Value in Health

The Estimation and Inclusion of Presenteeism costs in Applied Economic Evaluation: A systematic review

Jesse Kigozi, PhD[1]; Sue Jowett PhD[1]; Martyn Lewis PhD[2]; Pelham Barton PhD[1]; Joanna Coast PhD[3]

[1]Health Economics Unit, School of Health & Population Sciences, University of Birmingham B15 2TT

[2]Arthritis Research UK Primary Care Centre, Primary Care Sciences, Keele University, Staffordshire ST5 5BG

[3] School of Social and Community Medicine, University of Bristol, Bristol, BS8 2PS

Address correspondence to:

Jesse Kigozi, Health Economics Unit, School of Health & Population Sciences, University of Birmingham B15 2TT, United Kingdom.

E-mail: j.kigozi@bham.ac.uk

Telephone: (00) 447863731140

Keywords: economic evaluation, presenteeism, reduced productivity and productivity costs

Highlights

- Presenteeism is rarely included in full economic evaluations, but is more often included in cost of illness studies
- There are a variety of methods available for generating estimates of presenteeism and valuing these, but little consistency across studies
- More methodological work is required to generate better estimates of presenteeism, particularly using a friction cost approach

Abstract

Introduction

Given the significant costs of reduced productivity (presenteeism) in comparison to absenteeism, and overall societal costs, presenteeism has a potentially important role to play in economic evaluations. However, in practice these costs are often excluded. This paper provides a comprehensive overview of the current state of practice in the valuation methods and impact of presenteeism in cost of illness studies and economic evaluations.

Methods

A structured systematic review was carried out to explore (i) the extent to which presenteeism has been applied in cost of illness studies and economic evaluations and (ii) the overall impact of including presenteeism on overall costs and outcomes. Potential articles were identified by searching Medline, PsycINFO and NHS EED databases. A standard template was developed and used to extract information from economic evaluations and cost of illness studies incorporating presenteeism costs.

Results

A total of 28 studies were included in the systematic review which also demonstrated that presenteeism costs are rarely included in full economic evaluations. Estimation and monetisation methods differed between the instruments. The impact of disease on presenteeism whilst in paid work is high.

Conclusions

The potential impact of presenteeism costs needs to be highlighted and greater consideration should be given to including these in economic evaluations and cost of illness studies. The importance of including presenteeism costs when conducting economic evaluation from a societal perspective should be emphasised in national economic guidelines and more methodological work is required to improve the practical application of presenteeism instruments to generate productivity cost estimates.

INTRODUCTION

Productivity costs can be defined as 'Costs associated with production loss and replacement costs due to illness, disability and death of productive persons, both paid and unpaid' [1]. According to neoclassical theory, the idea of productivity is part of a production function, with labour as a key input contributing to output. Productivity therefore is a measure of output per unit of input [2]. Detailed theoretical and methodological discussions on this concept have been extensively discussed elsewhere [2].In the context of this paper, productivity loss due to sickness refers to output loss resulting from work absence and/or reduced labour input due to sickness (that is, it is not concerned with lost income from the individual perspective, but with lost output from the societal perspective). Productivity costs have an important, yet controversial, role in economic evaluation. This is particularly the case when the evaluation is performed from a societal perspective. There have been strong arguments in favour of adopting a societal perspective within economic evaluations [3, 4], although there is no theoretical consensus on the most appropriate perspective [5, 6]. Some have argued that adopting a narrower perspective – such as a specific provider or institution, patient or third-party provider could lead to biased health policies for society as a result of ignoring important cost categories outside the healthcare sector [4]. Comprehensive discussions on the issue of perspectives are addressed elsewhere in more detail [3, 4]. In theory when adopting a societal perspective, all relevant costs and consequences to whomsoever they accrue should be considered within the evaluation, including productivity costs. It is important to note that there have been various debates about the inclusion of productivity costs in economic evaluations. These debates include whether productivity costs should be included on the cost or outcome side, and the methods used to measure and value productivity costs, especially in relation to paid work [2, 7-9]. The inclusion of productivity costs has mostly been limited to the context of paid work which is the broad focus of this paper. Another issue often ignored in productivity costs that will not be covered in this paper relates to unpaid work. Detailed methodological and practical discussions in relation to unpaid work are provided elsewhere [10].

Paid work broadly consists of productivity loss to society as a result of absence from work (absenteeism) or working with limitations due to illness (presenteeism). Compared to absence from

work, the evidence suggests that presenteeism generates significantly higher cost estimates than absenteeism [11]. Productivity costs related to presenteeism seem to be rarely considered in economic evaluations [12], although there is limited evidence on this. Ignoring these costs could significantly underestimate the value of interventions that reduce limitations at work due to illness.

The exclusion of societal costs related to presenteeism in economic evaluations may be explained by several factors. Firstly, an overview of most national economic guidelines, where a societal perspective is recommended, shows there tends to be a bias towards including absenteeism costs, but not presenteeism costs [13]. Secondly, the theoretical literature suggests a lack of consensus on the most appropriate instrument for measuring presenteeism, and on the valuation methods for generating monetary estimates from existing measures. Both are required if presenteeism costs are to be included in economic evaluation [14, 15]. A scoping review [16] of existing productivity loss measurement instruments reported in various systematic reviews identified a total of 24 instruments [2, 15, 17-26]. The most commonly reported were the Work limitations Questionnaire (WLQ)[27] , Health and Work Performance Questionnaire (HPQ)[28] , Work productivity and Activity impairment questionnaire (WPAI)[29] , Health and Labour Questionnaire (HLQ)[30] , and Health and Work Questionnaire (HWQ)[31] . These instruments differ both in the ways that presenteeism is measured and valued. Inevitably, this will impact on comparability between studies that use different instruments.

