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A Review of Health-Related Workplace Productivity Loss Instruments

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Contents

Abstract

The objective of this review was to identify health-related workplace productivity loss survey instruments, with particular emphasis on those that capture a metric suitable for direct translation into a monetary figure.

A literature search using Medline, HealthSTAR, PsycINFO and Econlit databases between 1966 and 2002, and a telephone-administered survey of business leaders and researchers, were conducted to identify health-related workplace productivity measurement survey instruments. This review was conducted from the societal perspective. Each identified instrument was reviewed for the following: (i) reliability; (ii) content validity; (iii) construct validity; (iv) criterion validity; (v) productivity metric(s); (vi) instrument scoring technique; (vii) suita-

bility for direct translation into a monetary figure; (viii) number of items; (ix) mode(s) of administration; and (x) disease state(s) in which it had been tested.

Reliability and validity testing have been performed for 8 of the 11 identified surveys. Of the 11 instruments identified, six captured metrics that are suitable for direct translation into a monetary figure. Of those six, one instrument measured absenteeism, while the other five measured both absenteeism and presenteeism. All of the identified instruments except for one were available as paper, self-administered questionnaires and many were available in languages other than English.

This review provides a comprehensive overview of the published, peer-reviewed survey instruments available to measure health-related workplace productivity loss. As the field of productivity measurement matures, tools may be developed that will allow researchers to accurately calculate lost productivity costs when performing cost-effectiveness and cost-benefit analyses. Using data captured by these instruments, society and healthcare decision makers will be able to make better informed decisions concerning the value of the medications, disease management and health promotion programmes that individuals receive.

Healthcare costs in the US have risen dramatically and, in response, healthcare purchasers have implemented various strategies for cost containment such as contracting with healthcare organisations, limiting individuals' choice of health plans and shifting costs to individuals.[1] With the limited resources available, society and healthcare policy makers need to be able to determine the value of pharmaceuticals or healthcare interventions to both purchasers and patient consumers.

One way to estimate the value of health technologies and determine their return on investment is by performing a cost-benefit analysis. Within sick populations, the benefits resulting from interventions may include increased work productivity or decreased medical expenditures.

In order to estimate an individual's health-related loss in work productivity, the individual's absenteeism, presenteeism,[2] and compensation need to be captured. Absenteeism is generally defined as the number of days missed from the workplace, while presenteeism is the reduced productivity while at paid work.[3] Researchers investigating productivity have argued that an individual's absenteeism, short-term disability, and presenteeism need to be collectively evaluated in order to have a complete and accurate picture of lost workplace productivity.[3]

One of the controversies within the field of lost productivity surrounds how the opportunity costs for individuals should be valued. In general, lost work productivity is a function of an individual's wage or compensation. There are two techniques for defining the components of lost work productivity, the human capital approach (HCA) and the friction cost approach (FCA).[4,5]

The HCA was first presented in the 1960s,[6] and since then has become the most widely used methodology for assigning monetary value to lost productivity.[2,4,7-14] The HCA estimates lost productivity as the expected or potential earnings lost due to a disease or disorder. The HCA is therefore a function of one's compensation,[4,5] where 1 hour of lost productivity is valued as 1 hour of an individual's compensation.[7] The HCA usually allocates a zero dollar figure to the opportunity costs of individuals who are not paid for work outside of the home, such as homemakers and the elderly, although there are exceptions to this rule.[15-17]

In 1992, Koopmanschap introduced the FCA.[5] To estimate lost productivity using this technique,

the frequency and length of the friction periods and the friction costs associated with the friction period are required. The friction period is the time needed to replace a sick worker and reach the productivity level of the previous well worker. Friction costs include: (i) the lost productivity output prior to an absent worker being replaced; (ii) the decreased productivity associated with any new replacement employee; and (iii) the cost of hiring, replacing and training any new replacement employees.[11] The FCA assumes that for long-term absences, sick individuals are replaced by someone who is unemployed.[11] However, this assumption may be limited since it is unlikely that individuals who are unemployed would always replace sick workers, especially in economies where there is a moderately low rate of unemployment. As with the HCA, the FCA allocates a zero dollar figure to the opportunity costs of individuals who are not paid for work outside of the household.

There may be circumstances in which either the HCA or the FCA may be more appropriate. The HCA is based in economic theory from a societal perspective and is the preferable technique for investigations from this point of view.[2] If one was interested in estimating lost productivity from an individual (employee) perspective, the HCA is the appropriate technique.[12] The FCA includes employer costs (i.e. costs of hiring and training new employees) that cannot be allocated to specific individuals, thereby rendering it more suitable for studies involving the employer perspective. However, an employer needs to consider if the costs of hiring and training new employees included in the FCA are pertinent to the firm and the specific lost productivity situation.

Whether the HCA or the FCA is used, estimating the health-related lost work productivity of a population provides critical information about the impact of disease and treatments on workers, which assists society and healthcare decision makers in better estimating the value of healthcare interventions. One potential means of capturing health-related work productivity is the use of survey instruments. Healthcare purchasers can use the absenteeism and presenteeism data collected from these instruments to assess the magnitude, impact and effects of a particular condition or disease among their population.

We conducted a review from the societal perspective to identify the health-related workplace productivity loss survey instruments, with particular emphasis on those that capture lost productivity suitable for direct translation into a monetary figure.

1. Literature Search and Analysis Methods

A literature search using Medline, HealthSTAR, PsycINFO and Econlit databases covering the time period between 1966 and 2002 was first conducted to identify survey instruments to measure lost health-related work productivity. The search strategy included individual terms and combinations from the following list: lost productivity, productivity, work loss, days missed from work, absenteeism, presenteeism, conceptual model, theoretical model and indirect costs. A bibliography review of the retrieved manuscripts was performed to identify any additional health-related productivity instruments.

In addition to a literature review, a telephone-administered survey of 19 business leaders and researchers who are actively involved or interested in productivity measurement was conducted. As part of the qualitative interviews, participants were asked to identify and appraise relevant instruments. QOL surveys, which have been used as an approximation for productivity impairment, were excluded from this analysis since these instruments do not directly measure productivity. Instruments were limited to those that were developed specifically to collect health-related lost workplace productivity data.

Next, an appraisal of the instruments was conducted from the societal perspective. Ideally, the instrument would yield the following data for an individual: (i) absenteeism and presenteeism for workplace activities; (ii) usual number of work

hours per day; and (iii) usual number of workdays per week. In addition, the ideal instrument should be reliable as well as have face, content, construct and criterion validity.

Therefore, the specific evaluation criteria were:

- reliability
- content validity
- construct validity
- criterion validity
- productivity metric(s)
- instrument scoring technique
- suitability for direct translation into a monetary figure
- number of items
- mode(s) of administration
- disease state(s) in which it has been tested.

