The return of investment for preventive healthcare programmes

A calculation framework for GSK’s Partnership for Prevention (P4P)

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This report aims to summarise the existing evidence on the effectiveness of workplace related preventive health programmes, outlining the challenges involved in calculating the return on investment (ROI) of such interventions.

This report is funded by GlaxoSmithKline (GSK).
This report describes a modelling framework for calculating the return on investment (ROI) for GSK’s Partnership for Prevention preventive healthcare programme. Subsequently, general challenges in calculating an ROI for preventive health programmes are discussed and evidence on the effectiveness of specific interventions is included in Partnership for Prevention is outlined. The report includes a case study to calculate the Partnership for Prevention’s ROI in South Africa.
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Workplace preventive health initiatives are growing in number and scope around the world, as employers increasingly realise the link between employee health and wellbeing and company’s performance. The simple logic is that effective investment in health and wellbeing can save a company more than it spends on the interventions through reduced productivity loss as a result of lower absenteeism and presenteeism, as well as lower healthcare spending. Indeed, it is well documented that a large proportion of diseases and disorders are preventable and a growing body of literature shows that employee’s physical and mental health are important determinants of their performance at the workplace.

Multiple health promotion programmes take place in a number of pharmaceutical companies. In general, programme goals are to improve employee’s health and wellbeing by providing healthcare support, healthy lifestyle alternatives, developing a workplace culture that promotes and provides support for healthy living, and taking into account mental health. Notwithstanding that, based on the findings that RAND Europe conducts within the Britain’s Healthiest Workplace (BHW) competition, from 170 surveyed UK companies from various different sectors, only around 17 per cent measure their ROI on health and wellbeing initiatives and of those, only about 3 per cent measure ROI financially (in terms of £).

GSK’s Partnership for Prevention aims to provide all GSK employees and their benefits-eligible dependants’ access to preventive healthcare services. Some GSK employees work in countries where publicly funded preventive healthcare may be unavailable or limited, and this is where Partnership for Prevention bridges a gap. However, some of the interventions, particularly those aimed at smoking cessation or lowering blood pressure and cholesterol, go beyond a simple substitution of necessary preventive healthcare services and aim to improve employee’s wellbeing as well as preventing possible future health complications.

In this report we discuss the drivers of a successful workplace health promotion programmes and develop a framework to analyse the RoI of such projects, applying it subsequently to the GSK’s Partnership for Prevention programme. The economic model is embedded in a predictive methodological framework based on identifying essential factors impacting the ROI, examining their relationships, and combining parameter estimates obtained from the existing literature with GSK-specific variables to calculate the predicted annual return on investment into the programmes. This complex economic model is implemented in an Excel spreadsheet tool to provide numerical results.

Based on data provided by GSK, as well as other publicly available data sources, such as the Global Burden of Disease (GBD) data, we were able to calculate the ROI for GSK’s Partnership for Prevention programme using South Africa as a case study. The estimated ROI is between $0.26 and $2.12, meaning
that the investment is expected to be fully repaid and further bring additional net returns. This clearly
demonstrates the potential business case for companies such as GSK to invest globally in health and
wellbeing of its workforce.
The authors wish to thank a number of people for their suggestions and comments on earlier versions of this document. First of all, we are grateful to Crystal Vega and Sharon Wheatley from GSK for providing data, guidance and suggestions.

We are also grateful to a number of experts and RAND colleagues who reviewed and commented on the modelling approach in this study.
# Abbreviations

| Abbreviation | Description                                    |
|--------------|------------------------------------------------|
| BHW          | Britain’s Healthiest Workplace competition     |
| DALY         | Disability-Adjusted Life Year                  |
| CVD          | Cardiovascular Disease                         |
| GBD          | Global Burden of Disease                       |
| NCD          | Non-communicable diseases                      |
| RCT          | Randomised Controlled Trial                    |
| ROI          | Return on Investment                            |
| WHO          | World Health Organisation                      |
1. Introduction

1.1. Background

There is increasing public acceptance that health and wellbeing at work can have profound impacts on individuals, organisations and societies. With over half of the working population spending the majority of their time at work, the World Health Organization (WHO) has identified the workplace as a target setting for health promotion, forming a *Global Plan of Action on Workers’ Health (2008-2017)* in order to raise awareness and promote health at work.¹ In that regard, the World Economic Forum (WEF) established the Workplace Wellness Alliance with over 150 member organisations with a total of more than 5 million employees globally. The Alliance aims to promote the business rational for investing in health and wellbeing in the workplace. In the United Kingdom, Dame Carol Black’s review – *Working for a Healthier Tomorrow* – acknowledged that there is strong and growing evidence that work, health and wellbeing are closely and powerfully linked and need to be addressed together (Black, 2008).²

For instance, in the United Kingdom during 2013–2014 an estimated 1.2 million people who worked during the last year were suffering from an illness (long-standing as well as new cases) they believed was caused or made worse by their current or past work. Half a million of these appear to be new conditions which started during the year. Approximately 28.2 million days were lost due to work-related ill health or injury. The Black and Frost report on the UK workplace highlights that 140 million working days are lost to sickness absence and 300,000 individuals leave the workplace each year due to ill-health. This puts the approximate cost of sickness absence to British business at approximately £15bn annually (Black and Frost, 2011).³ In addition, businesses face significant costs not only due to sickness absence but also from employees attending work while sick, which is referred to as ‘presenteeism’ (other related terms are ‘sickness presence’ or ‘lost health-related productivity’). It is estimated that presenteeism due to mental illness costs the UK economy about £15bn per year (Centre for Mental Health, 2011).⁴

There is also increasing evidence that chronic diseases, often related to modifiable health risk behaviours, are rising in less industrialised countries, affecting workforce productivity across the globe. Non-communicable diseases (NCDs) such as heart diseases, stroke, cancers, diabetes, chronic kidney disease,

¹ [http://www.who.int/occupational_health/publications/global_plan/en/](http://www.who.int/occupational_health/publications/global_plan/en/)
² Black, C.M., (2008) ‘Working for a healthier tomorrow: Dame Carol Black’s review of the health of Britain’s working age population’. The Stationery Office.
³ Black, C.D., Frost, D., (2011) ‘Health at work—an independent review of sickness absence’. The Stationery Office.
⁴ Centre for Mental Health, 2011. Managing presenteeism: a discussion paper.
are increasingly prevalent in low- and middle-income countries (LMICs). This rising health burden in LMICs is driven by rapid urbanisation and ‘westernisation’ of lifestyle, rapidly decreasing physical activity, changes in dietary habits and ageing of the population. For instance, diabetes, the vast majority of which is Type 2 diabetes, is estimated to affect globally over 8% of the adult population, with 80% of all cases in low- and middle-income countries (LMICs) (see e.g. Whiting et al., 2011). NCDs are associated with markedly increased mortality, particularly in younger and middle aged adults, and with health care costs that are on average 2 to 3 times higher than in age and sex matched individuals without NCDs. The prevention and management of NCDs present major challenges to health systems in LMICs, which are often already coping with the cost pressure from other diseases such as HIV/AIDS. Against this background, there is a strong business case for investing in health and wellbeing of employees.

1.2. Why should a business invest in health promotion and disease prevention?

The simple logic is that effective investment in health and wellbeing can save a company more in terms of health care spending, and lost productivity due to absenteeism and presenteeism. It is well documented that a large proportion of diseases and disorders are preventable. Modifiable health risk factors are precursors to a variety of diseases, disorders and premature death and are associated with increased health care costs (Goetzel et al, 2012). There is further evidence that modifiable health risks can be improved through workplace financed health promotion and disease prevention programs and that improvement in health risks of a company’s workforce can lead to reductions in health costs. A handful of case studies, notably in some large Anglo-Saxon employers highlight that preventive worksite health promotion and disease prevention programmes can save companies money and produce a positive return on investment (ROI). RAND Europe’s work for the Boorman Review on the health and wellbeing of National Health Service (NHS) staff gave a sense of the possible savings organisations might make by adopting more effective ways of managing health and wellbeing. That study estimated that bringing lost productivity in the NHS down to levels experienced by better public sector performers (essentially, by halving lost productivity) would save the NHS about £500m a year (Boorman, 2009).

However, corporate knowledge and measurement of the effectiveness of interventions and programmes – and of contextual factors which influence wellbeing – is still emerging. Our experience with organisations participating in the Britain’s Healthiest Workplace (BHW) competition shows that few companies measure returns on investment or understand the effectiveness of health interventions and services they offer. For instance, RAND Europe’s analysis showed that only a small number of companies measure some form of return of investment on their staff health and wellbeing investments. Of these, only a small minority

5 Whiting, D. R., Guariguata, L., Weil, C. and Shaw, J. (2011) ‘IDF Diabetes Atlas: Global estimates of the prevalence of diabetes for 2011 and 2030’. Diabetes Res Clin Pract 94, 311-321, 2011.10.029 (2011);
6 Goetzel, R.Z., Pei, X., Tabrizi, M.J., Henke, R.M., Kowlessar, N., Nelson, C.F., Metz, R.D., (2012) ‘Ten modifiable health risk factors are linked to more than one-fifth of employer-employee health care spending’, Health Aff. (Millwood) 31, 2474–2484.
7 Boorman, S., (2009) ‘NHS Health and Well-being: Final Report’.
measure the return in money terms, while the other companies use more ‘soft’ indicators to measure the return, e.g. in the form of higher staff engagement.