The evidence on whether, and how, presenteeism costs are estimated in economic studies and on the size of these costs, also appears to be limited. Previous literature has involved assessing appropriateness of existing instruments [18, 22] and valuation methods [15, 20] but not studied which instruments have been used to estimate presenteeism in practice in the context of cost of illness studies or economic evaluation. This review goes further by assessing which instruments have been used in practice, and how, to estimate presenteeism costs. A 2009 review of presenteeism considered the impact of presenteeism on the total cost of health conditions from a narrow employer perspective, but did not examine the methods used in economic studies [25]. The review found that job-related reduced productivity was a major component of total employer costs for various health conditions, but was not able to assess presenteeism instruments used in practice, and how, to estimate presenteeism costs at the time. The more up-to-date review presented here aims to extend the earlier review by

investigating two related research questions in relation to this area: (i) what methods are economic studies using to estimate presenteeism in current practice? and (ii) what is the impact of presenteeism on the total costs of interventions and health conditions in existing economic studies?

METHODS

A systematic review of published applied economic studies, comprising cost of illness studies and economic evaluations, was conducted to explore the research aims.

Search strategy

Searches were conducted in MEDLINE (OVID), PsycINFO (OVID), and the specific health economics database NHS Economic Evaluation (NHS EED), and limited to studies published up to 31st August 2015 with no starting date limitation. The search strategies used were based on the following key pre-defined search keywords: 'presenteeism' OR 'reduced productivity' OR 'productivity costs OR 'lost productivity' OR 'work limitations' OR 'work productivity' OR 'work performance', subsequently in conjunction with the terms 'cost and cost analysis' or 'cost-effectiveness analysis' or 'cost-utility analysis'. Where relevant, MeSH headings were exploded. The list of study titles was supplemented by a bibliographic review of papers included in the review, and through searching other electronic sources such as Google Scholar for articles from academics known in this area.

Study selection

Studies were included only if they: 1) were original applied cost of illness studies or economic evaluations; 2) incorporated costs related to presenteeism, and described the methods for doing so; and 3) were written in English. After excluding duplicates, the abstracts of the remaining articles were assessed in terms of these inclusion criteria. Full-texts were obtained for all studies that appeared to meet the inclusion criteria at this point, and were read to make a final decision on study inclusion. Initial study selection was performed by JK, and where there was any ambiguity about inclusion/exclusion, the study was discussed by the whole research team before a final decision was made.

Data extraction and analysis

A data extraction form was developed to extract systematic information on study characteristics related to study country, publication year, type of economic evaluation and disease area. Methodological characteristics of interest included type of instrument, recall period, productivity loss reported, type of instrument, monetisation algorithm used (if available), and the proportion of presenteeism costs in relation of absenteeism and/or overall total costs. Data extraction was performed by JK. Narrative synthesis was used to summarise and explain the findings.

RESULTS

Study selection

In total 610 potentially relevant articles were identified, of which 16 were excluded on the grounds they were duplicates. Of the remaining 594 articles, 538 did not meet the inclusion criteria on the basis of the abstract, leaving 56 papers that were read in full. Of these, 35 did not incorporate presenteeism, or were reviews or protocols and were subsequently excluded. Seven additional articles were identified through searching references of studies identified from the databases and other electronic sources. This resulted in a total of 28 studies that met the criteria for the review.

Study Characteristics

A summary of the 28 studies included in the review is presented in Table 1. The majority (57%) of studies identified were conducted in the United States (US). The others were from the Netherlands [32, 33], from Canada [34-36], the United Kingdom (UK) [37-39], Sweden [40], and Thailand [41]. There were two multi-country studies, with one set across Australia, US and the UK [42], and the other reporting cost estimates from 8 European countries including Germany, Italy, Lithuania, the Netherlands, Luxembourg, Austria, France, and Spain [43].

The studies evaluated a wide range of diseases and varied from national survey based costing studies covering various conditions to cost estimates from specific disease conditions. The most common conditions considered were obesity [37, 44, 45], rheumatoid arthritis [34, 36, 46], migraine [43, 47, 45] and Ankylosing spondylitis [32, 38, 39] .The majority of the studies were cross-sectional in design, but two used information from randomised clinical trials [33, 49]. The majority of studies

were cost-of-illness studies (n=23) and the remaining three studies were all cost-effectiveness analyses [33, 49, 50].

In total, nine instruments measuring presenteeism were identified from the 28 studies. Presenteeism was measured by either a study-specific questionnaire or visual analogue scale or an existing standardised questionnaire. The most commonly used standard questionnaires were the WPAI (n=6), the WLQ (n=5) and Work and Health Interview (WHI) (n=3). Other currently used multi-question instruments included the Stanford Presenteeism Scale (SPS) (n=1), HLQ (n=1), PROductivity and DISease Questionnaire (PRODISQ) (n=1) and HPQ (n=1). The remaining studies used a self-constructed global presenteeism question, based on a global response 0 – 10 scale adapted from standard questionnaires (n=8). One study used a modified version of the WLQ [51].

Methods of estimating presenteeism loss

One of the main prerequisites for including presenteeism in economic evaluations is the ability to convert the data collected in the measurement instrument to an estimate of lost productivity. The instruments differed in the way they measure the extent of presenteeism loss. The WPAI, HLQ and HPQ instruments generated productivity loss estimates that were directly translatable into monetary costs, while the estimates from the SPS, WLQ, WHI, PRODISQ and QQ could be indirectly quantified into reduced productivity loss with some assumptions. Based on a previous categorisation by Mattke et al [20], the estimation of presenteeism in the studies reported was categorised into three approaches: direct estimation of productivity loss in hours (19%); estimation of perceived percentage loss (77%); and the comparison of productivity loss obtained from an individual with a colleague in a similar role (12%).

The direct approach generates productivity loss values in a similar way to the approach used in obtaining absenteeism productivity loss. For example using the WHI, presenteeism loss is estimated from a combination of questions such as the average number of hours with low concentration at work, when working more slowly than usual, when feeling fatigued at work, and the time in between arriving at work and starting work on the days when an employee is sick [44]. Alternatively

respondents are asked to estimate the extra hours that would be needed to compensate for inefficient hours, a method used by the HLQ [32, 34]. The direct translation approach was found in 5 studies (19%).