Since productivity loss is a relatively new field of study, it was anticipated that some of the above aspects would not be available for all of the identified instruments. For example, criterion validity refers to the ability of an instrument to produce the same results as an identified gold standard.[18] Within the field of productivity measurement, there is no agreed upon gold standard for either absenteeism or presenteeism. In addition, for many occupations, there is no gold standard for productivity. Instruments were considered to be suitable for direct monetary translation if they captured a quantifiable unit of time lost from work activities, which could be multiplied by a monetary value (e.g. wage) for the time. The total cost of an individual's compensation (i.e. gross wages, fringe benefits and the employer's portion of the payroll taxes) was used to monetise the value of health-related lost productivity. In addition, an instrument's characteristics, including length, mode of administration and translation into language(s) other than English, were reviewed.

2. Appraisal of Productivity Instruments

Eleven health-related productivity survey instruments were identified from the literature and one additional instrument was identified via the qualitative interviews (table I). The literature was reviewed for the additional instrument, the MacArthur Health and Productivity Questionnaire. However, as of the writing of this report, there is no published information on this instrument; therefore, no descriptive information is provided.

Each identified questionnaire is discussed in detail in the following sections, with comparisons and psychometric properties provided in table I and table II, respectively. The techniques for direct monetary translation are provided in table III. The questionnaires are presented in chronological order so the evolution of the measurement tools may be examined.

2.1 Osterhaus Technique

The Osterhaus technique was the first method developed for the purpose of measuring productivity loss due to illness. The technique was developed in 1992 as part of a randomised clinical trial aimed at estimating the costs associated with migraine headache. The Osterhaus technique is a questionnaire that captures lost labour costs associated with decreased at-work productivity and missed workdays due to migraine (table I).[15,24] The reliability and validity of the questionnaire have not been reported in the literature (table II).

The Osterhaus technique measures absenteeism as the number of days in the past month that an individual missed school or work due to migraine headaches. In addition, it captures presenteeism as the number of days worked with migraine symptoms in the past month and the number of work hours the employee was affected by migraine symptoms during each migraine episode. In order to estimate the value of lost labour in monetary terms, an individual's daily compensation is multiplied by the sum of the number of workdays missed and the adjusted number of days worked with migraine symptoms during the past month (table III). The survey is a 12-item, self-administered questionnaire developed for individuals with migraine headache.[15,24]

Table I. Overview of health-related workplace productivity loss instruments

Name of instrument	Year published	Productivity metric(s)	Suitable for direct translation into a monetary figure	Characteristics	Disease states in which the instrument has been tested
Angina-related Limitation at Work Questionnaire (ALWQ)[19]	1998	Absenteeism Presenteeism	No	Length: 17 items Mode of administration: paper, self-administered Language: English	Angina
Endicott Work Productivity Scale (EWPS)[20]	1997	Absenteeism Presenteeism	No	Length: 25 items Mode of administration: paper, self-administered Language: English	Depression
Health and Labor Questionnaire or Illness and Labor Questionnaire (HLQ)[15,17]	1995	Absenteeism Presenteeism	Yes	Length: 4 modules Mode of administration: paper, self-administered Languages: several	Migraine; bladder electro-stimulation; knee surgery; hip prosthesis
Health and Work Questionnaire (HWQ)[21]	2001	Unable to determine with the limited data available	Unable to determine with the limited data available	Length: 27 items Mode of administration: paper, self administered Language: English	Smokers
Migraine Work and Productivity Loss Questionnaire (MWPLQ) [22,23]	1999	Absenteeism Presenteeism	Yes	Length: 23 items Mode of administration: paper, self-administered Language: English	Migraine
Osterhaus technique[24]	1992	Absenteeism Presenteeism	Yes	Length: 12 items Mode of administration: paper, self-administered Language: English	Migraine

Continued next page

Table I. Contd

Name of instrument	Year published	Productivity metric(s)	Suitable for direct translation into a monetary figure	Characteristics	Disease states in which the instrument has been tested
Stanford Presenteeism Scale (SPS)[25]	2002	Presenteeism	No	Length: 6 items Mode of administration: self-administered Language: English	Unable to determine with the limited data available
Unnamed Hepatitis Instrument[26]	2001	Absenteeism Presenteeism	Yes, absenteeism only	Length: 3 items Mode of administration: self-administered Language: English	Hepatitis
Work Limitations Questionnaire (WLQ)[27,28]	2001	Presenteeism	No	Length: 25 items Mode of administration: self-administered Language: English	Asthma; chronic daily headache; depression; epilepsy; gastrointestinal disease; psychiatric disorders; osteoarthritis; rheumatoid arthritis
Work Productivity and Activity Impairment Questionnaire – General Health (WPAI-GH)[29,30]	1993	Absenteeism Presenteeism	Yes	Length: 6 items Mode of administration: paper, self-administered and interview administered Languages: various[b]	Numerous[a]
Worker Productivity Index (WPI)[32]	1999	Absenteeism Presenteeism	Yes	Computer-based monitoring of customer service telephone operators	Mental health; respiratory; digestive; injury; musculoskeletal; cancer; diabetes mellitus; hypertension

a Allergies; angina; anxiety; arthritis; asthma; Alzheimer's disease; bronchitis; benign prostatic hyperplasia; cancer; claudication; congestive heart failure; depression; dermatitis; diabetes mellitus; hypertension; gastro-oesophageal reflux; migraine; musculoskeletal pain; panic disorder; renal disease; sleep disorder; social phobia; urinary incontinence; voice disorders; miscellaneous.

b Czech, Danish, Dutch, Finnish, French, English, German, Greek, Hebrew, Hungarian, Italian, Norwegian, Polish, Portuguese, Spanish, Swedish.[31]

2.2 Work Productivity and Activity Impairment Questionnaire

The Work Productivity and Activity Impairment Questionnaire (WPAI) was developed in 1993 for the purpose of collecting productivity loss data within clinical trials (table I).[31] There are several versions of the questionnaire available including the WPAI-general health (WPAI-GH), WPAI-specific health problem (WPAI-SHP), WPAI-allergy specific (WPAI-AS), and the WPAI-gastro-oesophageal reflux disease (WPAI-GERD).[33]

The test-retest reliability of the WPAI-GH was assessed using Pearson's correlation coefficient (table II).[29] For construct validity, the questionnaire measures were correlated with the Medical Outcomes Study Short Form 36-item health survey (SF-36) domains. To date, results pertaining to the questionnaire's content validity and criterion validity have not been published.

