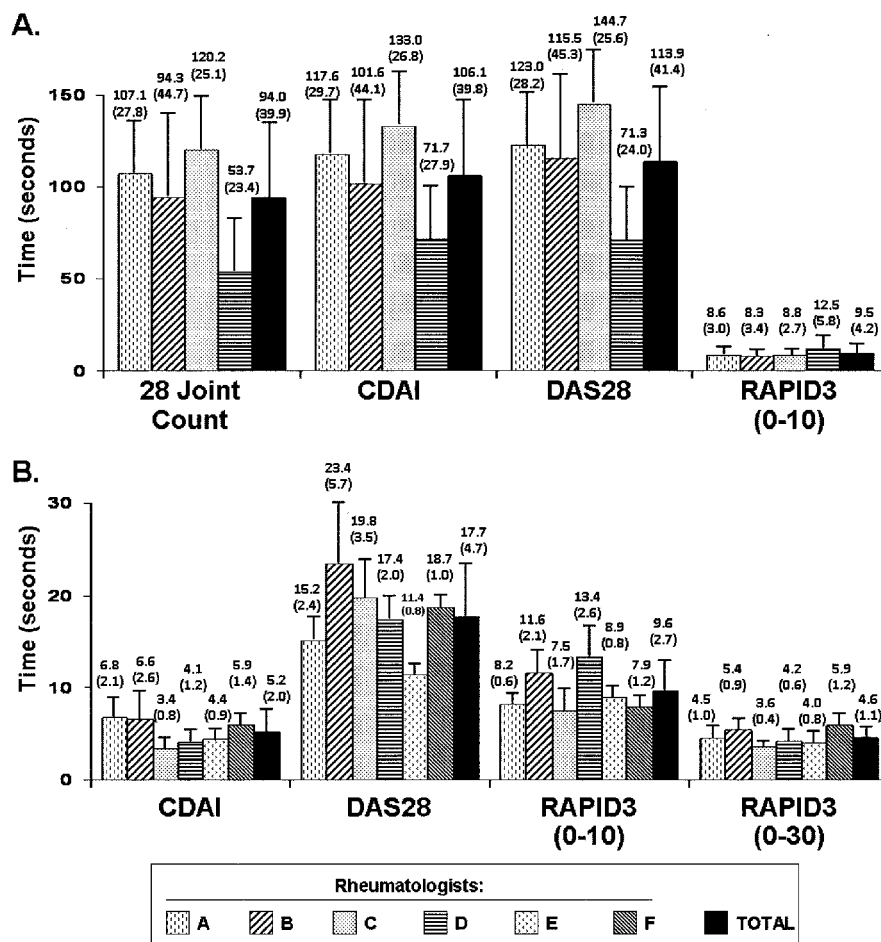‡ CDAI scores vs. RAPID3 scores: $\kappa = 0.27$, weighted $\kappa = 0.44$.

Figure 1. Results of "real-time" scoring in the clinic and the "paper patient" scoring exercise. **A**, Real-time clinic scoring: time in seconds required to score 28-joint count and 3 composite indices to assess 200 patients with rheumatoid arthritis by 4 rheumatologists (A, B, C, and D; $P < 0.0001$ for all comparisons). **B**, Paper patient scoring exercise: average time in seconds by all of the sites (6 rheumatologists) to calculate clinical outcome scores. CDAI = Clinical Disease Activity Index; DAS28 = Disease Activity Score; RAPID3 = Routine Assessment of Patient Index Data 3. Error bars show the SD. Values are expressed as mean ± SD.

adalimumab (40), abatacept (41), and infliximab (42) are similar to (often greater than) swollen and tender joint counts or laboratory tests.

One concern of rheumatologists is that patient questionnaire scores may reflect irreversible joint damage, and therefore be insensitive to detect changes in disease activity with treatment (43). However, the relative efficiencies data are similar across all of the clinical trials studied for joint count and patient questionnaire scores. These findings suggest that joint counts appear to reflect a similar level of irreversible changes as questionnaire scores, with similar changes over short periods to document control of inflammation.