Knowing what is (cost-)effective for a given working population is important but may not be the only barrier stopping organisations from investing in staff health and wellbeing. There is a common perception that larger companies may find it easier to make such investments compared to smaller organisations, which form the majority of all organisations and employ majority of workers. However, a RAND Europe study looking at data across Europe suggests that in many countries small employers actually offer the same type of support as larger employers. Regulatory and national contexts tend to be more important than the size and resources of an employer, emphasising the importance of attitudes towards workplace health and wellbeing (van Stolk et al., 2012). 8

1.3. GSK’s Partnership for Prevention

GSK’s Partnership for Prevention aims to provide all GSK employees and their benefits-eligible dependants’ access to preventive healthcare services. One of the rationales behind Partnership for Prevention is that preventive healthcare is important for good health and well-being, especially in light of the global rise in non-communicable diseases (NCDs). Some GSK employees work in countries where publicly funded preventive healthcare may be unavailable or limited, and this is where Partnership for Prevention bridges the biggest gap. The idea behind the programme is that healthier and happier employees will have reduced health care costs, lower absenteeism and presenteeism rates and hence enables a better focus on the customers GSK serves.

Partnership for Prevention is one of the most comprehensive employer preventive healthcare programmes. The 40 healthcare services offered by the programme were selected according to the following criteria:

- They represent the World Health Organization (WHO) primary standards to prevent or detect diseases.
- These services will have the greatest positive impact on GSK employees and their families.
- They demonstrate commitment from Partnership for Prevention and GSK in supporting the health and wellbeing of employees and their families.
- These services will help foster a healthy and high-performing workforce, increase employee engagement, and attract and retain talent.
- They will help reduce the costs related to ill-health and absence.

According to discussions with members from the GSK Partnership for Prevention team and based on employee satisfaction surveys, the perception across the business is that Partnership for Prevention is relatively successful in providing employees in different countries with access to preventive healthcare services. Awareness, participation and satisfaction of the programme is high. However, no detailed ROI of the provision of these services has been calculated at this stage. As funding of preventive healthcare

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8 Stolk, C. van, Staetsky, L., Hassan, E., Kim, C.W., (2012) ‘Management of Psychosocial Risks at Work’. 
projects is subject to budget constraints, there is a strong need to justify the implementation for such projects from a business point of view.

1.4. Objectives of the study

The aims of this report are twofold. Firstly we provide an overview of general constraints and challenges in calculating the ROI of preventive healthcare interventions. Secondly, and building on the knowledge gathered, we then develop a framework to analyse the ROI of such projects, and to apply the analytical framework to GSK’s Partnership for Prevention programme. In essence, the following research questions are addressed:

1. What are the drivers of successful health prevention programmes?
2. What are typical challenges in calculating ROI in preventive healthcare projects? What has been done to address these challenges?
3. What is known about the effectiveness of preventive healthcare interventions included in GSK’s Partnership for Prevention programme? How can the information about the effectiveness of interventions be unified and incorporated into a framework for the development of an effective ROI tool?

1.5. Research approach

This study utilised a three-pronged approach consisting of 1) literature review; 2) data collection; 3) developing model framework and calibration. Each of these components is discussed in turn below.

1.5.1. Literature review

The research team undertook as the first step in the development of an ROI framework a review of existing literature. The purpose of this review was twofold. The first objective was to collect evidence on how return on investment of workplace health promotion programmes (HPP) has been calculated in previous studies to inform the conceptual design of our framework. The second aim of the literature review was to collect available evidence on health and labour force benefits that have been demonstrated to be associated with workplace HPPs to ensure that our ROI model captures relevant types of return and utilises best available parameters.

The literature review focused on available academic literature and followed a series of formalised steps, which included:

1. Definition of source databases;
2. Development and piloting of search terms;
3. Determination of final set of search terms;
4. Definition of inclusion and exclusion criteria;
5. Multi-stage (title, abstract, full-text) screening of identified literature with double-screening of a sample of records;
6. Extraction of information into a standardised data template.
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Further details of the literature review can be found in Appendix A.

1.5.2. Further data collection

To complement information collected through the literature review, the research team extracted various parameters, such as incidence and prevalence rates for relevant diseases, to inform the ROI model from relevant databases and professional databases (see Appendix C for the full list of the calibration parameters). These included:

1. Global Burden of Diseases, Injuries, and Risk Factors Study (GBD)9;
2. Centers for Disease Control and Prevention10;
3. UNICEF11;
4. WHO12;

1.5.3. Model development and calibration

Based on the collected information, the research team developed a complex methodological framework describing elementary connections between individual variables, creating a simplified economic model calculating the impacts of workplace healthcare interventions on employees’ health and thus, indirectly, on a company’s performance. Specifically, the model uses country, age, and gender specific inputs such as prevalence and mortality rates, and combines them with country-specific input parameters (e.g. default vaccination rate in the population) and user-defined input parameters (e.g. average wage, gender structure of the employees) to create a bespoke calculator estimating a conservative ROI in healthcare interventions. In the model, each intervention is treated separately according to its likely effects on employees’ health, and takes into account importance of various diseases in the local settings.

1.6. Structure of this report

Chapter 2 describes the drivers of successful workplace health prevention programmes.
Chapter 3 summarises the challenges in calculating ROI of health prevention and wellness programmes.
Chapter 4 reviews the evidence on the effectiveness of interventions offered by GSK’s Partnership for Prevention.
Chapter 5 describes the development of a framework to calculate the ROI of GSK’s Partnership for Prevention programme and provides a calculation using South Africa as a case study.
Finally, Chapter 6 concludes the work and provides discussion of the findings.

9 http://www.healthdata.org/gbd
10 http://www.cdc.gov/
11 http://data.unicef.org/
12 http://www.who.int/gho/database/en/
2. Drivers of a successful workplace health prevention programme

This chapter outlines briefly the drivers of a successful workplace health prevention programme based on the existing academic literature.

2.1. What determines good practice and successful workplace health promotion programmes?

In essence, the literature on health prevention and wellness programmes emphasises three major elements that are crucial for successful programme design (Goetzel et al., 2008):13

1. Services/interventions offered;
2. Promotion and incentives activities;
3. Leadership and organisational commitment.

In designing a health prevention or wellness programme, employers have a number of options for services to offer their employees. Firstly, it is important for employers to offer a programme consisting of interventions that match the employees’ needs and preferences, otherwise programmes may be met with resistance from employees and senior management. For instance, as Weiner et al. (2009) note, employees are more likely to participate when they perceive a match between their values and those of the “innovation” (in this case, the wellness program).14 Thus, when choosing the service and intervention offer it is important that employers consider the needs and interests of their employees.

Secondly, what complicates even when services and interventions do meet the needs of certain types of employees, they may be inadequate or unattractive to other employees. These differences can be reflected in participation rates, which tend not to be equal across job types and demographic groups. For instance, white-collar, higher-income employees might be more likely to participate than lower-income, blue-collar employees. Since employees’ risk of developing disease varies by socio-economic status and high-risk

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13 Goetzel, R., Roemer, E., Liss-Levinsohn, R. and Samoly, D. (2008) ‘Workplace Health Promotion: Policy Recommendations that encourage employers to support health improvement programmes for their workers’, Prevention Policy Paper commissioned by Partnership for Prevention.

14 Weiner BJ, Lewis M and, Linnan L (2009) ‘Using organization theory to understand the determinants of effective implementation of worksite health promotion programs’. Health Educ Res. 2009;24(2):292–305.
groups are often not the ones participating in prevention and wellness programmes (Serxner et al, 2004). Hence, the literature suggests that a variety of services is important for providing employees at all levels of risk and with a number of conditions to engage with the programme (Engbers et al, 2005).

Thirdly, even programmes with wide employee buy-in and extensive services offered can suffer from low participation. One important aspect to increase programme participation are promotion and incentives (Goetzel et al., 2008). In essence, promotion efforts such as health fairs and regular notifications of service availability are important elements of effective programmes (Goetzel et al., 2010). For instance, Goetzel et al. (2010) evaluated a cholesterol-reduction and obesity-prevention randomised worksites to one of three types of programmes, each with different levels of promotion. The lowest level involved sending occasional emails and relied on mostly employee self-assessment. The highest level reached out to leadership and regularly engaged employees. The result was significant reductions in BMI and cholesterol among the programmes with higher levels of engagement.

Finally, in addition to incentives and promotion, another key driver important is that leadership needs to be engaged to get the best returns from preventive health and wellness programmes (Goetzel et al, 2010). Having management involved and committed in health promotion efforts has been linked with increased impact in terms of self-reported health, absenteeism and engagement. Having leadership engaged in health promotion efforts is essential to bringing about change, suggested by Berry et al. (2011), which have the engagement of multiple levels of leadership as the first pillar of an effectiveness wellness program.

2.2. How does GSK’s Partnership for Prevention compares against good practices in health prevention programmes?

GSK’s Partnership for Prevention programme has selected 40 preventive healthcare services/interventions to offer to their employees on the basis that they demonstrate high value in preventing ill health or detecting disease and are aligned to the WHO’s recommendations. As such, they include a range of adult and child vaccines for preventable illnesses such as hepatitis and tuberculosis, prenatal healthcare for women, HIV and cancer screenings and tobacco cessation treatment. Many of these are extremely relevant to the GSK workforce in middle and low income countries.

The Partnership for Prevention programme is not duplicating existing healthcare coverage, either through current GSK health provision or existing government health programmes. Employees are provided with

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15 Serxner S, Anderson DR, Gold D. Building program participation: strategies for recruitment and retention in worksite health promotion programs. Am J Heal Promot. 2004;18(4):1–5.
16 Engbers LH, van Poppel MNM, Paw MJMCA, van Mechelen W. Worksite health promotion programs with environmental changes: a systematic review. Am J Prev Med. 2005;29(1):61–70.
17 Goetzel RZ, Roemer EC, Pei X, et al. Second-year results of an obesity prevention program at the Dow Chemical Company. J Occup Environ Med Coll Occup Environ Med. 2010;52(3):291.
18 Berry LL, Mirabito AM, Baun WB. What’s the hard return on employee wellness programs? Harv Bus Rev. 2011;89(3):20–1.
19 Based on information received from GSK.
additional services that complement, rather than duplicate preventive healthcare services already available to the employees by the national and local healthcare systems.

