Supplementary Table 1. Summary of randomized clinical trials applying at-work limitations/productivity (presenteeism) outcome measure(s)

Primary Author / Year / Trial name	Patients	Comparison (intervention vs. control arms)	Study Duration	Worker Productivity Outcome Measure						Additional Notes About Outcome Measure	Effect Size (between arms)
				WPAI	WPS-RA	HPQ	WLQ-25	QQ	Other		
Anis (1) 2009 COMET	Early RA (n=205)	Etanercept + methotrexate vs. methotrexate alone	12 months	X*			X*			Presenteeism estimates were imputed, not directly measured in study	Intervention arm had 9.3 (WPAI, statistically significant vs. control arm) and 1.3 (WLQ-25, not significant vs. control arm) fewer lost workdays due to presenteeism over study period
Driessen (2) 2008 Stay@Work Study	Back, neck pain (n=2076)	Participatory ergonomics vs. usual practice	12 months			X†					Study protocol published in Driessen 2008; results of economic impact (i.e. HPQ) not yet published
Emery (ACR abstract) 2011 OPTIMA	Early RA (n=1032)	Adalimumab + methotrexate vs. methotrexate + placebo	26 weeks	X					X	Other work outcome used was the Work Instability Scale for Rheumatoid Arthritis (RA-WIS)	Mean improvement in WPAI presenteeism score from baseline was 21.2 (treatment)vs. 15.3 (control), $p<0.001$ At follow-up RA-WIS score was 7.5 (treatment) vs. 9.0 (control), $p<0.01$
IJzelenberg (3) 2007	LBP or UE disorders (n=489)	Prevention program for LBP vs. usual care	12 months					X		Total indirect costs (due to absenteeism and presenteeism) were compared	Over first 6 months: indirect cost difference of €61 for LBP (ns vs. control), €311 for UE (p<0.05 vs. control); over next 6 months: indirect cost difference of €344 (in favor of control, ns) for LBP, €122 for UE (ns)

Study	Condition	Intervention	Follow-up						Outcome Measure	Results
Kavanaugh (4) 2009 RAPID 1 & 2	RA (RAPID 1, n=982) (RAPID 2, n=619)	Certolizumab pegol (400mg) + metrotrexate (treatment arm 1) vs. certolizumab pegol (200mg) + methotrexate (treatment arm 2) vs. placebo + methotrexate (control arm)	12 months (RAPID 1); 6 months (RAPID 2)		X				Presenteeism item from WPS-RA: rating of arthritis interference with work productivity (0 = no interference, 10 = complete interference)	RAPID 1 (at week 52): mean presenteeism = 2.4 (treatment arm 1) and 2.4 (treatment arm 2); both $p<0.05$ vs. control arm (mean=5.2); (+) RAPID 2 (at week 24): mean presenteeism = 2.5 (treatment arm 1) and 3.0 (treatment arm 2); both $p<0.05$ vs. control arm (mean= 5.2)
Kimball (5) 2011 REVEAL	Psoriasis (n=224 with PsA) (n=94 with other form of arthritis)	Adalimumab vs. placebo	16 weeks	X					Total work productivity impairment (TWPI) calculated from WPAI (combining estimates of absenteeism and presenteeism)	PsA subgroup: TWPI improved by 15.6 (intervention) vs. deteriorated by 1.4 (control) (p<0.001); Arthritis subgroup: TWPI improved by 12.8 (intervention) vs. 0.1 (control) (p=0.01)
MacDermid (6) 2006	Rotator cuff tears (n=250)	Arthroscopic or mini-open surgical repair	24 months					X†	Work Limitations 26 (variant of WLQ-25)	N/A – protocol only
Martimo (7) 2010	Upper-extremity disorders, employed (n=177)	Ergonomic intervention vs. no intervention	12 weeks				X		At-work productivity loss estimated based on a specific formula combining quantity and quality scores	At-work productivity loss differed ($p<0.01$) between groups based on generalized estimating equation (controlled for covariates)
Osterhaus (8) 2009 FAST4WARD	RA (n=220)	Certolizumab pegol vs. placebo	24 weeks		X					Comparisons between ACR20 responders/non-responders were reported (not by intervention arms): SRM of 1.1 among ACR20 responders; SRM of 0.01 among ACR20 non-responders
Rauck (9) 2007	Chronic moderate to severe LBP (n=392)	Opiods: AVINZA (morphine sulphate) vs. OxyContin (no control group)	6 months			X				No significant differences in any of 4 WLQ subscales between arms.
Santos (10) 2011	Healthy (n=101)	Educational program for primary prevention vs. general health education	26 weeks			X				No statistical difference in any of 4 WLQ subscales or index score between arms
Skljarevski (11) 2010	Chronic LBP (n=401)	Duloxetine vs. placebo	12 weeks	X						No statistical difference on presenteeism component between arms