The WPAI-GH consists of six questions that ask the patient the number of hours missed from work and usual activities, as well as the degree to which work or regular daily activities were limited over the past 7 days.[29] The four scores of the questionnaire are expressed as impairment percentages, with higher numbers reflecting greater impairment and decreased productivity.[30] The four scores are: (i) percentage of work time missed due to health; (ii) percentage impairment while working due to health; (iii) percentage activity impairment due to health and (iv) an overall percentage work impairment score due to health problems.

Questions included in all WPAI tools are similar, with the exception that WPAI-SHP, WPAI-AS and WPAI-GERD make specific reference to a particular disease. All WPAI tools capture absenteeism and presenteeism; in order to calculate a monetary figure using the WPAI-GH, the overall percentage work impairment score can be multiplied by the employee's hourly compensation to determine the value of the lost productivity (table III).

The WPAI-SHP has been translated into 19 languages, while the WPAI-GH is currently available in English and Spanish.[30] Both the WPAI-SHP and WPAI-GH are available in interviewer- or self-administered versions.[31] The WPAI has been used within studies of several medical conditions (table I).

2.3 Health and Labor Questionnaire

The Health and Labor Questionnaire (HLQ) was developed to collect quantitative data on the relationship between illness and work performance (table I).[15,17] This tool consists of four modules to assess: (i) workplace absenteeism; (ii) workplace presenteeism; (iii) unpaid production (i.e. household duties); and (iv) impediments to work and unpaid production. Scores are calculated for each module.

In a sample of 667 persons administered the HLQ, the rate of missing data in completing the questionnaire was only 4.5% for the absenteeism section, 16% for the presenteeism section, 8–11% for unpaid production questions, and 7–11% for the impediment questions. These findings suggest that the HLQ is meaningful to patients.[17]

There are limited reported data supporting the validity of the HLQ. Although the instrument appears to demonstrate face validity, its content and construct validity have not been examined, and there is limited evidence to support its criterion validity versus other measures (table II).[15] With respect to the latter, one study demonstrated that the HLQ was not highly correlated with the Osterhaus scores ($r = 0.33$ and 0.37). However, when interpreting these results, it is important to recognise that the validity of the Osterhaus productivity technique itself has not been reported.[17]

Additional testing of the HLQ criterion validity was completed by comparing the instrument's absenteeism results to data from a government office of statistics in The Netherlands.[15] Specifically, non-disease specific absence from work was compared between the two measures.[15] Based on the 1993 national registry, the mean number of days missed from work per year was 12.9 and 13.8 days for men and women, respectively.[15] Of a sample of

Table II. Psychometric properties of health-related workplace productivity loss instruments. For further clarification, see text (section 2)

Name of instrument	Year published	Reliability	Validity
ALWQ[19]	1998	Internal consistency: Cronbach's α = 0.97	**Convergent validity**
		Item to item correlations were >0.75 for 14 items; 2 items 0.66 and 1 item 0.35	For 16 items, the mean SF-36 PCS was significantly lower for the subjects defined as 'limited'
		Pearson correlations = 0.73 and 0.75 for adjacent and non-adjacent pairs	Significant Spearman correlations (−0.35 to −0.63) between chest pain frequency score and items
			SF-36 PCS and MCS were significantly related to total work limitations score (r^2 = 0.76)
			Chest pain frequency significantly predicted total limitations (r^2 = 0.41)
EWPS[20]	1997	Intraclass correlation = 0.92	**Concurrent validity**
		Internal consistency: Cronbach's α = 0.93	*Patients with depression*
			Study initiation:
			HAM-D r = 0.27
			Global Clinical Index of Severity r = 0.42
			Study completion:
			HAM-D r = 0.61
			SCL-90 r = 0.50
			Global Clinical Index of Severity r = 0.46
			Community sample
			Zimmerman r = 0.57
			SCL-90 r = 0.55
HLQ[15,17]	1995	Missing data	**Criterion validity**
		Absenteeism: 4.5%	Pearson correlation with Osterhaus technique[24] (r = 0.33, 0.37)
		Presenteeism: 16% Unpaid production: 8–11% Impediment: 7–11%	1993 national registry: mean annual number of days missed from work: 12.9 and 13.8 days for men and women, respectively[15]
			HLQ: mean annual number of days missed from work: 12.2 and 14.1 days for men and women, respectively[15]
HWQ[21]	2001	Subscale internal consistency = 0.72–0.96	**Criterion validity**
		Internal consistency: Cronbach's α = 0.81	Correlations between HWQ total, subscale scores and total performance points (r = −0.043 to 0.219)
MWPLQ[22,23]	1999	Internal consistency: Cronbach's α = 0.80–0.95	**Face validity**

Continued next page

Table II. Contd

Name of instrument	Year published	Reliability	Validity
			Work difficulty domains applicable in >90% migraines
			Construct validity
			Congruent validity
			Moderately correlated to headache severity (r = −0.35 to 0.47), headache disability (r = 0.36–0.58), and 24-h MQoL (r = −0.31 to −0.65)
			Low to moderately correlated to SF-36 (r = −0.05 to −0.34)
			Discriminant validity
			Significant differences between individuals with migraine-specific versus usual migraine therapy
			Criterion validity
			Not available
Osterhaus technique[24]	1992	Has not been reported	Has not been reported
SPS[25]	2002	Internal consistency: Cronbach's α = 0.80	**Concurrent validity**
			Percentage of time productive r = 0.53
			Self-reported proportion of work accomplished r = 0.47
			Percentage of time likely to make more mistakes than usual r = −0.31
			Discriminant validity
			Job satisfaction r = 0.15
			Job stress r = −0.22
			Criterion validity
			Lower average score for individuals reporting a disability compared with those with no disability
Unnamed hepatitis instrument[26]	2001	Has not been reported	Has not been reported
WLQ[27,28]	2001	Item to total scale correlation >0.40[27]	**Construct validity**
		Item to total scale correlation >0.72[28]	All scales weakly correlated with SF-36 role limitation-physical (r^2 = 0.14–0.22)[27]
		Internal consistency: Cronbach's $\alpha \geq 0.88$[27,28]	Three scales weakly correlated with SF-36 role limitation-emotional (r^2 = 0.07–0.17)[27]
			Three WLQ scales significantly associated with a greater degree of work limitation for patients with osteoarthritis[28]

Continued next page

Table II. Contd

Name of instrument	Year published	Reliability	Validity
			All scales significantly associated with self-reported arthritis severity[28]
			Criterion validity
			Not available in the published literature
WPAI-GH[29,30]	1993	Test-retest reliability: Pearson's correlation coefficients for all items were >0.69	**Construct validity** Work productivity and regular activity impairment measures were positively correlated with SF-36 measures and symptom severity measures
			Regression model predicted between 54 and 65% of the variance in WPAI measures
WPI[32]	1999	Has not been reported	Has not been reported

ALWQ = Angina-related Limitation at Work Questionnaire; **EWPS** = Endicott Work Productivity Scale; **HAM-D** = Hamilton Rating Scale for Depression; **HLQ** = Health and Labor Questionnaire or Illness and Labor Questionnaire; **HWQ** = Health and Work Questionnaire; **MCS** = Mental Component Score; **MWPLQ** = Migraine Work and Productivity Loss Questionnaire; **PCS** = Physical Component Score; **SCL-90** = Symptom Checklist-90; **SF-36** = Medical Outcomes Study Short Form 36-item health survey; **SPS** = Stanford Presenteeism Scale; **WLQ** = Work Limitations Questionnaire; **WPAI** = Work Productivity and Activity Impairment Questionnaire **WPAI-GH** = Work Productivity and Activity Impairment Questionnaire – General Health; **WPI** = Worker Productivity Index; **24-h MQoL** = 24-h Migraine Quality of Life Questionnaire.