The second approach involved asking respondents to provide a perceived overall estimate of how much illness has hindered or affected their performance at work. This was the most common approach (22 studies (77%)). One productivity loss measurement approach (perceived percentage loss) required respondents to provide an estimate of their percentage loss of productivity at work due to illness [43, 50]. For example articles using the WLQ, obtained an estimate of the percentage presenteeism loss (or gain) from respondents compared to a baseline or benchmark value for each Individual [45, 53]. An alternative version of this approach involved asking respondents to provide an estimate of how illness has affected their performance at work on a 0 –10 scale which was then converted into a percentage productivity loss [37, 54]. Studies using the WLQ [36, 38, 45, 53] and SPS [55] also assessed perceived limitations in different work function domains and for different work aspects. The output from these different domains was then summarised to generate an index which is interpreted as a percentage loss attributed to reduced productivity. In the remaining studies, an estimate of perceived reduced productivity was estimated using non-standard stand-alone single-item questions as part of a wider questionnaire with a global question asking respondents to either estimate perceived impairment on a scale of 0-10 or percentage reduction at work due to illness [35, 40, 43, 47, 48, 56, 57]. Such a question has recently been validated within the context of low back pain [58].

A final approach, used in the Health and Work Performance Questionnaire (HPQ) [33, 34, 42], involved comparing global presenteeism estimates of a respondent with those of a colleague in a similar role both reported by the respondent. The respondent is asked to report a global rating for an average worker on their job, and their usual work performance, alongside a recent performance in order to estimate presenteeism related work loss. This is done on a scale of 0 (worst performance at work) to 10 (best performance).

Methods of valuing presenteeism loss

Having obtained a measure of productivity loss (such as hours lost, or percentage effort made), this metric can then be converted into a monetary estimate. All studies in the review used salary-based conversion approaches, more specifically the human capital approach, with the exception of Smit et al. [49] who used the friction cost approach. A variety of measures were used to assess the value of foregone earnings, and these included: an average wage for all groups (n=11), age-sex dependent wage-rates (n=6), and a self-reported gross salary (4) (Table 2). The wage-rates used were expressed variously as hourly, daily or annual wage-rates.

Studies were also assessed for whether they considered the impact of presenteeism on output, teamwork productivity and substitutability, often known as multiplier effects, and any compensation mechanisms [58]. Multiplier effects are additional costs that could result from the negative impact on productivity of sick co-workers particularly where team work is involved [60] .Compensation mechanisms are adjustments for productivity loss through internal employee substitution mechanisms or as a result of ill employees compensating for lost time [61]. These have been reported to have a significant impact on overall productivity costs [62]. None of the studies identified adjusted presenteeism costs for aspects of compensation mechanisms or included multiplier effects.

Impact of presenteeism on total costs

Overall nineteen studies (67%) provided enough detail to assess the impact of presenteeism on total costs. On average, presenteeism costs comprised 52% (ranging 19% to 85%) of the total costs of the interventions or disease conditions investigated (Table 2). The proportion of presenteeism was highest in rheumatoid arthritis, back pain and insomnia conditions. A further inspection of studies that did not report the overall total costs [32, 37, 43, 53, and 55] showed presenteeism costs were greater than absenteeism costs. The three cost-effectiveness studies within this review included productivity losses related to presenteeism, but did not provide enough detail to assess the impact of presenteeism on cost-effectiveness outcomes [33, 49, and 53].

DISCUSSION

This review assessed the methods used in estimating presenteeism in current practice and the impact of presenteeism on total costs of health conditions. In the studies reviewed here, only nine instruments were identified in spite of the many existing presenteeism instruments that have been reported in the literature. The findings indicated that losses from reduced productivity at work are rarely included in cost-effectiveness or cost-utility analyses, although presenteeism has been associated with significant costs. Only 3 full economic evaluations (cost-effectiveness or cost-utility analyses) that included presenteeism costs were identified in this review [33, 49, and 53]. Understanding of the impact of presenteeism is therefore derived largely from cost-of-illness studies. Whilst these show large costs of presenteeism resulting from illness, it is less clear what the impact of alternative health interventions on presenteeism is likely to be.

Further assessment of the studies revealed a lack of consensus about the most appropriate instruments and approaches for measuring and valuing presenteeism. The most common approach used in measuring presenteeism was the direct approach which has the advantage of generating directly usable productivity output values in lost hours that can easily be valued for use in economic evaluations. However, comparisons with other presenteeism approaches suggest this approach potentially underestimates lost productivity [63]. These findings are consistent with those of Schultz et al., [25] who found wide variations in approaches to monetary valuation for reduced productivity among different instruments. Moreover, from the few attempts that have been made to compare across measurement instruments within the same population, there is evidence that different instruments produced different estimates [23, 63, 64]. High costs were attributed to presenteeism in the studies included. It should be noted, however, that the majority of studies used the human capital method which is known to overestimate productivity loss; only one study from the Netherlands used the friction cost approach to take account of likely re-balance of labour duties in the workplace. Previous research has found little or no attempt to apply the friction cost approach in valuing presenteeism [20, 65]. The proportion of estimates using the human capital approach compared to the friction cost approach in this area needs further attention. All studies included in this review were based on

subjective measures and therefore are completed by the employee using their own judgement. It remains uncertain how these estimates would compare with measures of productivity loss obtained from employers.

To date, little evidence exists on presenteeism costs in cost-effectiveness or cost-utility analyses that typically inform the process of healthcare decision making. The majority of studies included in this review were cost-of-illness studies. There is limited literature on typical economic evaluations incorporating presenteeism costs and consequently their impact on overall cost-effectiveness results. These findings could be attributed to the studies adhering to national guidelines that in most cases do not prescribe inclusion of presenteeism or other related costs such as multiplier effects and compensation mechanisms [13]. Another reason could be a general lack of confidence in methodology regarding how to measure and value presenteeism. Given that presenteeism contributes significantly to overall total costs as has been shown in this review, the exclusion of this cost-category in economic evaluations is likely to result in biased societal decision making.