According to the GSK ‘combined satisfaction survey’ in some of GSK’s markets,20 over 80 per cent of respondents are aware of Partnership for Prevention and know what services are included. Over 80 per cent of respondents are also satisfied with the services and interventions provided by the programme. In addition, the majority of respondents agree that Partnership for Prevention is aligned with GSK’s wider mission.

The findings of the survey are very much in line with the characteristics of how the literature defines a ‘successful’ health prevention programme outlined in the previous section, including a high awareness and participation rate and commitment from the leadership.

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20 E.g. including the Middle East-Turkey and LatAM/CARICAM.
3. The challenges in measuring returns on investments for preventive healthcare programmes

This chapter outlines in more detail the challenges companies face in measuring returns on investment for their preventive healthcare systems and what approaches they take to calculate it.

Overall, the number of companies publicly highlighting that they measure systematically an ROI on their programmes is small. This is in line with findings from work RAND Europe is conducting within the Britain’s Healthiest Workplace (BHW) competition. In BHW, from 170 surveyed UK companies, only around 17 per cent measure their ROI on health and wellbeing initiatives and of those, only about 3 per cent measure ROI financially (in terms of £). The remainder of the companies measure the return in the form of reduced absenteeism rates. A survey by the International Foundation of Employee Benefit Plans (IFEBP) came to a similar finding, which highlighted that only about 28 percent of organisations on average measured the success of their wellness programs with traditional ROI.

A priori it is not clear why so few companies measure systematically the ROI on their workplace health and prevention programmes, since businesses should be familiar with the concept of calculating the success of their investments. The following section provides a short summary of the general challenges related to measuring ROI.

3.1. Challenges in measuring ROI of preventive healthcare programmes

3.1.1. Costs related to measuring ROI

Any calculation of ROI is dependent on having adequate data on a variety of different health and wellbeing parameters, including health risks, absent or sick days, presenteeism, biometric values, insurance claims, or measures of worker productivity and engagement (Cavallo, 2006). Analysing large data is associated with considerable time and budget requirements and companies often would need to seek extra help from specialist analytics companies to analyse the data. Often, companies do not make the extra

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21 Based on own calculations using BHW survey data from 2016.
22 IFEBP (2016): ‘A Closer Look: Workplace Wellness Outcomes’, available at https://www.ifebp.org/bookstore/workplace-wellness-outcomes/Pages/workplace-wellness-outcomes.aspx
23 Cavallo, D. (2006): ‘Using Return on Investment Analysis to Evaluate Health Promotion Programs: Challenges and Opportunities’, Health Promotion Economics, RTI-UNC Center of Excellence in Health Promotion Economics, Vol. 1, Issue 3, November 2006.
room in their budget to do the analytics. Some companies are also content with some observed measures such as reduced absenteeism rates, rather than calculating full financial returns.

3.1.2. Measuring adequately effectiveness of preventive healthcare programmes

Wellness programmes are targeted to improve the health and wellbeing of employees. They can create a variety of different outcomes that need to be measured in order to make an informed decision on whether the programme is effective. In essence, employees benefit from improved health, while employers benefit from fewer sick leave days and from enhanced employee productivity, but these metrics can be measured in many different ways. For instance, companies can look at measures such as weight loss, reduction of disease risk factors (e.g. smoking), total sick days, completed work, employee engagement, company profits or customer satisfaction. It is not always clear which measures a company should and can apply.

Nevertheless, even if a company can monitor all of the aforementioned factors, the identification of the actual cause of a potential improvement is difficult. Wellness programmes may be correlated with better well-being, productivity and company profits – but correlation and causation are different things. Many other factors outside the sphere of a company could lead to contemporaneous effects on productivity or profit increases. Examples of these external factors include industry demography shifts, business cycles or behavioural changes in the society with regard to health and wellbeing.24

3.1.3. Measurement issues

Often the benefits of a preventive healthcare programme accrue over a multiyear period and hence should include adjustments for both discounting (e.g. taking into account the current value of an amount of cash at a future point in time) and inflation (Ozminkowski & Goetzel, 2001).25 For some interventions, the potential positive results take longer than others to occur. For instance, while 20 minutes of physical activity every day may give employees an immediate push in productivity, other interventions such as improving the immune system or smoking cessation could take many years to generate benefits. In addition, many benefits and costs are not straightforward to quantify and convert into dollar terms (e.g. staff engagement, lives saved or improved quality of life).

Furthermore, preventive healthcare programmes consist in general of a variety of different initiatives and treatments, so identifying which of these caused the overall positive outcomes of a programme is often a challenge (see also chapter 4 for more details on the challenges determining the effectiveness of specific interventions). It is highlighted that only a well-defined and wellbeing programme tailored for needs of the specific population can reap big enough benefits to deliver a return on the cost of the investment made by the company (Mattke et al, 2013).26

24 E.g. a shift towards an acceptance that certain foods such as sugar or transfats are not healthy eating options.
25 Ozminkowski, R., and Goetzel, R. (2001) ‘Getting Closer to the Truth: Overcoming Research Challenges When Estimating the Financial Impact of Worksite Health Promotion Programs’, American Journal of Health Promotion, 2001;15(5):289-295.
26 Mattke, S., Hangsheng, L., Caloyeras, J. P. et al. (2013) Workplace Wellness Programs Study: Final Report. Santa Monica, CA: RAND Corporation. RR-254-DOL.
4. Evidence on the effectiveness of workplace health prevention programmes and interventions

This chapter summarises the existing evidence about the effectiveness of workplace health prevention and wellbeing programmes and describes the evidence collated for GSK’s Partnership for Prevention programme.

4.1. Evidence on the impact of workplace health prevention programmes

According to the reviewed literature, workplace health prevention programmes (HPPs) can have a positive impact on participants and their health, although there are important qualifications to the evidence presented, as discussed in the next section. Health outcomes reported in reviewed literature ranged from improvements in health behaviours, reductions in health risks and decreased incidence of adverse health events.

To illustrate this using a set of identified review articles, Osilla et al. (2012) reviewed 33 studies evaluating a range of 63 outcomes with the aim to analyse the impact of worksite wellness programmes on health and financial outcomes. Thirteen of the reviewed studies examined the effects on physical activity; of these, eight studies found improvements such as participants being more likely to exercise and increasing their weekly walking. Twelve studies evaluated diet-related outcomes; of these, six observed improvements such as higher fruit and vegetable consumption. The authors noted the same picture with respect to physiological markers such as BMI – of twelve studies that evaluated this type of outcome six found an improvement. Seven studies examined smoking-related outcomes, of which six reported positive effects. Three studies looked at alcohol-related outcomes, of which two reported reductions in alcohol use.

Postma et al. (2002) reviewed studies examining the effects of vaccinating healthy working adults to avert absenteeism and related production losses. Of 11 included studies, eight studies found a positive benefit-cost ratio, although after indirect costs and benefits in production gains or losses were excluded, this remained the case for only one reviewed study.

27 Osilla, K. C., Van Busum, K., Schnyer, C. et al. (2012). Systematic Review of the Impact of Worksite Wellness Programs. Am J Manag Care. 2012;18(2):e68-e81.

28 Postma, M. J., van Genugten, M. L., Heijnen, M. L. et al. (2002) Pharmacoeconomics of influenza vaccination for healthy working adults: reviewing the available evidence. Drugs 62(7):1013-24.
Cobiac (2010)\textsuperscript{29} reviewed seven studies examining programmes promoting fruit and vegetable consumption. All the included studies reported improvements in diet and in the mean number of DALYs averted.

Cahill and Lancaster (2014)\textsuperscript{30} reviewed 57 studies on workspace interventions for smoking cessations. The author’s meta-analysis found that some interventions targeting individual smokers led to increased odds of quitting smoking, although the strength of the effect varied by intervention type. Similarly, Leeks (2010) on the basis of ten reviewed studies concluded that incentives and competitions implemented at the workplace alongside additional interventions have a positive effect on tobacco quit rates.

Rongen (2013)\textsuperscript{31} conducted a meta-analysis of 18 randomized trials (covering 21 interventions) evaluating the effect of workplace HPPs aimed at a variety of areas, including smoking cessation, physical activity, healthy nutrition, work absence and work productivity. The author found a significant positive effect when results of the included studies were both pooled and stratified by outcome.

Janer (2002)\textsuperscript{32} reviewed 45 trials of HPPs focusing on major risk factors for cancer. The included studies were selected for their quality design and the author concluded that the overall evidence suggested a “modest but positive” effect.

Finally, Mattke et al. (2013)\textsuperscript{33} concluded in their study incorporating a literature review, a survey of employers, a series of case studies and an analysis of secondary data from wellness programmes:

“… lifestyle management interventions as part of workplace wellness programs can reduce risk factors, such as smoking, and increase healthy behaviors, such as exercise. We find that these effects are sustainable over time and clinically meaningful. This result is of critical importance, as it confirms that workplace wellness programs can help contain the current epidemic of lifestyle-related diseases.” (p.xxv)

Further evidence on the effectiveness of workplace HPPs is available from additional reviews and individual studies identified through the literature review. However, the scope of this report does not allow for a more detailed discussion.

\textsuperscript{29} Cobiac, Linda J., Vos, Theo, & Veerman, J. Lennert. (2010). Cost-effectiveness of interventions to promote fruit and vegetable consumption. Plos One, 5(11), e14148-e14148.

\textsuperscript{30} Cahill, K. and Lancaster, T. (2014) Workplace interventions for smoking cessation. Cochrane Database Syst Rev. Feb 26;(2):CD003440.

\textsuperscript{31} Rongen, A., Robroek, S.J.W., van Lenthe, F.J. et al. (2013). Workplace health promotion: A meta-analysis of effectiveness. American Journal of Preventive Medicine, 44(4), 406-415.