346 individuals working in paid jobs, the nondisease-specific absenteeism from work according to the HLQ was similar to the national registry, 12.2 and 14.1 days for men and women, respectively.[15] These findings support the criterion validity of the HLQ.

In the HLQ, workplace absenteeism is assessed by having the respondent indicate each day(s) of the preceding 2 weeks in which he/she performed work or was absent because of illness or another reason (e.g. vacation).[15] To assess presenteeism, individuals are asked the number of additional hours that should have been worked to compensate for the production losses because of illness at work. In addition, respondents are asked seven questions to determine specific problems (e.g. concentration) related to presenteeism.

For the unpaid production, individuals are asked about four specific activities: household work, shopping, caring for children and miscellaneous jobs around the home.[15] Individuals are asked to estimate the number of hours they performed each of these activities in the past 2 weeks. For the impediments to work and unpaid production, employed individuals are asked to determine the level of impediment experienced while working.

To translate the responses of the HLQ directly into a monetary figure, absenteeism needs to be converted to the number of work hours lost, added to the presenteeism metric, and then multiplied by an employee's hourly compensation (table III). The HLQ has been used in a variety of disease states such as migraine headache and knee surgery.[15]

2.4 Endicott Work Productivity Scale

Endicott and Nee[20] developed the Endicott Work Productivity Scale (EWPS) to assess the degree to which a medical condition affects an individual's work functioning (table I). The EWPS appears to possess test-retest reliability and internal consistency, with an intraclass correlation coefficient of the EWPS total score of 0.92 upon test-retest, and an internal consistency coefficient of 0.93 (table II).

Table III. Health-related workplace productivity loss instruments suitable for direct translation into a monetary figure

Name of instrument	Productivity metric(s) suitable for direct translation into a monetary figure	Technique to directly translate into a monetary figure
Health and Labor Questionnaire or Illness and Labor Questionnaire (HLQ)[15,17]	Absenteeism Presenteeism	Lost hours due to absenteeism = (number of days missed from work over the last 2 weeks) × number of hours worked per day
		Reduced productivity at work = number of additional hours that should have been worked to compensate for production losses due to illness on working days over the last 2 weeks
		Lost productivity ($) = (employee hourly compensation[a]) × [(lost hours due to absenteeism) + (reduced productivity at work)]
Migraine Work and Productivity Loss Questionnaire (MWPLQ)[22,23]	Absenteeism Presenteeism	Total hours of work loss = hours of paid work missed + [(1 minus percentage effectiveness when working with symptoms/100) × hours worked with migraine]
		Lost productivity ($) = (employee hourly compensation[a]) × total hours of work loss
Osterhaus technique[24]	Absenteeism Presenteeism	Lost productivity ($) in past month = {(number of days missed from work due to migraine) + [(days worked with migraine symptoms per month) × (number of hours work is affected by migraine) × (percent productivity when working with symptoms) × (number of hours worked per day)]} × (employee daily compensation[a])
Unnamed hepatitis instrument[26]	Absenteeism	Lost productivity ($) = (employee hourly compensation[a]) × (number of hours worked per day) × (number of days not able to work due to hepatitis/treatment)
Work productivity and activity impairment questionnaire (WPAI)[29]	Absenteeism Presenteeism	Lost productivity score = {(percentage of hours missed due to health problems) + [(1 minus percentage of hours missed due to health problems/100) × percentage impairment while working due to health problems)]}
		Lost productivity ($) = (employee hourly compensation[a]) × lost productivity score
Worker Productivity Index (WPI)[32]	Absenteeism Presenteeism	Lost hours per week due to absenteeism = (total weekly illness hours + total weekly short-term disability hours)/weeks employed
		Lost hours per week due to failure to meet productivity standard = [100% − (overall weekly productivity score[b,c])/ 0.5)] × average weekly staffing hours
		Total lost hours per week = lost hours per week due to absenteeism + lost hours per week due to failure to meet productivity standard
		Lost productivity ($) = (employee hourly compensation[a]) × total hours of work lost per week

a Compensation includes total gross wage, fringe benefits and the employer's portion of the payroll taxes.

b Employee weekly productivity standard (both handle and auxiliary time) is 1 if average of daily productivity standards is ≥0.5; otherwise standard is 0.

c If overall weekly productivity score is <0.5.

The content and criterion validity of the EWPS have not been assessed. However, the concurrent validity of the EWPS total score as a measure of the severity of illness was estimated by determining the extent to which the total score correlated with illness severity. One study compared the EWPS scores of patients who were participating in a randomised study of depression to scores of community residents who did not have depression.[20] Within the group with depression, EWPS total scores were compared with the Hamilton Rating Scale for Depression (HAM-D) total scores, Global Clinical Index of Severity, Symptom Checklist (SCL)-90 total scores and Zimmerman total scores. Within the group without depression, EWPS total scores were compared with SCL-90 and Zimmerman total scores.

For the patients with depression, the EWPS total score was found to have a correlation coefficient of 0.27 and 0.42 to the HAM-D total score and Global Clinical Index of Severity, respectively, at the initiation of the treatment study.[20] At study completion, the EWPS total score was found to have a correlation coefficient of 0.61, 0.46 and 0.50 to the HAM-D total score, Global Clinical Index of Severity and SCL-90 total score, respectively.[20] For the community sample, the EWPS total score was found to have a correlation coefficient of 0.57 and 0.55 to the Zimmerman total score and the SCL-90 total score, respectively.[20]

The EWPS measures both absenteeism and presenteeism and was designed to capture lost productivity data within clinical trials.[31] Each item within the EWPS captures the frequency of productivity-related behaviours during the past week, using a 5-point Likert scale. A sum of scores is then computed, with total EWPS scores ranging from 0 (best score) to 100 (worst score).