These conclusions need to be considered in light of the strengths and limitations of this study. One strength is that the review provides an overview of the instruments and methods used to estimate presenteeism in practice. It also comprehensively assesses cost-of-illness studies and economic evaluations from various databases showing the impact of presenteeism on total cost of health conditions. There were some limitations with the study. Firstly, we used a limited set of databases for our search of economic evaluations including presenteeism. As a result, although care was taken to include all relevant studies, we could have missed some economic evaluations that considered presenteeism. However, the databases included spanned the health economics, medical and behavioural science disciplines and therefore provide a comprehensive overview of the literature. Secondly, the selection process in this review did not fully adhere to the cochrane review selection process. Notably, the review set out to provide an insight into the current role of productivity costs in relation to reduced productivity at work in economic evaluations. It does not seem likely that a more

extensive search strategy and selection process would significantly alter the conclusions of this review. Finally, studies could have been missed by excluding non-English articles.

In spite of the limitations of this study, some important policy and research implications may be drawn. Firstly, there is a need to build a greater awareness about the potential impact of presenteeism-related conditions on productivity, employers and society in cost-effectiveness or cost-utility analyses in order to identify the most effective strategies and interventions of managing these conditions. This is particularly important because presenteeism, from this review, appears to contribute significantly to productivity costs (or savings) and overall total costs of certain disease areas such as musculoskeletal pain, migraine and mental health related disorders. Economic evaluation recommendations in these disease conditions that do not include estimates of presenteeism may result in less than optimal resource allocation decisions from a societal perspective. Determining the extent to which resource allocation is less than optimal is a research area that needs to be prioritised. In order to do so, however, it is clear that there is a need for greater consensus on the methods that should be used to estimate presenteeism in economic evaluations. Current proposed cost-effectiveness ratio thresholds may not be truly representative of the willingness of society to pay for interventions from a societal perspective. Evidence in support of changing current willingness-to-pay thresholds remains inconclusive [66, 67] and further research on whether and how to explicitly determine acceptable decision making ICER threshold values when incorporating productivity costs in economic evaluation would be very helpful.

Previous research has highlighted the role of the friction cost approach in estimating more realistic absence related productivity costs compared to the human capital approach, particularly in the long run [64]. It is possible that attempts to apply the friction cost approach to generate presenteeism costs may lead to more realistic productivity loss estimates than current estimates based on the human capital method, as they have in relation to absenteeism [9] . However, the application of this approach within the context of presenteeism remains unclear. Additional evidence is needed to determine how to estimate and value presenteeism wage-related multiplier effects and compensation mechanisms at

work when estimating productivity costs [62]. The latter issue is particularly important as presenteeism costs appear to be greater than those related to absenteeism [44, 52]. Additional research is needed to add to this evidence base in these areas.

Finally, a number of measurement instruments have been reported in the literature, although few studies have used these productivity instruments to estimate the cost of presenteeism in economic evaluation costing practice. The methods used in the instruments varied widely and the impact of the alternative estimation approaches on overall cost-effectiveness results needs to be further assessed. One way forward is to establish a reference case of standard instruments and corresponding validated cost conversion algorithms for estimating the cost of presenteeism. To promote increased transparency, a useful practice could be to cross compare instruments and also include a brief justification of the instruments chosen (given the number available) with clear reporting of the estimation and valuation methods. Although including presenteeism is not feasible for all conditions, we would suggest that a first step could be for studies to include presenteeism as a sensitivity or secondary care analysis where appropriate to assess the robustness of findings with respect to wider costs associated with lost productivity. Also studies that exclude presenteeism costs could justify their decision in terms of (ir) relevance to the condition being investigated.

CONCLUSION

The estimation of reduced productivity at work (presenteeism) seems to be very limited within current economic evaluation practice. The development of various presenteeism measurement instruments has also not translated into applied costing practice. To enable wider inclusion of presenteeism costs, a reference case and guidance regarding standard instruments, methodology for estimating and valuing productivity costs related to presenteeism need to be developed. Given the significance of presenteeism in relation to lost productivity, and its potential impact on diseases and interventions as shown here, more attention needs to be given to the methods used to estimate presenteeism and methods for its inclusion in economic evaluations.

References

1. Brouwer, W.B., M.A. Koopmanschap, and F.F. Rutten, Productivity costs in cost-effectiveness analysis: numerator or denominator: a further discussion. Health Economics, 1997. 6(5): p. 511-4.
2. Zhang, W., N. Bansback, and A.H. Anis, Measuring and valuing productivity loss due to poor health: A critical review. Social Science & Medicine, 2011. 72(2): p. 185-92.
3. Gold, M., et al., Cost-effectiveness in health and medicine. 1996, New York: Oxford University Press.
4. Drummond, M., et al., eds. Methods for the economic evaluation of health care programmes. 2005, Oxford University Press: New York.
5. Johannesson, M.J., Bengt Jönsson L, Kobelt G, Zethraeus N. Why Should Economic Evaluations of Medical Innovations Have a Societal Perspective? Office of Health Economics, Editor. 2009.
6. Brouwer, W.B., et al., A dollar is a dollar is a dollar--or is it? Value Health, 2006. 9(5): p. 341-7.
7. Tilling, C., et al., In or out? Income losses in health state valuations: a review. Value in Health, 2010. 13(2): p. 298-305.
8. Krol, M., W. Brouwer, and F. Rutten, Productivity costs in economic evaluations: past, present, future. Pharmacoeconomics, 2013. 31(7): p. 537-49.
9. Krol, M. and W. Brouwer, How to estimate productivity costs in economic evaluations. Pharmacoeconomics, 2014. 32(4): p. 335-44.
10. Krol, M., et al., A noticeable difference? Productivity costs related to paid and unpaid work in economic evaluations on expensive drugs. Eur J Health Econ, 2015.
11. Ricci, J.A., et al., Pain exacerbation as a major source of lost productive time in US workers with arthritis. Arthritis care & research, 2005. 53(5): p. 673-681.
12. Pritchard, C. and M. Sculpher, Productivity Costs: Principles and Practise in Economic Evaluation. 2000, Office of Health Economics.