\textsuperscript{32} Janer, G., Sala, M. and Kogevinas, M. (2002). Health promotion traits at worksites and risk factors for cancer. Scandinavian Journal of Work, Environment & Health, 28(3), 141-157

\textsuperscript{33} Mattke, S., Hangsheng, L., Caloyeras, J. P. et al. (2013) Workplace Wellness Programs Study: Final Report. Santa Monica, CA: RAND Corporation. RR-254-DOL.
4.2. Applicability of the evidence to GSK’s Partnership for Prevention

Evidence collected through the literature review were categorised by the eight intervention areas covered by the GSK programme. Below follows a brief discussion of findings from selected studies in each of the intervention areas. For interventions where there were review papers available, these are prioritised in the discussion below. Please note that the discussion below does not attempt to provide an exhaustive account of all existing evidence. The literature review and its search terms were primarily designed to capture studies that calculate or at least comment on the programmes’ return on investment, which may have left out papers focusing on other aspects of workplace health promotion programmes. A more detailed narrative of how this information was operationalised in the design of the ROI analytical framework is presented in Chapter 5. Appendix B provides a detailed summary overview of all relevant studies in each intervention area.

4.2.1. Vaccination

Olsen et al. (1998) examined the effects of a free workplace immunisation programme in Minnesota. They compared the number of sick leave hours taken by two groups of programme participants – those who reported having been vaccinated prior to the previous year’s influenza season and those who reported they had not been vaccinated in the previous year. The authors found that employees who had not been immunised in the previous year took 1.2 fewer hours of sick leave when participating in the programme than during a comparable period of time one year earlier. In particular, female employees with one or more children took 3.1 fewer hours of sick leave after the participation in the program. Employees who were vaccinated in both consecutive years took 0.7 hours more sick leave the second year. Based on these findings, the authors concluded that “consideration should be given to workplace immunization programs” although they cautioned against a ‘one-size-fit-all’ approach. Bourgeois et al. (2008) examined an employee-based programme in northeast USA on the use of personally controlled health records to improve knowledge, beliefs, and behaviour surrounding influenza prevention. As part of the programme, randomly-assigned intervention group participants received targeted health messages on influenza illness and prevention. Compared with the control group, participants in the intervention group were more likely to believe that the influenza vaccine was effective, that there were actions they could take to prevent the flu, and that the influenza vaccine was unlikely to cause a severe reaction. However, there was no difference in immunisation rates between the two groups. Cook (2014) analysed the results of a free immunisation workplace programme in restaurants in the Seattle metropolitan area by conducting a regression analysis with employee level data. She found that there was an association between the intervention and the likelihood that an employee would be vaccinated.

54 Olsen, G.W., Burris, J.M., Burlew, M.M. et al. (1998). Absenteeism among employees who participated in a workplace influenza immunization program. Journal Of Occupational And Environmental Medicine / American College Of Occupational And Environmental Medicine, 40(4), 311-316.
55 Bourgeois, F. T., Simons, W. W., Olson, K> et al. (2008). Evaluation of influenza prevention in the workplace using a personally controlled health record: randomized controlled trial. Journal Of Medical Internet Research, 10(1), e5-e5.
56 Cook, M. A. (2014). Workplace-based vaccination promotion: An examination of employers’ views and practices and an evaluation of a pilot intervention. (74), ProQuest Information & Learning, US.
4.2.2. Cancer screening

Ma et al. (2012)\(^{37}\) evaluated the effectiveness of a workplace–based cancer awareness and screening assistance intervention programme in eight worksites in Nanjing, China. Employees in worksites in the intervention group attended group education and role play discussion sessions on breast cancer, its risks and benefits of early detection. They all received educational handouts and mammography navigation assistance, which included financial support from the employer, help with appointment arrangements, transportation to appointments and release time for mammograms. The control group participants received general cancer education. The authors found that exposure to the intervention resulted in substantial increases in the uptake of mammography. This difference between the two groups was significant even when adjusting for education levels. Campbell et al. (2002)\(^ {38}\) analysed the effects of a health-promotion program for female blue-collar workers in North Carolina. The programme offered individualised computer-tailored health messages and made available a lay health advisor at the workplace. The study randomly assigned workplaces to either the intervention condition or to delayed intervention. Rate of cancer screening were one of the outcomes of interest, along with BMI, diet indicators, physical activity, and smoking status. While the authors found positive effects in the majority of outcomes, they did not find any difference in cancer screening rates between the two groups. Tilley et al. (1999)\(^ {39}\) assessed the impact of a colorectal cancer screening programme in the USA and examined whether its effectiveness can be enhanced by a personally tailored behavioural intervention. Participating worksites were randomised to a control group, which received the screening programme as usual, and an intervention group, where participants underwent an enhanced version consisting of the standard programme and an educational booklet/telephone call. The authors assessed participants’ compliance (i.e. rates of completion) of all prescribed examinations and the programme’s coverage (i.e. completion of at least one examination). They found that compliance and coverage were higher in intervention worksites compared to their control counterparts.

4.2.3. Smoking

Cahill and Lancaster (2014)\(^ {40}\) conducted a metaanalysis of studies assessing the effectiveness of workplace health promotion programmes focusing on smoking cessation. The study found that the programmes’ effectiveness varied depending on their design. Individual counselling (based on eight trials) and pharmacotherapies (based on five trials) were found to be the most effective, followed by group therapy programmes (based on eight trials) and multiple intervention programmes aimed solely or mainly on smoking cessation (based on six trials). Self-help materials were considered comparatively less effective.

\(^{37}\) Ma, G. X., Yin, L., Gao, W. et al. (2012). Workplace-based breast cancer screening intervention in china. Cancer Epidemiology, Biomarkers & Prevention: A Publication Of The American Association For Cancer Research, Cosponsored By The American Society Of Preventive Oncology, 21(2), 358-367.

\(^{38}\) Campbell, M. K., Tessaro, I., DeVellis, B. et al. (2002). Effects of a Tailored Health Promotion Program for Female Blue-Collar Workers: Health Works for Women. Preventive Medicine, 34(3), 313.

\(^{39}\) Tilley, B. C., Vernon, S. W., Myers, R. et al. (1999). The Next Step Trial: impact of a worksite colorectal cancer screening promotion program. Preventive Medicine, 28(3), 276-283.

\(^{40}\) Cahill, K. and Lancaster, T. (2014) Workplace interventions for smoking cessation. Cochrane Database Syst Rev. Feb 26(2):CD003440.
(based on six trials) while two relapse prevention programmes included in the study did not help sustain long-term smoking cessation. A systematic review of 33 studies on workplace programmes by Osilla et al. (2012)\textsuperscript{41} included seven studies examining smoking outcomes. Six of the seven studies found positive effects (either higher quit rates or less tobacco use). Of these six studies, four were RCTs and two were observational studies. Janer et al. (2002)\textsuperscript{42} reviewed 45 trials explicitly selected for their quality research designs. Of these, 27 studies focused on tobacco control, either as an exclusive goal or as part of wider workspace interventions. Sixteen studies explicitly reported on smoking cessation outcomes and all of them found positive effects in the form of higher quit rates. This positive effect was statistically significant in nine of the thirteen studies that reported statistical significance.

### 4.2.4. Cardiovascular disease/diabetes

Studies included in a systematic review by Osilla et al. (2012)\textsuperscript{43} reported on a range of outcomes relevant to cardiovascular disease (CVD) and diabetes. Eight studies (three RCTs, four observational studies and one study with a non-random control group) reported improvements in physical activity while four RCTs and one study utilising a non-random comparison group found no beneficial effect. Twelve studies included in the review examined diet outcomes. Of these, six (three RCTs, two observational studies, and one study with a non-random comparison group) found positive effects while six did not (four RCTs, one observational study and one study with a non-random comparison group). Twelve studies also assessed changes in physiological markers (e.g. weight, BMI, waist circumference). Again, half of these found beneficial effects (three RCTs, two observational studies and one study with a non-random comparison group), while the other half did not (three RCTs and three observational studies). A review by Rongen et al. (2015)\textsuperscript{44} included 18 studies covering 21 interventions, which were mostly targeting the areas of physical activity, lifestyle, data and weight. The outcomes of interest were self-perceived health, sickness absences, productivity and work ability. The pooled effect of all the reviewed programmes was significant and positive and remained positive even when only good quality studies were included. The authors also commented on what programme features were associated with greater effectiveness and noted that programmes were more effective with at least weekly contacts, while interventions incorporating counselling or provision of personal advice were less effective. The programmes’ effect was not influenced by the presence or absence of an exercise or educational components.

\textsuperscript{41} Osilla, K. C., Van Busum, K., Schnyer, C. et al. (2012). Systematic Review of the Impact of Worksite Wellness Programs. Am J Manag Care. 2012;18(2):e68-e81

\textsuperscript{42} Janer, G., Sala, M. and Kogevinas, M. (2002). Health promotion traits at worksites and risk factors for cancer. Scandinavian Journal of Work, Environment & Health, 28(3), 141-157.