Although individuals may be ranked according to their total EWPS score, results cannot be directly converted to monetary units. In order to convert the total score to dollars, the ordinal responses scales could be treated as continuous data, however this technique may not be desirable and, to date, methods specific to the EWPS have not been published. The EWPS is a 25-item, self-administered questionnaire that appears to be suitable to assess the work functioning of patients with various disease states. However, to date, the EWPS has only been used in patients with depression.[20]

2.5 Angina-Related Limitations at Work Questionnaire

In 1998, Lerner et al.[19] developed the Angina-Related Limitations at Work Questionnaire (ALWQ), a questionnaire to measure work limitations of patients with chronic stable angina pectoris (table I). The reliability of the ALWQ was assessed in a study of 40 patients with a physician-confirmed diagnosis of chronic stable angina. There were few or no missing data for the items of the ALWQ and all of the items except for one (doing any lifting, carrying or moving objects at work) appeared to be applicable to the study participants.[19] The responses to all of the items of ALWQ appeared to be skewed towards the floor, since the majority of the responses for each item indicated "no difficulty due to angina." In terms of internal consistency, the ALWQ was found to have a Cronbach's α of 0.97 (table II).[19]

The content and criterion validity of the ALWQ do not appear to have been evaluated as a part of this study; however, construct validity was reported. According to their responses to each of the 17 items of the ALWQ, individuals were categorised as 'limited' or 'not limited'. For each item, the physical component scores (PCS) and the mental component scores (MCS) of the SF-36 of the two groups (i.e. limited, not limited) were compared. For one item, all of the respondents were classified as 'not limited' therefore the convergent validity was not assessed for this question. For each of the other 16 items, the average PCS was significantly lower for those individuals who were categorised as 'limited'. In addition, for 15 items, the MCS was also significantly lower for those who were categorised as 'limited'.

The ALWQ demonstrated weak to moderate construct validity with Spearman correlations ranging from −0.35 to −0.63 between chest pain frequency and its 17 items (table II).[19]

Similar to the EWPS, the ALWQ captures employee absenteeism and presenteeism but the results cannot be directly converted to monetary units. In order to convert to dollars, the ordinal responses could be treated as continuous data, however this methodology may not be desirable. The ALWQ is a 17-item tool, and each question consists of a 5-item Likert response scale pertaining to work functions, with responses ranging from 'no difficulty' to 'so much difficulty, couldn't do it at all'. A total score is derived from the standardised item mean.[19] The ALWQ was designed for use within clinical trials and treatment effectiveness investigations.[19]

2.6 Migraine Work and Productivity Loss Questionnaire

Lerner and colleagues[23] developed the Migraine Work and Productivity Loss Questionnaire (MWPLQ) in 1999. Building on earlier work with the development of the ALWQ, the MWPLQ was designed to measure the impact of migraine headache on patients' work performance by measuring migraine-related difficulties in meeting on-the-job work role demands (table I).

The internal consistency of the 18 work difficulty questions of the MWPLQ was examined and found to have Cronbach's α values that ranged from 0.80 to 0.95, suggesting high internal consistency (table II).[22]

Additional findings support specific types of validity. First, the work difficulty questions appear to have face validity; individuals stated the questions were applicable in over 90% of their work-related migraine attacks, with the only exception being the environmental domain.[22]

There are also data supporting the MWPLQ's construct validity (specifically congruent validity). Results of the two questionnaire sections were compared with headache severity (none, mild, moderate and severe), functional disability (none, mild, severe, unable to do/requiring bedrest), 24-hour Migraine Quality of Life Questionnaire (24-h MQoL) scores,[34,35] and SF-36 scores. The total hours of work loss, percent effectiveness, and work difficulty domains were moderately correlated to headache severity (r = −0.35 to 0.47), headache disability (r = 0.36–0.58), and 24-h MQoL scores (r = −0.31 to −0.65). The total hours of work loss, the percent effectiveness, and the work difficulty domains appear to have low to moderate correlation with SF-36 domains (r = −0.05 to −0.34).

In addition to congruent validity, discriminant validity of the MWPLQ was assessed through analyses comparing migraine-specific therapy and usual therapy.[22] Results showed that individuals receiving migraine-specific therapy (i.e. serotonin receptor agonist) reported significantly fewer lost work hours, fewer hours worked with migraine and more effective work performance than individuals who received usual therapy.[22] The criterion validity of the MWPLQ has not been assessed.

In terms of productivity metrics, the MWPLQ captures employee absenteeism and presenteeism. Using methods discussed earlier,[29] the total number of hours of work lost due to migraine may be calculated and directly translated into a monetary figure (table III). An overall questionnaire score is not derived.

The MWPLQ is a 23-item questionnaire consisting of two sections. The first section of the survey consists of five questions that address the number of hours of paid work lost because of migraine and the individual's percentage effectiveness while working with migraine headache,[23] while the second section includes 18 questions pertaining to the individual's difficulty working at specific tasks. Each of these 18 questions consists of a Likert 5-item scale with responses ranging from 'no difficulty' to 'so much difficulty, couldn't do it at all'.

2.7 Worker Productivity Index

The Worker Productivity Index (WPI) is unique because it is the only tool identified that incorporates an objective measure of employee absenteeism and a subjective measure of presenteeism (i.e. failure to maintain the job productivity standard) to create an index for measuring workplace productivity.[32] It was specifically designed for a population of customer service employees. The WPI collects objective information and may serve as a gold standard for absenteeism data. The reliability and validity testing of the subjective portion of the WPI have not been reported.

Through the use of a computer-based system, the total time an employee is working at a workstation is objectively and electronically monitored. The objective measure of the index includes computer-based tracking of employee time variables. These variables are combined to create two productivity measures: handle time and auxiliary time. Handle time is the sum of an employee's talk-time, transfer or hold time, and the time for follow-up work for each answered call.[32] Auxiliary time is the amount of time in which an employee is unavailable to receive telephone calls at his or her workstation.[32]

There is also a subjective component to the WPI, which evaluates the accuracy of information and interpersonal skills provided by customer service employees.[32] These parameters are subjectively assessed by supervisors and the monitored telephone calls that employees have with customers.

Scoring the WPI involves combining results from the subjective and objective measures. It involves a standard index, which is described in more detail in table III.[32] In order to directly translate the index into a monetary unit, the employer may multiply the employee's hourly compensation by that individual's total lost work hours per week. Since the WPI uses a unique computer-based system, it may not be feasible or appropriate for use outside of telephone-based occupations. The WPI has been used in a variety of disease states such as mental health, diabetes mellitus and hypertension.[36]

2.8 Health and Work Questionnaire

In 2001, the Health and Work Questionnaire (HWQ) was developed for use in studies of worker health and productivity (table I).[21]

The reliability and validity of the HWQ was reported through a study of employees at a US-based airline reservation centre (table II).[21] Internal consistency, as reported by Cronbach's α values for each of the subscales, ranged from 0.72–0.96 (table II). Construct validity (specifically discriminant validity) was assessed by evaluating the relationship between smoking status and HWQ responses. Results demonstrated a significant difference between individuals based on smoking status for the personal life satisfaction subscale and other's assessment of productivity.[21]

This study also examined the criterion validity of the HWQ by examining the correlations between objective measures of productivity and the six subscales. Objective study measures included: (i) average time an individual was unavailable between telephone calls without an authorised excuse; and (ii) performance points, which is a company-owned formula based on the income generated, call waiting time and ticket delivery service created by the employee.[21] The HWQ subscales appear to be poorly correlated with the two objective measures of productivity ($r = -0.043$ to 0.219).