13. Knies, S., et al., The transferability of valuing lost productivity across jurisdictions. Differences between national pharmacoeconomic guidelines. Value in Health, 2010. 13(5): p. 519-527.
14. Johns, G., Presenteeism in the workplace: A review and research agenda. Journal of Organizational Behavior, 2010. 31(4): p. 519-542.
15. Brooks, A., et al., Presenteeism: critical issues. Journal of Occupational & Environmental Medicine, 2010. 52(11): p. 1055-67.
16. Kigozi, J.B.L., The economics of back pain: alternative approaches to productivity cost estimation in economic evaluation of healthcare, in School of Health and Population Sciences. 2014, University of Birmingham. p. 358.
17. Beaton, D., et al., Measuring worker productivity: frameworks and measures. Journal of Rheumatology, 2009. 36(9): p. 2100-9.
18. Lofland, J.H., L. Pizzi, and K.D. Frick, A review of health-related workplace productivity loss instruments. Pharmacoeconomics, 2004. 22(3): p. 165-84.
19. Loeppke, R., et al., Health-related workplace productivity measurement: general and migraine-specific recommendations from the ACOEM Expert Panel. Journal of Occupational & Environmental Medicine, 2003. 45(4): p. 349-59.
20. Mattke, S., et al., A review of methods to measure health-related productivity loss. American Journal of Managed Care, 2007. 13(4): p. 211-7.
21. Nieuwenhuijsen, K., R.L. Franche, and F.J. van Dijk, Work functioning measurement: tools for occupational mental health research. J Occupational Environ Med, 2010. 52(8): p. 778-90.
22. Prasad, M., et al., A review of self-report instruments measuring health-related work productivity: a patient-reported outcomes perspective. . Pharmacoeconomics, 2004. 22(4): p. 225-244.
23. Ozminkowski, R.J., et al., The application of two health and productivity instruments at a large employer. Journal of Occupational & Environmental Medicine, 2004. 46(7): p. 635-48.

24. Roy, J.S., F. Desmeules, and J.C. MacDermid, Psychometric properties of presenteeism scales for musculoskeletal disorders: a systematic review. J Rehabil Med, 2011. 43(1): p. 23-31.
25. Schultz, A.B., C.-Y. Chen, and D.W. Edington, The cost and impact of health conditions on presenteeism to employers: a review of the literature. Pharmacoeconomics, 2009. 27(5): p. 365-78.
26. Schultz, A.B. and D.W. Edington, Employee health and presenteeism: a systematic review. Journal of Occupational Rehabilitation, 2007. 17(3): p. 547-79.
27. Lerner, D., et al., The Work Limitations Questionnaire. Med Care. 2001(1): p. 72-85.
28. Kessler, R.C., et al., The World Health Organization Health and Work Performance Questionnaire (HPQ). J Occupational Environ Med, 2003. 45(2): p. 156-74.
29. Reilly, M.C., A.S. Zbrozek, and E.M. Dukes, The validity and reproducibility of a work productivity and activity impairment instrument. Pharmacoeconomics, 1993. 4(5): p. 353-65.
30. van Roijen, L., et al., Labor and health status in economic evaluation of health care. The Health and Labor Questionnaire. International J Technol Assess Health Care, 1996. 12(3): p. 405-15.
31. Shikiar, R., et al., Development of the Health and Work Questionnaire (HWQ): an instrument for assessing workplace productivity in relation to worker health. Work, 2004. 22(3): p. 219-29.
32. Boonen, A., et al., Impact of ankylosing spondylitis on sick leave, presenteeism and unpaid productivity, and estimation of the societal cost. Annals of the Rheumatic Diseases, 2010. 69(6): p. 1123-8.
33. Uegaki, K., et al., Cost-utility analysis of a one-time supervisor telephone contact at 6-weeks post-partum to prevent extended sick leave following maternity leave in The Netherlands: results of an economic evaluation alongside a randomized controlled trial. BMC Public Health, 2011. 11: p. 57.
34. Zhang, W., et al., Short-term influence of adalimumab on work productivity outcomes in patients with rheumatoid arthritis. Journal of Rheumatology, 2008. 35(9): p. 1729-36.

35. Daley, M., et al., The economic burden of insomnia: direct and indirect costs for individuals with insomnia syndrome, insomnia symptoms, and good sleepers. Sleep, 2009. 32(1): p. 55-64.
36. Li, X., M.A. Gignac, and A.H. Anis, The indirect costs of arthritis resulting from unemployment, reduced performance, and occupational changes while at work. Med Care, 2006. 44(4): p. 304-10.
37. Finkelstein, E.A., et al., The costs of obesity in the workplace. Journal of Occupational & Environmental Medicine, 2010. 52(10): p. 971-6.
38. Cooksey, R., et al., The Cost of Ankylosing Spondylitis in the UK Using Linked Routine and Patient-Reported Survey Data. PLoS ONE, 2015. 10(7): p. e0126105.
39. Rafia, R., et al., Healthcare costs and productivity losses directly attributable to ankylosing spondylitis. Clinical & Experimental Rheumatology, 2012. 30(2): p. 246-53.
40. Hellgren, J., et al., Allergic rhinitis and the common cold--high cost to society. Allergy, 2010. 65(6): p. 776-83.
41. Thavorncharoensap, M., et al., The economic costs of alcohol consumption in Thailand, 2006. BMC Public Health, 2010. 10: p. 323.
42. Hilton, M.F., et al., Mental ill-health and the differential effect of employee type on absenteeism and presenteeism. Journal of Occupational & Environmental Medicine, 2008. 50(11): p. 1228-43.
43. Linde, M., et al., The cost of headache disorders in Europe: the Eurolight project. Eur J Neurology, 2012. 19(5): p. 703-11.
44. Ricci, J.A. and E. Chee, Lost productive time associated with excess weight in the U.S. workforce. Journal of Occupational & Environmental Medicine, 2005. 47(12): p. 1227-34.
45. Goetzel, R.Z., et al., A multi-worksite analysis of the relationships among body mass index, medical utilization, and worker productivity. Journal of Occupational & Environmental Medicine, 2010. 52 Suppl 1: p. S52-8.