\textsuperscript{43} Osilla, K. C., Van Busum, K., Schnyer, C. et al. (2012). Systematic Review of the Impact of Worksite Wellness Programs. Am J Manag Care. 2012;18(2):e68-e81

\textsuperscript{44} Rongen, A., Robroek, S. J. W., van Lenthe, F. J. et al. (2013). Workplace health promotion: A meta-analysis of effectiveness. American Journal of Preventive Medicine, 44(4), 406-415.
4.2.5. HIV/AIDS

Van der Borght et al. (2009)\textsuperscript{45} examined the effectiveness of a multi-country HIV workplace programme in sub-Saharan Africa. As part of the programme, employees and their families were eligible for free healthcare at company clinics or private facilities contracted by the company. The authors assessed mortality rates and incidence of AIDS and performed two main analysis. The first analysis covered all adult HIV-1 patients who were not yet eligible for HAART and the other two analysis, one on patients who have already started HAART. The study found that the mortality rate for patients not yet eligible for HAART was low and the survival of patients after four years of treatment was high, estimated at 89%. The authors concluded that the HIV workplace programme was effective and achieved long-term high survival. In addition, the authors outlined three parameters crucial for the success of HIV workplace treatment – 1) proportion of eligible individuals tested for HIV, 2) proportion of eligible patients able to start HAART before becoming critically ill, and 3) durability of successful treatment, likely linked to good adherence. The examined programme was found to fare well on all three parameters, achieving particularly high values on the latter two. Fielding et al. (2008)\textsuperscript{46} undertook an observational cohort study of a workplace-based HIV care programme in South Africa, primarily for workers in the mining sector. The programme included provision of counselling, antiretroviral therapy and guidelines, clinical and laboratory monitoring and opportunistic infection prophylaxis. The authors found that virological response at 6 weeks was the strongest predictor of negative outcomes at 12 months, which may be used to identify individuals in need of additional support. They also noted strong variation in outcomes across individual sites and recommended further examination of health system-level factors that may affect the delivery of these types of programmes. Similarly, Charalambous et al. (2007)\textsuperscript{47} undertook a cohort analysis of a workplace HIV treatment programme in South Africa. As outcomes of interest, the authors examined participants’ CD4 count, viral load, mortality and weight. The study concluded that the programme achieved virological outcomes comparable to those reported by programmes in high-income countries, although more needed to be done to improve retention. With respect to implementation, the authors noted that challenges faced by the programme were similar to those associated with implementing a public-sector programme.

4.2.6. Preventive health examination

The literature review did not yield any studies on workplace health promotion programmes offering general preventive health examinations. In their absence, insights were drawn from studies assessing the effectiveness of general checks in medical contexts. A Cochrane systematic review and metaanalysis by

\textsuperscript{45} Van der Borgh, S. F., Clevenbergh, P., Rijckborst, H. et al. (2009). Mortality and morbidity among HIV type-1-infected patients during the first 5 years of a multicountry HIV workplace programme in Africa. Antiviral Therapy, 14(1), 63-74.

\textsuperscript{46} Fielding, K. L., Charalambous, S., Stenson, A. L. et al. (2008). Risk factors for poor virological outcome at 12 months in a workplace-based antiretroviral therapy programme in South Africa: a cohort study. BMC Infectious Diseases, 8, 93-93.

\textsuperscript{47} Charalambous, S., Innes, C., Muirhead, D. et al. (2007). Evaluation of a workplace HIV treatment programme in South Africa. AIDS, 21(Suppl 3), S73-S78.
Krogsboll et al. (2012) identified 16 randomised trials on the effectiveness of general preventative exams, of which 14 had available outcome data (covering a total of 182,880 participants). Nine included studies reported on total mortality, eight on cardiovascular mortality and eight on cancer mortality. The authors did not find any evidence of reductions in morbidity and mortality, neither overall nor when examining specific cardiovascular or cancer causes. Different results were reported in a systematic review and meta-analysis by Si et al. (2014). The study focused on general practice-based health checks and their effects on both surrogate and final outcomes. The authors identified six randomised trials and concluded that health checks were associated with small but significant improvements in surrogate outcomes. The trials included in the review did not allow for an assessment of mortality.

4.2.7. Prenatal care

The literature review did not yield any studies on workplace health promotion programmes offering prenatal care. In their absence, insights were drawn from studies on prenatal care in medical settings, in particular in relation to the prevention of pre-eclampsia. To illustrate, evidence on various types of intervention are summarised in WHO (2011) and von Dadelszen and Magee (2014). Among older sources, a Cochrane review by Knight et al. (2000) identified 32 trials with nearly 30,000 women on the use of antiplatelet agents. The evidence from these trials suggested that there was a 15% reduction in the risk of developing pre-eclampsia associated with this intervention.

4.2.8. Limitations to the applicability of collected data

The collected data on the effectiveness of interventions is comprehensive and applicable to a broader context, however, some limitations of the applicability of data collected through the literature review need to be acknowledged upfront, particularly when considering the context and content of GSK’s Partnership for Prevention programme:

1. The preponderance of collected evidence is available from high-income countries, which may seriously impact the relevance of the collected data for a range of reasons. For instance, there may be substantial differences in health care provision between high-income countries and LMICs. This may mean the options available to individuals outside of HPPs may vary substantially. Specifically in relation to the suitability of evidence available from the US, the relatively large role of employers in their employees’ health (most notably through the provision of health care insurance) may not be replicated in other contexts.

48 Krogsbøll, L. T., Jørgensen, K. J., Grønhøj Larsen, C. et al. (2012). General health checks in adults for reducing morbidity and mortality from disease. The Cochrane Library.

49 Si, S., Moss, J. R., Sullivan, T. R. et al. (2014) Effectiveness of general practice-based health checks: a systematic review and meta-analysis. Br J Gen Pract 2014; DOI: 10.3399/bjgp14X676456

50 WHO (2011) WHO recommendations for Prevention and treatment of pre-eclampsia and eclampsia. Geneva: World Health Organization.

51 Von Dadelszen, P. and Magee, L.A. (2014) Pre-eclampsia: An Update. Curr Hypertens Rep 16:454

52 Knight, M., Duley, K.M., Henderson-Smart, D.J. et al. (2000) Antiplatelet agents for preventing and treating pre-eclampsia. Cochrane Database of Systematic Reviews, Issue 2.
2. There appears to be an uneven volume of evidence available for the eight intervention areas covered by existing literature. While programmes targeting lifestyle-related diseases seem to be predominantly the subject of existing evaluations and reviews, evidence on programmes targeting other areas such as communicable diseases appears to be thinner.

3. While the overall balance of evidence tends to point in the direction of positive effects of workplace HPPs, there is substantial variation in the observed effect sizes across reviewed studies. Furthermore, in some instances, this variation may be a reflection of the methodological design of individual studies. For instance, in the review by Osilla et al. (2012), all studies utilising observational designs reported positive physical activity outcomes but only three out of seven included RCTs did.

4. In some instances, reviewed studies did not or could not isolate the effects of workplace interventions. This was a possibility in review articles which brought together HPPs from a variety of settings or in studies that examined multicomponent HPPs. To some extent, this uncertainty is related to the first limitation presented above, i.e. the possible role of alternative (or non-work-related) healthcare interventions.

5. Interventions and HPPs covered by the reviewed studies are delivered in a variety of ways and available evidence suggests that the design and execution of HPPs may affect their effectiveness. To illustrate, Rongen (2013) in his review noted that workplaces with the presence of at least weekly contact with participants were more effective. Similarly, Mattke et al. (2013) identified five facilitators of successful programmes, which included a) effective communication strategies, b) opportunity for employees to engage, c) leadership engagement, d) use of existing resources and relationships, and e) continuous evaluation. Still, the authors noted that more research is needed on which programme design features are most likely to yield positive results.

6. Ultimately, the way to overcome the limitations presented above is through monitoring and data collection on the ground by GSK to decrease the reliance on parameters transferred from other contexts.

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53 Osilla, K. C., Van Busum, K., Schnyer, C. et al. (2012). Systematic Review of the Impact of Worksite Wellness Programs. Am J Manag Care. 2012;18(2):e68-e81

54 Rongen, A., Robroek, S.J.W., van Lenthe, F.J. et al. (2013). Workplace health promotion: A meta-analysis of effectiveness. American Journal of Preventive Medicine, 44(4), 406-415.

55 Mattke, S., Hangsheng, L., Caloyeras, J. P. et al. (2013) Workplace Wellness Programs Study: Final Report. Santa Monica, CA: RAND Corporation. RR-254-DOL.
5. A framework to calculate the ROI of preventive healthcare programmes

This chapter develops a framework for the calculation of ROI of preventive healthcare programmes in workplace settings, specifically tailored to the interventions offered by GSK. It draws on information collected from the academic and wider literature, data from international health databases and data provided by GSK directly.

In this chapter we first briefly summarise the best practices in impact evaluation of healthcare interventions, outlining the possible options and drawing attention to their advantages and drawbacks, and then follow up with a description of our unique methodological framework and its implementation in calculating the ROI for the currently active interventions offered by GSK. Even though the general modelling framework can be used across all countries, we describe some of its specifics using South Africa as a case study.

5.1. Different ways for impact evaluation of healthcare interventions

As discussed e.g. in Baxter et al. (2014),56 Grossmeier et al. (2010),57 or Goetzel et al. (2014)58 measuring impacts and the ROI from a workplace healthcare or wellness interventions is complicated due to the implicit lack of a counterfactual. Indeed, the generic question: “What would have happened in the absence of this intervention?” is particularly difficult to answer due to a multitude of related factors. For instance, in the absence of a vaccination intervention, would the employees seek analogous treatment from other sources? If yes, would it be as effective? Would an alternative be available and accessible?

In the literature, such a “do nothing” scenario is often established using an experimental study design with a treatment and a comparison group. In an ideal world, for each subject in the treatment group, i.e. each person participating in the offered intervention, a similar subject (in terms of gender, age, health

56 Baxter, S., Sanderson, K., Venn, A. J., Blizzard, C. L., & Palmer, A. J. (2014). The relationship between return on investment and quality of study methodology in workplace health promotion programs. American Journal of Health Promotion, 28(6), 347-363.
57 Grossmeier, J., Terry, P. E., Cipriotti, A., & Burtaine, J. E. (2010). Best practices in evaluating worksite health promotion programs. American Journal of Health Promotion, 24(3), TAHP-1, Chicago
58 Goetzel, R. Z., Tabrizi, M., Henke, R. M., Benevent, R., Brockbank, C. V. S., Stinson, K., ... & Newman, L. S. (2014). Estimating the return on investment from a health risk management program offered to small Colorado-based employers. Journal of occupational and environmental medicine/American College of Occupational and Environmental Medicine, 56(5), 554.
condition etc.) is found in the relevant population, against whom the study outcomes are subsequently compared. However, just the fact that some workers choose to participate and others do not creates a so-called selection bias, suggesting that the intent to participate may be correlated with other confounding factors such as healthy lifestyle. In other words, intervention participants may be less likely to be at risk of having health issues than their comparison group counterparts even without actually participating in the intervention – comparison of the intervention effects is thus likely to be misleading as it assumes the compared subjects to be identical by default.