				WPAI	WPS-RA	HPQ	WLQ-25	QQ	Other		
Strand (12) 1999	RA (n=482)	Leflunomide vs. methotrexate vs. placebo	52 weeks				X			Work Limitations Questionnaire of the National Opinion Research Center Survey (0 – 100, 100= higher productivity at home, school, work)	Leflunomide arm: mean change of 9.8 (p<0.0001 vs. placebo); methotrexate arm: mean change of 7.5 (p<0.05 vs. placebo); placebo arm: mean change of 0.3
			Total	3	2	0	3	2	--		

WPAI, Work Productivity and Activity Impairment Questionnaire; WPS-RA, Rheumatoid Arthritis-specific Work Productivity Survey; HPQ, World Health Organization Health and Work Performance Questionnaire; WLQ-25, Work Limitations Questionnaire - 25; QQ, Quantity and Quality method; RA-WIS, Work Instability Scale for Rheumatoid Arthritis; RA, rheumatoid arthritis; PsA, psoriatic arthritis, AS, ankylosing spondylitis; LBP, low back pain; UE, upper-extremity; VAS, visual analog scale; ACR20, American College of Rheumatology 20 response criteria; SRM, standardized response means. *excluded from total count because worker productivity outcomes were imputed ecause results not yet available.

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Supplementary Table 2. Highlights of key OMERACT filter evidence for candidate measures of at-work limitations/productivity (presenteeism)

Instrument	OMERACT Truth		OMERACT Discrimination				OMERACT Feasibility
	Face/Content Validity	Construct validity	Reliability & Internal Consistency (if applicable)	Responsiveness (within-group discrimination)	RCT (between-group discrimination)	Score Interpretability	
	(e.g. patient involvement in development; positive evaluation or endorsement of content from experts/patients)	(e.g. expected level of correlations with similar constructs (or longitudinal change); known-group differences consistent with expectations)	(e.g. score agreement between test-retest (ICCs >0.7); Cronbach's alpha or KR-20 >0.7)	(e.g. ES or SRM estimates consistent with degree of change observed; high correlation with relevant external indicator of change or AUC>0.7)	(e.g. significant between-group difference (where intervention efficacy expected)	(e.g. cut-score estimates associated with Patient Acceptable State or Minimal Important Difference)	(e.g. evidence of low respondent and administration burden, considering time, cost, accessibility of measure)
Global measures							
Work Productivity Activity Impairment (WPAI, item 5) $ assesses the extent to which health condition affected productivity while working (0-10)	Items generated from cognitive debriefing of patients with allergic rhinitis (13) Included in several literature reviews of work productivity measures (14-17)	Moderate correlation (r=0.39) with HLQ presenteeism score; moderate-to-high correlations (r=0.67-0.77) against a series of health status indicators (function, pain, patient globals) in RA (18) Moderate correlations with QQ method (r=0.61) and HLQ presenteeism score (r=0.48) in RA; moderately comparable cost difference per week due to presenteeism between RA and control groups were estimated from WPAI-GH (€200), QQ (€152) and HLQ (€57) approaches. (19)	$ICC_{2,1}$ of 0.84 among workers with IA or OA over 2 week test-retest (preliminary results from CAN-funded "discrimination" study) See also: (13)	In a 24-week adalimumab RCT in AS: SRM of -0.89 to -0.86 were found among clinical responders ; SRM of -0.52 to -0.46 were found among non-responders (21) See also: (5)	Significant difference in the change in presenteeism global from WPAI:SpA between clinical responders vs. non-responders over 24 weeks in a RCT of adalimumab in AS (21) Mean improvement in WPAI presenteeism global was 21.2 (adalimumab + methotrexate arm) vs. 15.3 (methotrexate + placebo arm), p<0.001, in a 26 week trial in early RA (22) See also:	PAS cut-points estimated among workers with AS (23) Study initiated by working group in progress, PAS/MID cut-score estimates available from authors	Single item; easy to administer/score Various versions of WPAI accessible from developer's website Can be adapted to be applied to various occupations/health conditions; various languages Self-administration may lead to more missing data than interviewer-administration (13)