46. Stewart, W.F., et al., Lost productive work time costs from health conditions in the United States: results from the American Productivity Audit. J Occup Environ Med, 2003. 45(12): p. 1234-46.
47. Fishman, P. and L. Black, Indirect costs of migraine in a managed care population. Cephalalgia, 1999. 19(1): p. 50-7; discussion 1.
48. Burton, W.N., et al., The economic burden of lost productivity due to migraine headache: a specific worksite analysis. Journal of Occupational & Environmental Medicine, 2002. 44(6): p. 523-9.
49. Smit, F., et al., Cost-effectiveness of preventing depression in primary care patients: randomised trial. Br J Psychiatry, 2006. 188: p. 330-6.
50. Snedecor, S.J., et al., Cost-effectiveness of eszopiclone for the treatment of adults with primary chronic insomnia. Sleep, 2009. 32(6): p. 817-24.
51. Burton, W.N., et al., The association of health risks with on-the-job productivity. Journal of Occupational & Environmental Medicine, 2005. 47(8): p. 769-77.
52. Braakman-Jansen, L.M.A., et al., Productivity loss due to absenteeism and presenteeism by different instruments in patients with RA and subjects without RA. Rheumatology, 2012. 51(2): p. 354-61.
53. Lerner, D., et al., Impaired work performance among women with symptomatic uterine fibroids. J Occup Environ Med, 2008. 50(10): p. 1149-57.
54. Wilson, D.A., et al., Economic costs associated with acute attacks and long-term management of hereditary angioedema. Ann Allergy Asthma Immunol, 2010. 104(4): p. 314-20.
55. Collins, J.J., et al., The assessment of chronic health conditions on work performance, absence, and total economic impact for employers. Journal of Occupational & Environmental Medicine, 2005. 47(6): p. 547-57.
56. Cisternas, M.G., et al., A comprehensive study of the direct and indirect costs of adult asthma. J Allergy Clin Immunol, 2003. 111(6): p. 1212-8.

57. Henke, R.M., et al., The relationship between health risks and health and productivity costs among employees at Pepsi Bottling Group. Journal of Occupational & Environmental Medicine, 2010. 52(5): p. 519-27.
58. Kigozi, J., et al., Construct validity and responsiveness of the single-item presenteeism question in patients with lower back pain for the measurement of presenteeism. Spine (Phila Pa 1976), 2014. 39(5): p. 409-16.
59. Nicholson, S., et al., Measuring the effects of work loss on productivity with team production. Health Econ, 2006. 15(2): p. 111-23.
60. Pauly, M.V., et al., Valuing reductions in on-the-job illness: 'presenteeism' from managerial and economic perspectives. Health Economics, 2008. 17(4): p. 469-85.
61. Krol, M., et al., Productivity cost calculations in health economic evaluations: correcting for compensation mechanisms and multiplier effects. Social Science & Medicine, 2012. 75(11): p. 1981-8.
62. Zhang, W., et al., Development of a composite questionnaire, the valuation of lost productivity, to value productivity losses: application in rheumatoid arthritis. Value in Health, 2012. 15(1): p. 46-54.
63. Zhang, W., et al., Productivity loss due to presenteeism among patients with arthritis: estimates from 4 instruments. Journal of Rheumatology, 2010. 37(9): p. 1805-14.
64. Meerding, W.J., et al., Health problems lead to considerable productivity loss at work among workers with high physical load jobs. Journal of Clinical Epidemiology, 2005. 58(5): p. 517-23.
65. Kigozi, J., et al., Estimating productivity costs using the friction cost approach in practice: a systematic review. Eur J Health Econ, 2016. 17(1): p. 31-44.
66. Donaldson, C., et al., The social value of a QALY: raising the bar or barring the raise? BMC Health Services Research, 2011. 11(1): p. 8.
67. Claxton, K., et al., Methods for the estimation of the NICE cost effectiveness threshold. CHE Research Paper 81. 2013.

68. Goetzel, R.Z.L., Stacey R; Ozminkowski, Ronald J; Hawkins, Kevin; Wang, Shaohung; Lynch, Wendy, Health, absence, disability, and presenteeism cost estimates of certain physical and mental health conditions affecting U.S. employers. Journal of Occupational & Environmental Medicine, 2004. 46(4): p. 398-412.
69. Henke, C.J., et al., Work loss costs due to peptic ulcer disease and gastroesophageal reflux disease in a health maintenance organization. Am J Gastroenterol, 2000. 95(3): p. 788-92.
70. Lamb, C.E., et al., Economic impact of workplace productivity losses due to allergic rhinitis compared with select medical conditions in the United States from an employer perspective. Current Medical Research & Opinion, 2006. 22(6): p. 1203-10.
71. Stewart, W.F., et al., Lost productive time and cost due to common pain conditions in the US workforce. JAMA, 2003. 290 (18): p. 2443-54.