Given the aforementioned issues, randomised controlled trials (RCTs) are considered the best practice in the field. RCT in this setting would start with a pool of employees randomly selected into a treatment and a comparison group, where the treatment group would be offered the opportunity to join a workplace health promotion programme and the other half not. Subsequently, individual factors such as motivation to improve one’s health, demographic variables, or prior health and healthcare utilisation patterns would be randomly distributed in each group. This way, in principle, there would be as many employees willing to participate in both groups and the difference in healthcare costs (or any other variable of interest) between the groups can be directly interpreted as the effect of the intervention. The RCT design is used e.g. in Robroek et al. (2007). 59

However, conducting an RCT in company settings is often extremely difficult due to ethical considerations, insufficient number of employees, inability to restrict an employee subgroup from access to intervention, or simply the lack of upfront determined evaluation methodology. Therefore, alternative quasi-experimental study designs with non-randomly selected comparison groups are often used. For instance, Dement et al. (2015) 60 evaluated the impacts of a long-standing workplace health promotion programme on healthcare utilisation and costs using a retrospective, observational cohort design. To minimise the selection bias, propensity score matching is used to determine the probability of each observed employee, both in the treatment and comparison group, to participate in the offered interventions using several relevant personal characteristics. Each participant is then matched, where possible, based on their propensity score with an equivalent counterpart(s) from the comparison group.

Importantly, all the described study designs look to assess outcomes realised in the past. By contrast, predictive studies, often involving some form of simulation techniques, aim to determine the likely outcome of an intervention based on certain relationships and parameters observed in the past. For example Baxter et al. (2015) 61 developed a workplace health savings calculator, essentially estimating savings made through reductions in sick leave absence and staff turnover resulting from the

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59 Robroek, S. J., Bredt, F. J., & Burdorf, A. (2007). The (cost-) effectiveness of an individually tailored long-term worksite health promotion programme on physical activity and nutrition: design of a pragmatic cluster randomised controlled trial. BMC public health, 7(1), 1.

60 Dement, J. M., Epling, C., Joyner, J., & Cavanaugh, K. (2015). Impacts of workplace health promotion and wellness programs on health care utilization and costs: results from an academic workplace. Journal of Occupational and Environmental Medicine, 57(11), 1159-1169.

61 Baxter, S., Campbell, S., Sanderson, K., Cazaly, C., Venn, A., Owen, C., & Palmer, A. J. (2015). Development of the Workplace Health Savings Calculator: a practical tool to measure economic impact from reduced absenteeism and staff turnover in workplace health promotion. BMC research notes, 8(1), 1.
implementation of a workplace health and wellbeing programme. In order to do so, they surveyed existing
literature to locate appropriate effectiveness measures and reviewed employer-facilitated programmes
aimed at improving the health and wellbeing of employees. This enabled the authors to produce change
estimates surrounding these measures by using the identified parameters in an economic modelling
framework. Similarly, Warner et al. (1996) 62 examined the health and economic implications of a
workplace smoking-cessation programme by using a stochastic, discrete-event, object-oriented simulation
model based on real-world parameters obtained from the literature.

Even though predictive studies implicitly eliminate selection and similar biases by simulating both the
‘reality’ and the corresponding counterfactual, 63 their inherent uncertainty combined with substantial
theoretical preparations and reliable data sources requirements often make them infeasible for evaluation
of workplace health interventions. Indeed, unlike equivalent experimental studies, predictive studies
require a modelling framework determining essentially every single relation between variables, such as the
effect of smoking on absence rates, which can often be very complex. 64 This is in contrast with
comparative analytical studies that are primarily aimed at observing the outcomes, often assuming that the
channel of effects is a ‘black box’. This issue was partially discussed in the previous section; the complexity
of offered programmes and observation of outcomes in real world settings makes it very difficult to isolate
particular causal effects and it is thus often unclear (e.g. what is the causal effect of dietary counselling
when combined with physical activity intervention on reduction in BMI). Finally, since the calibration
parameters for predictive studies are principally obtained from empirical literature, any flaws in the study
design can be indirectly reflected in the results of the simulation study as well.

While RCT’s are generally considered the gold standard for comparative analytical studies, the remaining
characteristics need to be tailored to the objectives and context of the study. For instance, the focus of
Herman et al. (2014), 65 a study on the cost-effectiveness of a worksite-based individualised lifestyle
counselling and nutritional medicine on primary prevention of cardiovascular disease (CVD), was
primarily on the net decrease of 10-year CVD event risk, together with net annual savings in terms of
societal and employer costs. Hence, they collected biometric and self-report data such as total cholesterol
levels, smoking status, or presenteeism rate, and combined them with the medical claims and sick leave

62 Warner, K. E., Smith, R. J., Smith, D. G., & Fries, B. E. (1996). Health and economic implications of a work-site smoking-
cessation program: a simulation analysis. Journal of Occupational and Environmental Medicine, 38(10), 981-992.
63 This is done by simulating two alternative scenarios – with and without the intervention – in the same settings, i.e. with the
same employee base, choice of parameters, or even a set of random events. We can thus directly observe the change in outcomes
for two identical individuals – a perfect counterfactual with no biases.
64 Using the effect of smoking on absence rates as an example, a brief selection of the relevant paths would include various
smoking-related illnesses, potentially higher propensity to be screened against some of them, working time spent smoking, etc. In
addition, there are often multiple alternatives to workplace healthcare programmes available to employees, such as those offered
by insurance companies. All nuances, such as the relative effectiveness of the programme compared to the workplace intervention,
its cost, or likelihood of employee participation, need to be precisely modelled in order for the simulation to capture all relevant
differences between the scenarios.
65 Herman, P. M., Szczurko, O., Cooley, K., & Seely, D. (2014). A naturopathic approach to the prevention of cardiovascular
disease: cost-effectiveness analysis of a pragmatic multi-worksite randomized clinical trial. Journal of Occupational and
Environmental Medicine, 56(2), 171-176.
records. Another study, Bridges et al. (2000),66 aimed to evaluate the effectiveness and cost-benefit of influenza vaccine in preventing influenza-like illness, looking at associated physician visits and work absenteeism reported in biweekly questionnaires. Notwithstanding that, Grossmeier et al. (2010)67 list the most common measures of success for worksite health promotion programmes: biometric health and clinical impacts, engagement metrics, satisfaction metrics, health behaviour change, population-level risk reduction, productivity impacts, healthcare cost impacts, and return on investment.

5.2. Methodological framework to calculate the ROI of preventive health programmes

Due to the general purpose of the study – to provide evidence on the potential benefits of having workplace healthcare interventions in place – and the lack of comprehensive data on employees and their health status, particularly as a result of participation in the interventions, conducting a retrospective comparative study is infeasible. Therefore, we propose a predictive methodological framework based on identifying essential factors impacting the ROI, examining their relationships, and combining parameter estimates obtained from the existing literature with GSK-specific variables to calculate the predicted annual return on investment into the programmes. This complex economic model is implemented in an Excel spreadsheet tool to provide numerical results.

According to the provided information, GSK currently offers interventions in eight broad categories that are discussed in detail below. Given the inherent differences in the interventions and their impacts on employee health and firm’s performance across the categories, each of the categories requires an individual approach; however, the interventions within a single category are broadly similar, especially in terms of the assumed paths of effect, and often require only change of input data rather than different methodology.68 Moreover, adult and childhood immunisation, as well as smoking and non-communicable diseases are very similar in the key characteristics and are therefore approached similarly from the methodological perspective.

Throughout the systematic literature review, we have identified a broad range of relevant factors playing a role in the developed framework. Those are depicted in Figure 1. In the top-left corner, country and employee characteristics are principal determinants of the relevant diseases and risk factors. For instance, cervical cancer is relevant only for women, cardiovascular disease is a greater threat for older people, and HIV has higher prevalence rates in Africa than in Europe. In the top-right corner, there are factors aiming to mitigate against these risks; however, workplace interventions will only provide assumed benefits if the employees are made aware of them and participate in them. In return, not only will they receive

66 Bridges, C. B., Thompson, W. W., Meltzer, M. I., Reeve, G. R., Talamonti, W. J., Cox, N. J., ... & Fukuda, K. (2000). Effectiveness and cost-benefit of influenza vaccination of healthy working adults: a randomized controlled trial. Jama, 284(13), 1655-1663.
67 Grossmeier, J., Terry, P. E., Cipriotti, A., & Burtnae, J. E. (2010). Best practices in evaluating worksite health promotion programs. American Journal of Health Promotion, 24(3), TAHP-1. Chicago
68 This is particularly true for vaccination interventions, all of which are approached in the same way in terms of RoI calculation with only vaccine and illness related parameters changing.
appropriate treatment and thus reduce risk exposure, they are also likely to improve their mental wellbeing and show higher engagement at the workplace.

**Figure 1: Generalized framework for ROI assessment of workplace healthcare interventions**

These five categories then jointly determine costs and benefits determining the resulting ROI. Specifically, we assume direct and indirect benefits for the firm, as well as direct, indirect, and overhead costs. For each intervention category we thus determine the subset of applicable risks, their relevance for the particular country-age-gender population subgroup, assess the effects of interventions on risk reduction and analyse participation, in order to eventually compile a list of all measurable outcomes of interest. Subsequently, all variables in the framework are calibrated using real-world data, relevant proxies or expert assumptions.