Because of the limited data available on the HWQ, we were unable to determine its metrics and its utility for estimating productivity loss in monetary terms. The HWQ is a self-administered questionnaire that consists of 27 questions and six subscales. The productivity subscale is further subdivided into two dimensions: personal assessment of productivity and other's assessment of the worker's productivity. With the limited data available, we were unable to determine the disease states in which the HWQ has been studied.

2.9 Unnamed Hepatitis Instrument

We also identified an unnamed instrument, which was used within a study of QOL of patients with hepatitis C (table I). The reliability and validity of this instrument have not been reported. Although the productivity-related items capture both absenteeism and presenteeism, only absenteeism can be converted to monetary units, by multiplying an individual's daily compensation by total days lost from work (table III). Employee presenteeism data were captured as a dichotomous variable (decreased productivity within the workplace, 'yes' or 'no'), and cannot be directly translated into a monetary unit.

This is a self-administered questionnaire which includes three questions regarding workplace productivity and usual activity.[26] These three questions were designed to collect lost productivity among patients enrolled in a randomised controlled clinical trial.[26] No overall score was generated from the responses; however, patients were classified according to whether their productivity was better, worse, or unchanged since a baseline measurement.[26]

2.10 Work Limitations Questionnaire

The 25-item Work Limitations Questionnaire (WLQ) was developed to measure the impact of chronic diseases and treatment on on-the-job work performance (table I).[27]

To identify potential floor and ceiling effects associated with the WLQ, the distribution of the responses was reviewed. Less than 2% of the responses from the four scales were at the ceiling while less than 21% of the responses were at the floor.[27] The WLQ appears to be internally consistent, with Cronbach's α values ≥ 0.88 for each of the four scales, when tested using individuals from several chronic disease groups and osteoarthritis (table II).[27,28]

Two types of construct validity, concurrent and discriminant, were assessed. In a study of individuals with several chronic conditions, all four of the WLQ scales were weakly correlated ($r^2 = 0.14$–0.22) with the SF-36 role limitation-physical domain, and three of the scales were weakly correlated ($r^2 = 0.07$–0.17) with the SF-36 role limitation-emotional domain.[27] As of this writing, evidence of the criterion validity of the WLQ is not available within the published medical literature.

The WLQ captures presenteeism by measuring an individual's on-the-job performance. The 25 items of the WLQ are grouped into four demand scales: time management, physical, mental-interpersonal and output. The scale scores represent the amount of time in the past 2 weeks that an individual was limited on the job.

Scoring the WLQ involves straightforward arithmetic. In order to create a score for each demand scale, the questionnaire's ordinal responses are converted to an interval scale. The average scores for items within each scale are summed, divided by the total number of scale items, and then multiplied by a factor of 25. The overall questionnaire scores range from '0' (least limited) to '100' (most limited).[27] For example, a score of '50' indicates that the patient was limited in performing work demands during 50% of the reporting period.

Although individuals may be ranked according to their total WLQ score, results cannot be directly converted to monetary units. In order to convert the total score to dollars, the ordinal score could be treated as continuous data, however, no specific methods for the WLQ have been published. The questionnaire has been used to evaluate the impact of various disease states on work limitation (table I)[27] and a recent investigation used the WLQ to assess the effectiveness of selective serotonin reuptake inhibitors on work functioning.[37] The tool was created to collect lost productivity data within research studies such as clinical trials.[31]

2.11 Stanford Presenteeism Scale

One of the newer instruments available for estimating lost productivity is the Stanford Presenteeism Scale (SPS-6).[25] This instrument was devel-

oped to assess the relationship between presenteeism, health problems and productivity within the workplace.

Reliability of the SPS-6 was evaluated in a study of county health workers. The SPS-6 overall presenteeism score demonstrated high internal consistency with a Cronbach's α of 0.80 (table II).[25] In reference to construct validity (specifically concurrent validity), correlation coefficients between the SPS-6 score and other presenteeism items (e.g. percentage of time not productive) was calculated. The presenteeism items to which the SPS-6 score was compared had different response scales (e.g. 0–100%) than the SPS-6.[25] The SPS-6 score was significantly correlated to responses for the following: (i) percentage of time that the individual was productive ($r = 0.53$); (ii) self-reported proportion of work accomplished ($r = 0.47$); and (iii) percentage of time that the individual was likely to make more mistakes than usual ($r = -0.31$).[25]

The discriminant validity of the SPS-6 was evaluated by determining the correlation between the SPS-6 score and job satisfaction and job stress, constructs that should not be strongly related to presenteeism.[25] The SPS-6 score was weakly correlated with job satisfaction ($r = 0.15$) and job stress ($r = -0.22$) suggesting that presenteeism can be differentiated from the work constructs of job satisfaction and job stress.[25]

Establishing the criterion validity for a presenteeism instrument such as the SPS-6 could prove quite difficult, as objective measures of reduced functioning while 'on the job' are lacking. The authors of the SPS-6 selected the presence of a physical disability as a possible criterion for presenteeism. The criterion validity of the SPS-6 total score was determined by comparing the presenteeism scores between individuals reporting a disability and those reporting no disability. However, one could argue that disability does not imply a loss in productivity. Based on the results of the county health workers surveyed, average SPS-6 scores were significantly lower for individuals reporting a disability compared with those reporting no disability.[25]

The SPS consists of six questions, with each question consisting of a Likert 5-item response scale ranging from 'strongly disagree with the statement' to 'strongly agree with the statement'. The sum of the six items represents an overall presenteeism score (with a higher score indicating more presenteeism). Although individuals may be ranked according to their overall presenteeism score, results cannot be directly converted to monetary units. In order to convert to dollars, the overall score could be treated as a continuous variable, however this technique may not be desirable. The SPS-6 was created to collect lost productivity data within research studies such as clinical trials.[31] With the limited information available on the SPS-6, we were unable to determine the disease states in which this instrument has been tested.