Table I: Overview of studies included in this review

Author	Country	Clinical area	Type of study
Boonen et al.,2010 [32]	Netherlands	Ankylosing spondylitis	COI
Braakman-Jansen et al .,2012 [52]	US	Rheumatoid Arthritis	COI
Burton et al.,2002 [48]	US	Migraine	COI
Burton et al.,2005 [51]	US	Various health conditions	COI
Cisternas et al., 2003 [56]	US	Asthma	COI
Collins., 2005 [55]	US	Chronic conditions	COI
Cooksey et al 2015 [38]	UK	Ankylosing Spondylitis	COI
Daley et al., 2009 [35]	Canada	Insomnia	COI
Finkelstein et al., 2010 [37]	United Kingdom	Obesity	COI
Fishman and Black ,1999 [47]	US	Migraine	COI
Goetzel et al.,2004 [68]	US	Various conditions	COI
Goetzel et al.,2010 [45]	US	Obesity	COI
Hellgren et al.,2010 [40]	Sweden	Allergic rhinitis and common cold.	COI
Henke et al.,2000 [69]	US	PUD and GERD	COI
Hilton et al.,2008 [42]	US, UK, Australia	Psychological distress	COI
Lamb et al., 2006 [70]	US	Allergic Rhinitis	COI
Lerner et al., 2008 [53]	US	Fibroids	CEA
Li et al., 2006 [36]	Canada	Arthritis	COI
Linde et al., 2012 [43]	8 European countries	Headache	COI
Rafia et al., 2012 [39]	UK	Ankylosing spondylitis (AS)	COI
Ricci and Chee, 2005 [44]	US	Obesity	COI
Smit et al., 2006 [49]	Netherlands	Depression	CEA
Stewart et al.,2003a [46]	US	Headache, back pain, Arthritis.	COI
Stewart et al.,2003b [71]	US	Headache, back pain, Arthritis.	COI
Thavorncharoensap et al., 2010 [41]	Thailand	Alcohol consequences	COI
Uegaki et al., 2011 [33]	Netherlands	Maternity	CEA
Wilson et al.,2010 [54]	US	Acute attacks/ Hereditary	COI

		angioedema (HAE).	
Zhang et al.,2008 [34]	Canada	Rheumatoid Arthritis	COI

COI, Cost-of-illness; CBA, cost-benefit analysis; CEA, cost-effectiveness analysis; CUA, cost-utility analysis; RCT Randomised clinical trial, US United States ; UK United Kingdom

Table II: Methods for including presenteeism and overall impact of costs

Study	Instruments used	Recall	Labour measure used	Valuation Method	Productivity Metrics considered	Primary measure reported	Presenteeism summary approach	Findings (% - percentage of total costs)
Boonen et al.,2010 [32]	HLQ	2 weeks	Average wage	HCM	Presenteeism and Absenteeism	Extra work hour's needed to compensate for inefficient hours.	Direct approach	Annual presenteeism costs: €967; Absenteeism €1832 per patient per year. % of total NS.
Braakman-Jansen et al .,2012 [52]	QQ, WPAI	1 week	Average wage-rate per hour	HCM	Presenteeism and Absenteeism	WPAI: Degree of problems affecting work productivity QQ: Quantity and quality of work on an 11-point NRS from 0 to 10)	Perceived change approach	WPAI; Annual presenteeism costs: 318(73%) and 72(92%) for intervention and control. PRODISQ: Annual presenteeism: 299 (71%) and 154 (95%) for the intervention and control.
Burton et al.,2002 [48]	Global presenteeism question from interview question	Global presenteeism question from interview question	Daily Wage rates	HCM	Presenteeism only	Work days of reduced productivity	Perceived change approach	Annual presenteeism: $21.5M (60%)
Burton et al.,2005 [51]	Modified WLQ	2 weeks	NS	NS	Presenteeism only	% of time the respondent was limited in performing a specific dimension of job tasks	Perceived change approach	Annual Presenteeism costs: $1392 to $2592 per employee per year. Annual Extrapolated to $99M to $185M entire population.
Cisternas et al., 2003 [56]	Global presenteeism question from survey	Global presenteeism question from	Mean Hourly Wage from Census Survey	HCM	Presenteeism only	Reduced work hours due to sickness	Perceived change approach	Annual costs: $4912, Indirect costs: $1732 (35%). Presenteeism (28%).

Study	Instruments used	Recall	Labour measure used	Valuation Method	Productivity Metrics considered	Primary measure reported	Presenteeism summary approach	Findings (% - percentage of total costs)
		survey						
Collins., 2005 [55]	SPS and WOS	4 weeks	National average wage-rates per job type/	HCM	Presenteeism only	Percentage of "usual" productivity not achieved	Perceived change approach	Annual costs per employee: $6721 for Presenteeism. 10% of total productivity costs. 6.8% presenteeism.
Cooksey et al [38]	WLQ, WPAI	2 Weeks, 1 Week	Average gross wage	HCM	Presenteeism and Absenteeism	WPAI: Degree of problems affecting work productivity WLQ: Work limitations over different domains	Perceived change approach Direct approach	Annual costs: Absenteeism: £411; Presenteeism £3425; Total cost: £19,016.
Daley et al., 2009 [35]	Global presenteeism question	Global presenteeism question	Age-gender mean salaries	HCM	Presenteeism only	Extent to which insomnia is responsible for reduced productivity on a 0-10 scale.	Perceived change approach	Presenteeism $5 billion (76% of total) Total cost $6.6 billion
Finkelstein et al., 2010 [37]	WPAI	7 days	Age-gender specific wage	HCM	Presenteeism and Absenteeism	% reduction in productivity and estimate of time lost during past 7 days.	Perceived change approach	Presenteeism ($555 to $3792); % of total costs NS
Fishman and Black ,1999 [47]	Global presenteeism question	6 months	Age-gender working, educational, mental status	HCM	Presenteeism only	Degree to which headache affects normal activities on a scale of 0 to 10.	Perceived change approach	Presenteeism greater than absenteeism. % of total costs NS.