Based on the discussion from the previous section, we can reduce the list of relevant outcomes particularly to productivity impacts and healthcare costs impacts, which are combined into ROI measure using some variation of the general formula used e.g. in Trogdon et al. (2009):^69^

$$ROI = \frac{Benefits - Costs}{Costs},$$

where Costs are both direct and indirect monetary costs of the intervention such as cost of vaccine, the administration process, intervention promotion, etc., and Benefits are both costs that would occur in the absence of the intervention (e.g. medical costs saved by immunising people) and (in)direct positive impacts on workers and the firm (e.g. productivity improvements as a result of weight loss.

^69^ Trogdon, J., Finkelstein, E. A., Reyes, M., & Dietz, W. H. (2009). A return-on-investment simulation model of workplace obesity interventions. Journal of Occupational and Environmental Medicine, 51(7), 751-758.
The ROI calculated using (1) has a natural interpretation of a dollar spent on intervention and gives an estimated net benefit of \(x\) dollars saved or gained through its effects. That is, positive values of ROI denote return beyond repayment of the investment, negative values higher than -1 denote partial repayment of the investment, RoI of -1 denotes no significant monetary benefits for the company resulting from the intervention, and RoI lower than -1 would signalise negative effects of the intervention.

Note that there is a trade-off between model complexity and its reliability due to limited availability of data and compounding of error within the model, and an appropriate balance needs to be found. Cancer interventions serve as a clear example; even when considering one type of cancer, treatment length and probability of its success for any two patients will likely be different as a result of heterogeneity in personal health characteristics, particular type of cancer, its stage, and other factors. And while it would be preferable to model each case separately, the lack of data and principally the inherent uncertainty in determining the particular circumstances for each employee who may have cancer in the future, we rather assume all employees to be at the same risk of developing cancer (equal to the country-age-gender population average) and to have the same treatment options. We depict the particular pathways of effects in the following subsections.

Overall, the benefits of participation in the interventions come both from reduced costs for the firm and increased productivity (the actual form of benefits depends on intervention category – see below) and are compared against direct costs of interventions. The particular modelling approach depends principally on the intervention type: preventive or remedial. For instance, vaccination programmes are preventive and while their costs are immediate, the relevant benefits would not be, in the best case scenario, observable at all if the vaccinated person never fell ill. The counterfactual used to calculate the implied benefits is thus an illness, weighted by probability of falling ill if not vaccinated.

On the other hand, HIV treatment programme is a remedial intervention aiming to reduce existing costs to the company and to increase workers’ productivity while also extending their life expectancy given the illness. Here, the counterfactual is being HIV-positive but not offered treatment. Note that in this case the counterfactual does not say anything about being treated through other means. This is an issue common to all predictive modelling frameworks as there is virtually no limit on the number of possible scenarios; to overcome it, we assume for simplicity that the counterfactual is simply not being treated at all for all interventions (see section 5.5 for additional information).

The predictive nature of our model implicitly involves certain degree of uncertainty, which generally decreases with the amount of evidence available. To reduce the unwanted effects on the calculation, we include, where appropriate, a range of values covering the majority of occurrences of the variable in question (i.e. producing a form of a confidence interval). For instance, most of the illnesses that GSK offers vaccination against have well documented expected treatment length, which is often given as a broad interval; clearly, assuming the lower and upper bounds of the interval is strictly preferred to taking any single point from it, which would not provide any information on the likely margin of error. Further, in cases where we were unable to identify a broad consensus on the appropriate range of values to be used from the available literature, the tool allows the user to change the inputs or assumes e.g. a ±20% range around the original estimate.
5.3. Data input and calibration of the model

The data used in our study come from four sources: the Global Health Data Exchange website,\textsuperscript{70} where the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) data can be downloaded; peer-reviewed literature; and websites of several health organisations such as the Centers for Disease Control and Prevention and data provided by GSK on healthcare utilisation.\textsuperscript{71} GBD is the largest and most comprehensive effort to date to measure epidemiological levels and trends worldwide and contains mortality and prevalence rates for all diseases of interest, with differentiation on a country, age, and gender level. In our tool, the data are used to determine the probability of illness and death.

The relevant peer-reviewed literature described in the previous section serves primarily as a source of parameter estimates defining the effect of interventions on employees’ health; for instance, the probability of smoking abstinence after 6 months of participation in a smoking cessation programme. Unlike the GBD data, the expert literature is very thin in certain areas and just rarely covers all relevant countries. Hence, some of the parameters in our model are obtained indirectly as derivatives of related existing estimates, using the estimates from other countries, etc. For instance, a peer-reviewed study exists on the life expectancy of HIV-positive people in the South Africa, conditional on their CD4 cell count in a cubic millimetre of blood at the beginning of HIV treatment. However, it only contains results for CD4 counts up to 350, an additional parameter describing life expectancy of people with higher counts thus needs to be derived either from studies done in other countries, or assumed. Finally, parameters obtained from the health organisations’ websites relate principally to length of treatment.

Unfortunately, many of the parameters cannot be approximated using the existing data. This is particularly true for factors affected by individual’s personality; for instance, influenza-related absenteeism, defined as the proportion of worktime lost due to influenza over the whole period of illness, can substantially vary across individuals depending on many factors such as severity of the illness, position at work, propensity to stay home, etc. In these cases, we had to rely on a set of assumptions broadly based on relevant existing findings. Specifically, for influenza we assume, following the findings of e.g. Akazawa et al. (2003)\textsuperscript{72} or Schanzer et al. (2011)\textsuperscript{73} which show that the average number of days lost is around 1.2-1.8 per influenza event, and knowing that the average treatment length is 2-7 days, that the absenteeism rate is around 40% on average.

In addition, some of the studies do not explicitly model causal relationships, particularly because it is often impossible due to the character of the observed issue. Where possible, we selected our parameters from studies implementing an RCT or a similar convincing design aiming to capture causal relationships.

\textsuperscript{70} http://ghdx.healthdata.org/ghd-data-tool
\textsuperscript{71} http://www.cdc.gov/
\textsuperscript{72} Akazawa, M., Sindelar, J. L., & Paltiel, A. D. (2003). Economic Costs of Influenza-Related Work Absenteeism. Value in Health, 6(2), 107-115.
\textsuperscript{73} Schanzer, D. L., Zheng, H., & Gilmore, J. (2011). Statistical estimates of absenteeism attributable to seasonal and pandemic influenza from the Canadian Labour Force Survey. BMC infectious diseases, 11(1), 90.
However, this was often impossible for areas with a limited amount of literature. The complete list of parameters used together with their sources is shown in the Appendix C to this report.

5.4. Estimation of costs and benefits for GSK’s Partnership for Prevention

In this section we describe in more detail how we propose to calculate the ROI for Partnership for Prevention with an emphasis on a case study for South Africa, based on the data and methodological framework we described above. It is important to stress that the data we described in the previous section can be used to calibrate the developed ROI tool in many different country settings, with some adjustments to the input parameters depending on the prevalence of certain diseases in the population. Most of the country-specific parameters to be adjusted can be easily obtained from the GBD database. Parameters obtained from peer-reviewed literature are considered to be identical across countries. This is a necessary simplification to overcome the lack of country-specific data.

The actual estimation of costs and benefits is based on the generalised framework depicted in Figure 1, although the particular ROI formulae differ by intervention category. The economic model is developed to provide conservative estimate of the ROI, taking lower bound estimates of benefits upper bound of cost estimates, aiming to possibly underestimate the resulting ROI rather than to risk its overestimation. The resulting estimate is thus likely to be lower than the actual return to the programmes.

This is particularly true for broader psychological and social effects such as overall change in behaviour, positive spillovers to other employees, or employee engagement – their direct effects on productivity and other outcome measures are difficult to measure (see section 3.3.3).

In the model, intervention-specific ROI is calculated only if the intervention has nonzero participation using per-patient treatment costs compared to benefits that the intervention would bring through better health of each participant. For whole categories of interventions, the relevant costs and benefits are first summed up and subsequently compared, providing an average net return on investment weighted by the number of participants in each intervention.

All estimations are done on population subgroup level given by gender, age, and country, reflecting the essential differences between the likelihood of illness/death across these variables. The values reflect likely costs and savings over a five-year period applying annual discounting specified in the input data. For preventive interventions, the assumed period starts at the point of vaccination/screening. For remedial interventions, the period starts following the assumed treatment length for which parameter estimates are available, e.g. 6 months for a smoking cessation programme, reflecting the time inconsistency in return to the various interventions.

5.4.1. Vaccination

Vaccination is a prime example of a preventive intervention. In simplified terms, vaccine provides, with certain probability, immunity against infection and provides return through lower presenteeism, 74 For instance, HIV is much more prevalent in South Africa than in Pakistan.
The return of investment for preventive healthcare programmes

absenteeism, and turnover rates among employees who are less likely to become ill. The ROI is a function of probability of being infected, probability of resisting the infection, length and severity of illness if infected, and the impacts of illness on work absence and productivity. The relevant factors and the path of effect is summarised in Table 1 and follows the general approach outlined in Figure 1. In particular, we take country-age-gender specific prevalence and mortality rates data to approximate the existing risks, and combine them with intervention-specific pieces of information driving benefits and costs. Subsequently, we compare those in order to obtain the resulting ROI.

Note that we exclude, in line with our conservative approach, other mental wellbeing and social benefits that would be difficult to estimate, such as the positive impact on the external corporate image (i.e. showing corporate responsibility) or higher productivity due to ease of mind.