The MDHAQ and RAPID3 scores do not replace either a careful joint examination or conversation with the patient. On the contrary, a careful joint examination is required to interpret MDHAQ data and RAPID3 scores in clinical decisions, and the MDHAQ enhances conversation with saving of time based on the RADAI self-report joint count (33) on page 1, and a review of systems, recent medical history,

and demographic measures on page 2 (see Supplementary Appendix A, available in the online version of this article at http://www3.interscience.wiley.com/journal/77005015/home) (44).

The MDHAQ was developed from the standard HAQ, and RAPID3 on a 0–30 scale is scored in approximately 5 seconds versus 42 seconds to score a standard HAQ (29). MDHAQ features that enhance clinical scoring include 10 rather than 20 physical function activities, scoring templates to convert raw physical function scores from 0–3 to 0–10 for RAPID3 composite scores, and VAS for pain and global estimate comprised of 21 numbered circles rather than a 10-cm line, to eliminate a need for a ruler.

Data in this report confirm and extend previous reports that RAPID3 scores are significantly correlated with DAS28 and CDAI scores in usual clinical care (25). Overall, 80% of the patients identified as having high or moderate activity according to the DAS28 and CDAI, the level at which rheumatologists might identify incomplete response and strongly consider a change in therapy, had
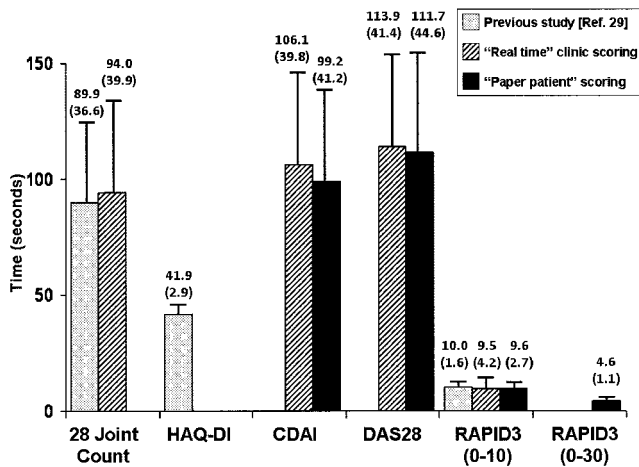
Figure 2. Mean time in seconds required to score 28-joint count, Health Assessment Questionnaire disability index (HAQ-DI), Clinical Disease Activity Index (CDAI), Disease Activity Score (DAS28), Routine Assessment of Patient Index Data 3 (RAPID3) on a 0–10 scale, and RAPID3 on a 0–30 scale in a previously published study (29), in "real time" in clinical visits of 200 patients seen by 4 rheumatologists, and in a "paper patient" scoring exercise completed by 6 rheumatologists. Not all of the measures/indices were evaluated in each study. The time required to perform a 28-joint count (94 seconds) is included in the time required to score CDAI and DAS28 reported for the paper patient exercise. Error bars show the SD. Values are expressed as mean ± SD.

high or moderate activity according to the RAPID3. Fewer patients had low activity/remission according to the RAPID3 compared with the DAS28 and CDAI (25).

Correlations between the RAPID3 versus the DAS28 and CDAI, and agreement of the proportions of patients with various activity levels according to the DAS28, CDAI, and RAPID3, were significant, although not as high in this study as in the previous study (25). Nonetheless, kappa levels for the 4 rheumatologists of 0.34 for the DAS28 versus RAPID3 and 0.55 for the CDAI versus RAPID3 in an analysis of high/moderate activity versus low activity/remission are in the range of comparisons of other clinical measures for a similar construct. For example, kappa values for a normal versus abnormal ESR compared with a normal versus abnormal C-reactive protein (CRP) level were 0.21, 0.44, and 0.50, and a correlation of ESR and CRP was 0.51 for patients of the 3 rheumatologists in the previous study (ref. 25 and Pincus T: unpublished observations), which is lower than the RAPID3 compared with the DAS28 and CDAI.