2.12 Summary of Findings

Reliability and validity testing have been performed for 8 of the 11 identified surveys. Of the 11 survey instruments identified, six capture metrics that are suitable for direct translation into a monetary figure. Of those six, the unnamed hepatitis instrument measures absenteeism only, and the other five, the Osterhaus technique, WPAI, HLQ, MWPLQ and the WPI, measure both absenteeism and presenteeism. All of the identified instruments, except for the WPI, are available as paper, self-administered questionnaires; however, readers should note that instruments might be available in other modes of administration (i.e. the Internet).

3. Discussion

This report provides a comprehensive review of health-related work productivity instruments published in the peer-reviewed scientific literature. Although each of these instruments appear to have applicability to specific research questions, only data collected through six of the questionnaires is suitable for direct translation into a monetary figure.

The latter is relevant since expression of productivity losses in monetary terms may prove more useful for health policy efforts involving the input of society, employers, health insurers and political decision makers. Specifically, monetary productivity losses and gains can be quantitatively weighed against the costs of treatment, enabling policy makers to assess the value of specific medical interventions (e.g. pharmaceuticals, disease management, or health promotion programmes). The remaining five instruments capture absenteeism or presenteeism on a Likert scale, thus requiring additional techniques and considerations in order to translate lost productivity into monetary terms. However, data collected using ordinal response scales (such as the Likert scale) can be useful for qualitatively assessing and ranking the lost productivity of specific employee and/or disease populations.

This review revealed that most health-related workplace productivity loss questionnaires were developed through *ad hoc* efforts aimed at addressing specific types of research questions. In addition, there does not appear to be a preferred method for capturing lost productivity in terms of using absolute versus ordinal scales.

Most of the instruments are relevant for specific diseases and/or occupation types (ALWQ, MWPLQ, Osterhaus Technique and the unnamed hepatitis instrument). These tools may be useful for researchers who need to capture the productivity of patients with the specific disorder, e.g. angina, migraine headache, or hepatitis C. However, if the productivity of a population with various disease states needs to be measured, one of the productivity loss measures with broad applicability may be more appropriate. It is interesting to note that half of the instruments have been developed for or used in patients with migraine or chronic daily headaches (table I).

Despite the inconsistency of productivity instrument efforts to date, researchers have made progress in the science of measuring lost productivity. Within the past decade alone, instruments have evolved from capturing patient-reported productivity loss data for specific diseases (Osterhaus technique) to measuring the lost productivity for general health conditions, to collecting an objective measure of employee lost productivity (WPI). It is important to note that, although it incorporates an objective measure, the WPI was developed for a population of customer service telephone operators whose work time is electronically documented. Therefore, the WPI may not be applicable to other populations with occupations (e.g. administrators) that have heterogeneous skill sets that are difficult to quantify.

In order for society and healthcare purchasers to have an accurate picture of workplace productivity loss, both presenteeism as well as absenteeism should be collectively evaluated.[3] For example, research has shown that individuals with migraine report to work despite having migraine symptoms and these symptoms result in patient-reported decreased productivity while at work.[38] Without an understanding of the nature of the lost productivity associated with a disease, one may erroneously assume that lost productivity is limited to absence from work or friction costs resulting from employee turnover. However, for certain diseases such as migraine, allergic rhinitis, or musculoskeletal injuries presenteeism costs could be significant.

There were some limitations to this review. We relied only on the published literature, without contacting authors for additional information. In addition, this review focused on survey instruments, which represent only one way of measuring lost productivity. Use of other methods, such as retrospective analysis of absence, workers' compensation, and/or disability claim data was not evaluated.

4. Conclusion

This review provides a comprehensive list of the published, peer-reviewed survey instruments available to measure health-related workplace productivity loss. Of the 11 instruments identified, six capture lost productivity suitable for direct translation into a monetary unit. As the field of productivity measure-

ment matures, new tools may be developed with the intent of allowing researchers to incorporate productivity findings into cost-effectiveness and cost-benefit analyses. Subsequently, with these instruments, society and healthcare decision makers will be able to make better-informed decisions concerning the value of the medications, disease management and health promotion programs that they purchase and individuals receive.

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Addendum

Since this manuscript was accepted for publication, information on the WHO Health and Work Performance Questionnaire (HPQ) was released. The HPQ is the latest instrument to be developed for the estimation of absenteeism and presenteeism.

The HPQ is a self-reported work performance measure in which individuals from four different occupation samples were tested: airline reservation agents, customer service representatives, executives of an automobile manufacturer, and railroad engineers.[39] The HPQ consists of 89 questions that ask the individual questions regarding absenteeism, presenteeism and job-related injuries. In terms of productivity metrics, the HPQ captures absenteeism, presenteeism and job-related accidents. For absenteeism, the HPQ captures the number of (i) hours worked during the past 4 weeks; (ii) hours missed on a workday (i.e. came in late); (iii) extra work hours; (iv) total hours absent from work; and (v) hours each week normally expected to work. For work performance or presenteeism, individuals are asked about their overall work performance in the past 4 weeks on a 0–10 point scale in which 0 indicates one's worst performance while a 10 indicates one's best performance.[39]

To date, the reliability of the HPQ has not been published. However, a recent publication reports the criterion validity and calibration studies of the HPQ compared with objective measures of workplace performance.[39]

In this report, the objective measures included the Experience Sample Method (ESM), supervisor performance ratings and records of employee absenteeism.[39] The ESM is a technique in which study participants were given a beeper and a diary to keep with them at all times during the study period. Participants were randomly paged five times throughout the course of each study day. Respondents were asked to complete the study diary immediately upon receiving each page. Diary questions included items regarding whether the respondent was at work and the quantity and quality of his/her work when he/she was paged.[39]

When examining the criterion validity of respondents' presenteeism, lower HPQ scores were more likely to be associated with the lowest 20% of the supervisor and ESM work performance measures.[39] In addition, there was a statistically significant relationship between HPQ scores and the odds of high supervisor performance ratings or ESM work performance for reservation agents and customer service representatives; however, this was not true for the automobile industry executive population (white collar workers) that was studied.[39]

In terms of absenteeism, for reservation agents and customer service representatives, an increase in the number of HPQ reported hours worked was associated with an increased likelihood of being at work according to the ESM data.[39]

The details regarding the scoring technique for the HPQ have not been published but are available from the developers.[40] Kessler et al. state that the results from the HPQ can be monetised, however, the specifics of these calculations have not been published either. According to the instrument devel-

opers, software has been created which can be used to make these monetary calculations.[40]

The HPQ is available either as a paper and pencil survey, an Internet questionnaire, or an interactive voice response telephone interview. According to the instrument creators, the entire HPQ takes approximately less than 10 minutes to complete.[40] As stated earlier, the HPQ has been tested in four different occupations. However, the specific disease states in which it has been tested have not been reported. A study is currently underway to evaluate the effects on work productivity of detecting and treating working individuals with major depression.[39]