Study	Instruments used	Recall	Labour measure used	Valuation Method	Productivity Metrics considered	Primary measure reported	Presenteeism summary approach	Findings (% - percentage of total costs)
			specific wage					
Goetzel et al.,2004 [68]	Global questions in survey	2weeks, 3 months, 12 months	National Hourly wage rates	HCM	Presenteeism only	Rate at which performance was reduced because of health problems.	Perceived change approach	Annual presenteeism: 61% of total cost in 10 conditions.
Goetzel et al.,2010 [45]	WLQ	2 weeks	National average wage-rates	HCM	Presenteeism only	% of time the respondent was limited in performing a specific dimension of job tasks due to obesity.	Perceived change approach	Annual absenteeism and presenteeism combined ($2596). Direct costs ($2842). % of total costs NS.
Hellgren et al.,2010 [40]	Global question from HRA	Global question from HRA	Self-reported Salary	HCM	Presenteeism only	Number of days at work with rhinitis and self-reported productivity while at work during the last month/year	Perceived change approach	Annual: € 2.7 billion. Presenteeism (37%), Absenteeism (44%).
Henke et al.,2000 [69]	General question as part of interview Questionnaire	3 months.	Self-reported Salary	HCM	Presenteeism only	Reduced productivity because of PUD or GERD	Perceived change approach	Presenteeism: Annual PUD costs per year $205 (28% of total), Annual GERD $72 (27% of total).
Hilton et al.,2008 [42]	HPQ	4 weeks	Mean Wage-rates ONS from UK and	HCM	Presenteeism and Absenteeism	Self-reported scale of performance of 0 to 10 (worst to best).	Comparative approach	Annual total costs USD$11.1 billion. % of total costs NS.

Study	Instruments used	Recall	Labour measure used	Valuation Method	Productivity Metrics considered	Primary measure reported	Presenteeism summary approach	Findings (% - percentage of total costs)
			Australia					
Lamb et al., 2006 [70]	WPSI	Not reported	Standard hourly wage	HCM	Absenteeism/Presenteeism	Number of unproductive hours spent at work during the recall period.	Direct approach	% of total costs NS.
Lerner et al., 2008 [53]	WLQ	2 weeks	Average wage	HCM	Presenteeism only	% of time the respondent was limited in performing a specific dimension of job tasks (%)	Perceived change approach	Annual Presenteeism: $2341 for intervention group; $836 for control group. % of total costs NS.
Li et al., 2006 [36]	WLQ	2 weeks	Annual-average wage-rate	HCM	Presenteeism only	% of time the respondent was limited in performing a specific dimension of job tasks (%)	Perceived change approach	Total Annual costs: $11,553 Presenteeism: $4724 (41% of total costs)
Linde et al., 2012 [43]	General presenteeism question	General presenteeism question	Average–gender specific wage-rate	HCM	Absenteeism and Presenteeism	Days at work when the amount done was ≥ 50% reduced productivity counted as 1 day of reduced productivity).	Perceived change approach	Annual cost per person: £ 1222; Presenteeism: £ 765 (63% of total costs).
Rafia et al 2012 [39]	WPAI	3 months	Average wage	HCM	Presenteeism and Absenteeism	WPAI: Degree of problems affecting work productivity	Perceived change approach	Total 3 month cost of £2,802. Absenteeism (1.4%) and presenteeism (19%).

Study	Instruments used	Recall	Labour measure used	Valuation Method	Productivity Metrics considered	Primary measure reported	Presenteeism summary approach	Findings (% - percentage of total costs)
Ricci and Chee, 2005 [44]	WHI	2 weeks	Self-reported salary	HCM variant	Presenteeism and Absenteeism	Self-reported reduced work productivity based on responses 5 specific domains.	Perceived change approach	Annual cost: $11.70 billion per year. Presenteeism (67% of total costs).
Smit et al., 2006 [49]	Global questions	Global questions	Age-gender wage-rate	HCM	Presenteeism only	Reduced productivity at work on a scale of 0 to 10	Perceived change approach	Annual presenteeism, intervention: €2232(33% of total costs); Annual total costs: €6766; Annual presenteeism ,control: €3175(39% of total costs); Annual total costs: €8614;
Stewart et al.,2003a [46]	WHI	2 weeks	Self-reported Salary	HCM variant	Presenteeism and Absenteeism	Self-reported reduced work productivity based on responses 5 specific domains.	Perceived change approach	Total cost $61.2 billion, presenteeism: $46.9 bn (76.6%). Presenteeism for Arthritis (84.4%) and Back pain (69.7%).
Stewart et al.,2003b [71]	WHI	2 weeks	Self-reported Salary	HCM variant	Presenteeism and Absenteeism	Self-reported reduced work productivity based on responses 5 specific domains.	Perceived change approach	Total productivity costs: $225.8 billion per year. On average, presenteeism 71% of total costs.
Thavorncharoensap et al., 2010 [41]	Questions from WPAI	1 week	Average income per year	FCA	Presenteeism and Absenteeism	Reduced productivity at work and during regular activities	Direct approach	Annual Total costs: $ 9,627 million Annual Presenteeism: $ 2,804 million (29% total costs). Mortality costs: $6,422 million.
Uegaki et al., 2011 [33]	HPQ	2 weeks	Not included	HCM	Presenteeism and Absenteeism	Reduced work performance due to sickness	Comparative	Annual presenteeism, intervention: €765(40%); Annual total costs: €1911; Annual presenteeism, control: €655 (38%); Annual total costs: €1734. Overall costs, Indirect costs (37%) presenteeism (52%).

Study	Instruments used	Recall	Labour measure used	Valuation Method	Productivity Metrics considered	Primary measure reported	Presenteeism summary approach	Findings (% - percentage of total costs)
Wilson et al.,2010 [54]	WPAI-GH included in survey	7 days	Self-reported Gross Salary	HCM variant	Presenteeism and Absenteeism	Reduced productivity at work and during regular activities	Direct approach	Total costs: $41,992 Indirect Costs: $16,108.Absenteeism: $3402.Presenteeism $5,750. Presenteeism (14% total costs).
Zhang et al.,2008 [34]	HLQ, HPQ, WPAI, WLQ.	HLQ-2 weeks/HPQ- 4 weeks/WPAI-1 week, WLQ/2 weeks.	Age-gender employee type specific wage-rate	HCM	Presenteeism and Absenteeism	HLQ: Extra hours worked WPAI: Reduced productivity while working WLQ: Work limitations over different domains HPQ: Work performance during the past 7 days	Direct approach, Comparative	$30.03, $83.05, $284.07, and $285.10 (HLQ, WLQ, HPQ, WPAI) over 2 a period of weeks. % of total costs NS.

NS – not stated, HCM Human capital method, FCA Friction cost approach