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Property Summary rating	Face/Content Validity ++	Construct validity ++	Reliability (& IC) +	Responsiveness ++	RCT ++	Interpretability +	Feasibility ++
		Moderately correlated with ASQOL (r=0.60), SF-36 PCS (r=-0.67), SF-36 RP (r=-0.48) (20)			(1;5;11)		
Rheumatoid Arthritis-specific Work Productivity Survey (WPS-RA, item 4) $ Assesses the extent to which arthritis interfered with work productivity (0-10)	Developed through a literature review on worker productivity associated with RA or other chronic health conditions (8) Included in recent literature review of worker productivity measure in rheumatology (17)	Known-group comparisons found rate of arthritis interference on work productivity differed (p<0.01) among persons with RA stratified by HAQ-DI, SF-36 PCS, or SF-36 MCS scores (≤ first quartile vs. ≥third quartile) (8)	ICC$_{2,1}$ of 0.87 among workers with IA or OA over 2 week test-retest (preliminary results from CAN-funded "discrimination" study)	In a 24-week trial of certolizumab in RA, SRM of 1.10 and 0.01 were found among ACR20 responders and non-responders respectively; SRM of 1.12 and 0.03 were found among HAQ-DI responders and non-responders, respectively (8)	Significant difference in mean change in WPS-RA global between ACR20 responders vs. non-responders (P<0.01) as well as between HAQ-DI responder vs. non-responder (P≤0.001) in a 24 week trial of certolizumab in RA (FAST 4WARD study) (8) Significant difference in WPS-RA global were found (P≤0.05) between treatment arm(s) (certolizumab + methotrexate) and control arm (placebo + methotrexate) in two separate trials in RA (RAPID 1, 24 weeks; RAPID 2, 52 weeks) (4) Significant difference in mean change of WPS-RA global was found between	Study initiated by working group in progress, PAS/MID cut-score estimates available from authors	Single-item, low burden Accessible on the web; permission to use required Low frequencies of missing data (0% of n=85) with RA; (8)

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	Face/Content Validity	Construct validity	Reliability (& IC)	Responsiveness	RCT	Interpretability	Feasibility
					clinical responders vs. non-responders (P≤0.01) after 12 week treatment with certolizumab in RA (data pooled from RAPID 1 and RAPID 2 trials) (24)		
Property Summary rating	Face/Content Validity +	Construct validity +	Reliability (& IC) +	Responsiveness ++	RCT ++	Interpretability (+)	Feasibility ++
Health and Work Productivity Questionnaire (HPQ, item A12) $ Self-rating of overall work performance on working days over past 7 (or 28) days (0-10)	Developed with support from the World Health Organization Included in recent literature reviews of worker productivity measure (14;15)	Lost-hour estimated from HPQ global showed moderate agreement (ICC=0.61) with estimates from WPAI global and low agreement with WLQ-Index (ICC=0.26) and Health Labor Questionnaire (ICC=0.16) among workers with arthritis. (18) Moderate correlations with WALS (r=-0.45), SPS-6 (r=-0.49), EWPS (r=-0.62), RA-WIS (r=-0.56), WLQ-25 (r=-0.49) among workers with arthritis (25) See also: (26) (27)	$ICC_{2,1}$ of 0.83 among workers with IA or OA over 2 week test-retest (preliminary results from CAN-funded "discrimination" study) See also: (26)	No evidence of achievement to-date	No evidence of achievement to date	Study initiated by working group in progress, PAS/MID cut-score estimates available from authors	Low burden; global measure of presenteeism consists of 1 item (A12), can be used in conjunction with item A10 from HPQ to calculate relative presenteeism (28) Accessible from the web
Property Summary rating	Face/Content Validity ++	Construct validity ++	Reliability (& IC) (+)	Responsiveness ?	RCT ?	Interpretability (+)	Feasibility ++
Quantity & Quality Method (QQ) $	Developed by experts in the field	Moderate correlations with presenteeism scores from the WPAI-GH (r=0.61) and the	$ICC_{2,1}$ of 0.77 among workers with IA or OA over 2 week test-retest	No evidence of achievement to-date	Significant difference in at-work productivity loss estimated by QQ method	Cut-scores associated with Patient Acceptable	Low burden, QQ consists of two items from the Productivity and Disease