References

1. Kuttner R. The American health care system: employer-sponsored health coverage. N Engl J Med 1999; 340: 248-52
2. Liljas B. How to calculate indirect costs in economic evaluations. Pharmacoeconomics 1998; 13 (1 Pt 1): 1-7
3. Burton W, Conti D. The real measure of productivity. Bus Health 1999; 17 (11): 34-6
4. Johannesson M. The willingness to pay for health changes, the human-capital approach and the external costs. Health Policy 1996; 36: 231-44
5. Koopmanschap MA, van Ineveld BM. Towards a new approach for estimating indirect costs of disease. Soc Sci Med 1992; 34: 1005-10
6. Mushkin S. Health as an investment. J Polit Econ 1962; 70: 129-57
7. Ferrari M. The economic burden of migraine to society. Pharmacoeconomics 1998 Jun; 13 (6): 667-76
8. Koopmanschap MA, Rutten FF. Indirect costs in economic studies: confronting the confusion. Pharmacoeconomics 1993; 4 (6): 446-54
9. Robinson JC. Philosophical origins of the economic valuation of life. Milbank Q 1986; 64: 133-55
10. Koopmanschap MA, Rutten FF. A practical guide for calculating indirect costs of disease. Pharmacoeconomics 1996; 10 (5): 460-6
11. Koopmanschap MA, Rutten FF, van Ineveld BM, et al. The friction cost method for measuring indirect costs of disease. J Health Econ 1995; 14: 171-89
12. Brouwer WBF, Koopmanschap MA. How to calculate indirect costs in economic evaluations. Pharmacoeconomics 1998; 13 (5): 563-6
13. Peeples P, Wertheimer A, Mackowiak J, et al. Controversies in measuring and valuing indirect costs of productivity foregone in a cost of illness evaluation. J Res Pharmaceut Econ 1997; 8: 23-32
14. de Lissovoy G, Lazarus SS. The economic cost of migraine: present state of knowledge. Neurology 1994; 44: S56-62
15. van Roijen L, Essink-Bot ML, Koopmanschap MA, et al. Labor and health status in economic evaluation of health care. The Health and Labor Questionnaire. Int J Technol Assess Health Care 1996; 12: 405-15
16. Salkever DS. Morbidity costs: national estimates and economic determinants. Washington, DC: National Center for Health Services Research, 1986
17. van Roijen L, Essink-Bot ML, Koopmanschap MA, et al. Societal perspective on the burden of migraine in The Netherlands. Pharmacoeconomics 1995; 7 (2): 170-9
18. Spector WD. Functional disability scales. In: Spilker B, editor. Quality of life and pharmacoeconomics in clinical trials. 2nd ed. Philadelphia (PA): Lippincott-Raven; 1996: 133-43
19. Lerner DJ, Amick III BC, Malspeis S, et al. The Angina-related Limitations at Work Questionnaire. Qual Life Res 1998; 7: 23-32
20. Endicott J, Nee J. Assessment measures for clinical studies: Endicott Work Productivity Scale (EWPS): a new measure to assess treatment effects. Psychopharmacol Bull 1997; 33: 13-6
21. Shikiar R, Rentz AM, Halpern MT, et al. The health and work questionnaire (HWQ): an instrument for assessing workplace productivity in relation to worker health [abstract]. Value Health 2001; 4 (2): 181
22. Davies GM, Santanello N, Gerth W, et al. Validation of a migraine work and productivity loss questionnaire for use in migraine studies. Cephalalgia 1999; 19: 497-502
23. Lerner D, Amick III BC, Malspeis S, et al. The Migraine work and productivity loss questionnaire: Concepts and design. Qual Life Res 1999; 8: 699-710
24. Osterhaus JT, Gutterman DL, Plachetka JR. Healthcare resource and low labour costs of migraine headaches in the US. Pharmacoeconomics 1992; 2 (2): 67-76
25. Koopman C, Pelletier K, Murray JF, et al. Stanford presenteeism scale: health status and employee productivity. J Occup Environ Med 2002 Jan; 44 (1): 14-20
26. McHutchison JG, Ware Jr JE, Bayliss MS, et al. The effects of interferon alpha-2b in combination with ribavirin on health related quality of life and work productivity. J Hepatol 2001; 34: 140-7
27. Lerner D, Amick BC, Rogers WH, et al. The work limitations questionnaire. Med Care 2001; 39: 72-85
28. Lerner D, Reed JI, Massarotti E, et al. The work limitations questionnaire's validity and reliability among patients with osteoarthritis. J Clin Epidemiol 2002; 55: 197-208
29. Reilly MC, Zbrozek AS, Dukes EM. The validity and reproducibility of a work productivity and activity impairment instrument. Pharmacoeconomics 1993; 4 (5): 353-65
30. Reilly Associates health outcomes research. Available from URL: http://www.reillyassociates.net [Accessed 2002 Feb 5]
31. Lynch W, Riedel JE. Measuring employee productivity: a guide to self-assessment tools. 1-94 2001. Scottsdale (AZ): William M. Mercer Incorporate, Institute for Health & Productivity Management, 2001
32. Burton WN, Conti DJ, Chen CY, et al. The role of health risk factors and disease on worker productivity. J Occup Environ Med 1999; 41: 863-77
33. Wahlqvist P, Carlsson J, Stalhammar NO, et al. Validity of a work productivity and activity impairment questionnaire for patients with symptoms of gastro-esophageal reflux disease (WPAI-GERD): results from a cross-sectional study. Value Health 2002; 5: 106-13

34. Hartmaier SL, Santanello NC, Epstein RS, et al. Development of a brief 24-hour migraine-specific quality of life questionnaire. Headache 1995; 35: 320-9
35. Santanello NC, Hartmaier SL, Epstein RS, et al. Validation of a new quality of life questionnaire for acute migraine headache. Headache 1995; 35: 330-7
36. Burton W, Conti D. Use of an integrated health data warehouse to measure the employer costs of five chronic disease states. Dis Manag 1998; 1: 17-26
37. Kroenke K, West SL, Swindle R, et al. Similar effectiveness of paroxetine, fluoxetine, and sertraline in primary care: a randomized trial. JAMA 2001; 286: 2947-55
38. Lofland JH, Kim S, Batenhorst AS, et al. Cost effectiveness and cost benefit of sumatriptan in patients with migraine. Mayo Clin Proc 2001; 76: 1093-101
39. Kessler RC, Barber C, Beck A, et al. The World Health Organization Health and Work Performance Questionnaire (HPQ). J Occup Environ Med 2003; 45: 156-74
40. Kessler RC. World Health Organization Health and Work Performance Questionnaire. Available from URL: http://www.hcp.med.harvard.edu/hpq [Accessed 2003 Oct 23]

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