Data concerning time to score the indices are also similar to previous findings, as summarized in Figure 2, which includes data from the previous report (29) as well as real-time and paper patient scoring in this report. A swollen and tender 28-joint count was performed in 90 seconds in the previous study and 94 seconds in the real-time clinical study reported here. Scoring a HAQ disability index in the previous study (29) involved 42 seconds and was not studied here. The CDAI was scored in 106.1 seconds in real time and 99.2 seconds in paper patient scoring (94 seconds for the joint count plus 5.2 seconds for scoring). The DAS28 was scored in 113.9 seconds in real time and 111.7 seconds in paper patient scoring (94 seconds for

the joint count plus 17.7 seconds for scoring). The RAPID3 on a 0–10 scale was scored in 9.6 seconds in the previous study, 9.5 seconds in real time in the present study, and 9.6 seconds in paper patient scoring. The RAPID3 on a 0–30 scale was scored in 4.6 seconds in paper patient scoring in the present study.

Several limitations to this study are seen. First, only 4 rheumatologists were included, and variation in the results was seen. Nonetheless, agreement of indices for 2 rheumatologists is quite similar to or even greater than that seen in the previous study of 3 rheumatologists (29), and similarities in the aggregate are seen for 7 rheumatologists whose results have been analyzed. Second, the conditions are likely to underestimate the time required to score each of the indices in a real-time situation, as the physicians recognized that they were under observation. However, comparative times appear to provide accurate relative estimates, and findings again appear similar from the real-time and paper patient studies here and previous studies (23,29). Third, if an assistant is available to perform a joint count and score a DAS28 or CDAI, the time savings of RAPID3 for the physician are to a large extent irrelevant. However, assistants are unavailable to many rheumatologists, and if available, their time is valuable. Fourth, time to score could be similar for all of the indices in an all-electronic environment. However, the 90–94 seconds to perform a formal joint count would remain, and no data can be gleaned from electronic media in fewer than 5 seconds.

All quantitative measures and indices of RA must be interpreted by a caring and knowledgeable physician to apply to an individual patient in formulating clinical decisions. Neither RAPID3 nor any index should be regarded as a substitute for a careful history and physical examination or as indicating an invariant clinical decision. Clinical decisions are based on clinical judgment, incorporating all types of information pertinent to individual patients. Nonetheless, clinical judgment is better informed by availability of quantitative data, with RAPID3, as well as a DAS28, CDAI or any measure or index, viewed as guides, but not replacements, for clinical judgment.

The RAPID3 appears preferable to no quantitative clinical data at all (other than laboratory tests), as usually seen in contemporary rheumatology visits. All RA disease activity measures and indices are surrogates, and limitations are seen for the joint count (45) and DAS28 (37,46–48), as well as for patient questionnaires and RAPID3 (45). Nonetheless, physical function on a patient questionnaire, and not a laboratory test or radiograph, provides the most significant clinical prognostic indicator of most severe 5–10-year outcomes of RA (other than radiographic damage), including work disability, costs, and mortality (49).

The MDHAQ and RAPID3 add no additional work for the physician for comparison from one visit to another. A receptionist, nurse clinician, or other assistant can easily be taught to calculate RAPID3 scores using the scoring templates on the MDHAQ, as used by the authors in this study. A nonquantitative, careful joint examination, as generally performed by most rheumatologists, with quantitative data from RAPID3 and a self-report RADAI joint count to monitor clinical status, may be adequate for most

patient care. MDHAQ/RAPID3 scores provide valid, reliable, feasible, and acceptable measures for standard clinical care.

AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Dr. Pincus had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study conception and design. Pincus, Bergman, Colglazier, Yazici.
Acquisition of data. Pincus, Bergman, Colglazier, Kaell, Kunath, Siegel, Yazici.
Analysis and interpretation of data. Pincus, Swearingen, Bergman, Colglazier, Kaell, Yazici.

ROLE OF THE STUDY SPONSOR

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