	Face/Content Validity	Construct validity	Reliability (& IC)	Responsiveness	RCT	Interpretability	Feasibility
Assesses the quantity and quality of work performed compared to normal (2 items, 0-10)		Health Labor Questionnaire (r=0.34); Moderately comparable difference in costs per week due to presenteeism between RA and control groups were estimated from QQ (€152), WPAI-GH (€200), and HLQ (€57) approaches (19) See also: (29)	(preliminary results from CAN-funded "discrimination" study)		between intervention and control arm (p=0.013) in a RCT of ergonomic intervention in workers with upper-extremity disorders (7) See also: (3)	Work State were estimated among workers with AS (23) Study initiated by working group in progress, PAS/MID cut-score estimates available from authors	Questionnaire (PRODISQ) (29) Accessible from the web
Property Summary rating	**Face/Content Validity** +	**Construct validity** +	**Reliability (& IC)** (+)	**Responsiveness** ?	**RCT** +	**Interpretability** +	**Feasibility** ++
Work Ability Index (WAI, item 1) Assesses current work ability in relation to lifetime best (0-10)	Developed by the Finish Institute of Occupational Health (30) Widely applied in occupational health research, especially in European contexts	WAI global showed low-to-moderate Pearson r with carrying and lifting test (0.13), lower lifting strength test (0.20), and upper lifting strength test (0.40) among construction workers with musculoskeletal disorders (31) Among workers with RA, fatigue (OR=24), lack of autonomy (OR=3.7), lack of supervisor support (OR=3.6), lack of co-worker support (OR=6), high physical requirements (OR=4.3-24) were associated with lower WAI (32)	$ICC_{2,1}$ of 0.80 among workers with IA or OA over 2 week test-retest (preliminary results from CAN-funded "discrimination" DAP study)	Significant improvements in WAI global score (11%) after 1 year course of adalimumab in RA; SRM (0-6 months) = 0.34, SRM (0-12 months) = 0.41 (34) Significant improvement in WAI global score (10%) after 6 month course of tumor necrosis factor inhibitor in RA; SRM = -0.48 among those working, SRM = 0.19 among those not working (35)	No evidence of achievement to-date	Study initiated by working group in progress, PAS/MID cut-score estimates available from authors	Low burden to complete and score the measure Accessible on-line; free to use

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	Sick-listed group reported significantly lower WAI (mean=3.1) vs. working group (mean=6.6) among workers with repetitive strain injuries of the upper-limb (33) See also: (34) (35) (36;37)						
Property	Face/Content Validity	Construct validity	Reliability (& IC)	Responsiveness	RCT	Interpretability	Feasibility
Summary rating	++	++	+	++	?	(+)	++
Multi-item measures							
Workplace Activity Limitations Scale (WALS) Assesses workplace activity limitations	70% of 250 workers with arthritis endorsed the scale's comprehensiveness; and 32.6% preferred the WALS over 4 other work measures (38) Included in recent literature reviews of worker productivity measure in rheumatology (17)	High correlation with RA-WIS (r=0.77) among workers with RA or OA; Moderate correlations with self-related ability to work (r=-0.58) and self-rated difficulty doing work (r=0.66) (25) Moderate correlation (Pearson r=0.61) between WALS and Chronic Illness Job Strain Scale (39) Known-group differences: high WALS (>9) more likely to require work accommodation, experience work absenteeism, and job interruptions vs. low WALS (<5) (40)	$ICC_{2,1}$ of 0.93 among workers with IA or OA over 2 week test-retest (preliminary results from CAN-funded "discrimination" study) Cronbach's alpha of 0.87 among workers with RA or OA (25) Cronbach's alpha of 0.78-0.81 (n=349-491) with OA or IA over 4 time-points, each 18 months apart (41-43) See also: (39)	SRM=-0.79 among those 1-year improvement in self-rated work ability; SRM=0.50 among those 1-year deterioration in self-rated work ability (25)	No evidence of achievement to-date	Study initiated by working group in progress, PAS/MID cut-score estimates available from authors	97.6% of 250 workers with arthritis endorsed the scale's understandability and 77.6% endorsed the appropriateness of its length (38) 94% of n=250 workers with RA or OA completed ≥10/11 scale items; reflects low respondent burden (25)

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Property Summary rating	Face/Content Validity ++	Construct validity ++	Reliability (& IC) ++	Responsiveness +	RCT ?	Interpretability (+)	Feasibility ++
Work Limitations Questionnaire (WLQ-25) $ Assesses work role functioning over 4 domains of work: time-management, physical demands, mental-interpersonal, output-demands	Content and format developed from focus groups and cognitive interviewing with workers with various chronic conditions (non-arthritis); domain organization derived from psychometric testing in persons with rheumatoid arthritis, chronic headaches, and epilepsy (44) 92.8% of 250 workers endorsed the scale's comprehensiveness and 30.0% considered as preferred measure over 4 other work measures (38) Included in recent literature reviews of worker productivity measure (14-17;45)	Moderate-to-high correlation with RA-WIS (r=0.67) and WALS (r=0.61) among worker with RA or OA; moderate correlation (r=-0.49) with self-rated work productivity (25) Low-to-moderate correlations with the SF-36 MCS (r=-0.60), SF-36 PCS (r=-0.49), fatigue VAS (r=0.50), pain VAS (r=0.46); HAQ (r=0.56), HAQ-II (r=0.54), days with limited activities (r=0.38), and days unable to work (r=0.29)(46) See also: (44) (46-48)	$ICC_{2,1}$ range of 0.79-0.93 (subscales and Index score) among workers with IA or OA over 2 week test-retest (preliminary results from CAN-funded "discrimination" DAP study) In OA, Cronbach's alpha range of 0.93-0.97 for 4 subscales (49) (Lerner 2002) In RA, Cronbach's alpha range of 0.83-0.88 for 4 subscales (46) See also: (25)	SRM=-0.64 among those 1-year improvement in self-rated work productivity; SRM=0.08 among those 1-year deterioration in self-rated work productivity (lower than expected) (25)	Several RCT showed no effect between groups, see: (6;9;10;12)	PAS cut-points estimated among workers with AS (23) Study initiated by working group in progress, PAS/MID cut-score estimates available from authors	78.6% of 250 workers with arthritis endorsed the scale's understandability and 79.9% endorsed the appropriateness of its length (38) Minimal missing data (<1%) when applied in OA (49) Missing proportion of 3.1 – 21.8% for individual scale items (46) Reverse orientation of instructions in the PD subscale compared to other 3 subscales could be a source of confusion for respondents (a non-issue with the adapted WLQ-25)
Property Summary rating	Face/Content Validity ++	Construct validity ++	Reliability (& IC) ++	Responsiveness +	RCT -	Interpretability +	Feasibility ++

Full details of OMERACT filter evidence for all measures available from authors

$ instrument has potential for use in economic evaluations

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Ratings (based on overall appraisal of all available evidence in arthritis or musculoskeletal conditions):

For construct validity, reliability, and responsiveness

++ = evidence of this measurement property from 2 or more studies, in the absence of conflicting evidence

+ = evidence of this measurement property from at least 1 study, and overall body of evidence supporting >refuting

+/- = conflicting evidence available, current evidence does not meet ++ or +

- = only negative evidence available

? = no evidence available

For RCT

++ = 2 or more RCT providing evidence of discrimination (required for OMERACT endorsement)

+ = 1 RCT providing evidence of discrimination

(+) = ongoing RCT using worker productivity outcome measure (protocol available)

- = only evidence of lack of discrimination available

? = no RCT available

discrimination = includes between-group differences of within-group change, or between-group differences of final state

For score interpretability

++ = estimates available from 2 or more studies

+ = estimates available from 1 study

(+) = estimates expected from an ongoing study

? = not yet available

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