Table 1: Vaccination modelling framework

| Benefits                                                                 | Costs                                           | Path                                                                 |
|-------------------------------------------------------------------------|-------------------------------------------------|----------------------------------------------------------------------|
| Prevented costs of illness – work absence, lower productivity, and higher likelihood of necessity to be replaced. | Cost of vaccine and related medical expenses, time lost working. | Vaccination -> immunity to illness $X_t$ with probability $P_{1,1}$ -> probability of being infected and infecting colleagues $P_{1,2}$ -> prevented illness |
| Lower probability of contagion among employees.                         | Sick pay (= implicit reduction in prevented costs) | Example: Twenty men aged 15-49 have been vaccinated against influenza. The probability of having influenza in any given year is 15.94% (specifically for males aged 15-49) and the mortality rate within the country-gender-age group is 0.001%. Assuming average daily wage of $102, treatment length between 2 and 7 days, absenteeism and presenteeism rates of 40% and 20%, respectively, and replacement costs of $20,000, we can calculate the baseline and actual costs as: |
|                                                                        |                                                 | $BC = 20 \times PR \times Coll \times (1 - BVR) + (1 - EF) \times BVR \times (TL \times (ABS + PRES) \times DW - max(0, TL \times ABS - SD) \times SP) + (MR \times RC) \times Years$ and |
|                                                                        |                                                 | $AC = 20 \times (1 - EF) \times PR \times Coll \times ((1 - BVR) + (1 - EF) \times BVR) \times (TL \times (ABS + PRES) \times DW - max(0, TL \times ABS - SD) \times SP) + (MR \times RC) \times Years + 20 \times INT + 20 \times TSI \times DW$ |
|                                                                        |                                                 | Where $BC$ are the baseline costs, $AC$ are the actual costs, $PR$ is prevalence rate, $Coll$ is the number of colleagues assumed to be infected, $BVR$ is baseline vaccination rate, $EF$ is vaccine’s effectiveness, $TL$ is treatment length, $ABS$ and $PRES$ are absenteeism and presenteeism rates, $DW$ is daily wage, $SD$ is the number of sickness days with full pay, $SP$ is sickness pay, $MR$ is mortality rate, $RC$ stands for replacement costs, $Year$ is the number of years for which the vaccine effective (maximum 5 years), $INT$ is intervention cost per employee, and $TSI$ is the time working lost due to vaccination process. |

In words, the twenty vaccinated employees have certain probability of being infected and resisting the infection if vaccinated. If the vaccine does not work, infected employees proceed to infect other five colleagues who may or may not be vaccinated.
All of them, if ill, are assumed to spend 40% of illness time at home and 60% at work, although their productivity is reduced by 20%. For up to three days they are paid full salary, followed by given sickness pay. Finally, the employee may die with a certain probability, in which case she is replaced at given cost.

For each vaccination type, the probability of becoming ill is calculated using gender-age-country specific prevalence data from the GBD, recalculated to population susceptible to the disease based on default vaccination rates. Given the probability of illness, we assume a lower and upper bound of treatment length as obtained from the literature, share of time being ill spent at home, effect on presenteeism, and probability of death in the given year. We do not consider possible complications, except for Human Papillomavirus which often leads to cervical and other types of cancer. Employees are assumed to get full pay in the first few days of the illness, followed by given reduction in salary for the remainder of the treatment.

For contagious illnesses, we assume that each infected employee would further infect five (this can be changed in the input sheet) other colleagues for whom we assume baseline country-wide vaccination rate to apply. Contagious illnesses with high baseline vaccination rates are thus less likely to spread. Note that our approach does not explicitly take into account that some of the infected colleagues may have also been vaccinated through the intervention; increase the resulting ROI by a non-negative amount, in line with our conservative approach.

Despite generally low costs of vaccines, vaccination interventions may not provide positive return on investment for the company if the incidence and mortality rates are low, even though the effects of the particular illness may be devastating (this also applies for other types of interventions). This is the case of e.g. Meningococcal vaccine, which can prevent severe infections of the lining of the brain and spinal cord, yet the incidence and mortality rates are so low that the expected return does not overweight the cost. On the other hand, illnesses such as influenza, despite often having rather mild effects on the patient as compared to other diseases, can provide substantial ROI due to high incidence rates and communicability. It is therefore important to look at the ROI results across all interventions in a category and to take their broader impacts into account, rather than to evaluate ROI for particular programmes separately.

In the calculation, the assumed path of effects for childhood vaccination is essentially identical to adult vaccination in the sense that the intervention aims to prevent future incidence of illness. Due to a lack of data on effects of children illness on absenteeism and presenteeism rates of their parents, we assume that a child’s illness would require an adult to spend a certain share of the treatment time absent from work.

\[ \text{Consider, for instance, prevalence of 1,000 cases per 100,000 people and year, giving baseline 1\% probability of becoming ill per year (see section 5.5 Issues to consider for discussion regarding the use of prevalence vs incidence rates). However, certain share of the population (say 40\%) is vaccinated and therefore less likely/immune to infection. Because the prevalence rates are calculated using the total population in the denominator, the probability of becoming ill would be underestimated. Given vaccine effectiveness of e.g. 95\%, the actual amount of people that can be infected, out of 100,000, is thus approximately 100,000×(0.4+0.6×0.05)=43,000, the resulting prevalence rate is 1,000/43,000 rather than 1,000/100,000, and the relevant probability of becoming ill is 2.3\% rather than 1\%.} \]
5.4.2. Cancer screening

Similarly to vaccination, cancer screening is a preventive intervention aimed at stopping the spread of cancer cells in a patient’s body as soon as possible. For some patients, this results in a mild treatment or surgery often requiring just a little time commitment and resulting in little to no further health consequences. For others, preventive screening generally increases survival rates while decreasing health, time, and financial costs of treatment.

On the other hand, compared to the relatively predictable development of most of the illnesses targeted in the vaccination category (neglecting the possible, but often very infrequent complications), cancers are more heterogeneous and so are their implications and treatment, which greatly depend on the stage at which the cancer was identified. While it in principle possible to model such heterogeneity in the model (i.e. to assign different values of parameters to patients based on their condition), the particular problem here is that it is upfront unknown into which category would the employees fit. Given the overall lack of available data, we have therefore decided (in contrast to the HIV intervention – see below) to model the effects of cancer using a single average. That is, we assume that all employees diagnosed with cancer of a specific kind would face the same treatment or probability of death.

In particular, we assume for simplicity that any cancer diagnosed through the screening would be in its early stage, with a counterfactual being that the cancer would be diagnosed only after its adverse effects on human body coerce the employee to seek medical assistance, which is usually the case for late-stage cancer. Conditional on the stage at which cancer has been diagnosed, we then assume length of treatment and mortality rates. The path of effects is summarised in Table 2.

**Table 2: Cancer screening modelling framework**

| Benefits                                                                 | Costs                                                                 |
|--------------------------------------------------------------------------|----------------------------------------------------------------------|
| Prevented costs: work absence, lower productivity, and higher likelihood of necessity to be replaced. Lower probability of death. | Cost of screening and related healthcare expenditures. Time lost working. |

Path

Probability of having a cancer \( X_t \) at time \( t \) of screening \( P_{1,2} \) -> screening process -> Probability of identifying the cancer \( P_{1,1} \) -> reduced negative effects

Example: Five women aged 15–49 have been screened for cervical cancer using pap smear. According to the data, cervical cancer treatment, if successful, takes between 115.6 and 137.1 hours of out- and inpatient care per year on average, depending on stage of the cancer, and the treatment takes 8 months. The related prevalence and mortality rates are 0.019% and 0.003%, respectively, and the relative risk of mortality from and incidence of advanced cervical cancer compared to no screening is 0.65. For each of the women, the assumed benefit, if they happen to have cancer, is the

We do not include sick pay as a separate parameter as it is more difficult to determine the number of times full sick pay can be obtained in case of a recurring illness.
difference in treatment length due to earlier recognition of the cancer (here 21.5 days), multiplied by the average daily wage, reduced productivity for 8 months, and reduced mortality (by 35%), multiplied by the replacement costs.

In addition to the aforementioned difficulties, modelling of cancer treatment is particularly difficult also due to the time inconsistency compared to other interventions. Specifically, cancer is a major cause of death, particularly among older people, and mortality rates are thus an important factor in the calculation. At the same time, it can often take up to several years between the cancer being diagnosed and patient’s death. For simplicity, we thus assume that any death due to cancer would occur in the same year and would be fully pronounced in the calculation.

In terms of the actual computation, prevalence and mortality are again used together with assumed length of treatment, work absence, and presenteeism to determine the prevented costs. The length of absence due to both in- and out-patient care was derived from peer-reviewed studies while the presenteeism rate was calculated using data from a large-scale employee survey from the South Africa.

5.4.3. Smoking, cardiovascular and diabetes health

Interventions aimed at smoking and non-communicable diseases are remedial programmes aiming at reducing existing risk factors and their negative effects. Particularly in developed countries, but increasingly in developing countries mainly among higher-income classes, smoking and other modifiable risk factors such as high blood pressure or cholesterol are the most important elements leading to premature death (see e.g. Islam et al. 2014). Similarly, diabetes can substantially reduce life expectancy unless properly treated and, if left completely untreated, it can eventually lead to major health complications such as blindness.

In contrast to the previously described interventions, particularly vaccination, all programmes in this category are targeted at employees who are already at risk or with relevant condition. Therefore, the interventions aim to reduce the risk factor and the related costs to both the employee and the company, as well as to lower the probability of future complications.

The interventions also differ in the sense that they are exclusively reliant on employees’ cooperation. Indeed, the same high blood pressure treatment can have vastly distinct effects on patients exerting different levels of effort in changing their diet, taking medicaments regularly, or doing physical exercise. The level of effort depends on personal characteristics, motivation, and beliefs, yet it is also affected by broader cultural background and support from other people. It is therefore virtually impossible to provide a reliable prediction on effects of the treatment because any used parameters are likely to be applicable to only a certain population. In this regard, the interventions are thus somewhat similar to cancer screening

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77 Islam, S. M. S., Purnat, T. D., Phuong, N. T. A., Mwingira, U., Schacht, K., & Fröschl, G. (2014). Non-Communicable Diseases (NCDs) in developing countries: a symposium report. Globalization and health, 10(1), 1.

78 National Eye Institute. As of 28 October 2016: https://nei.nih.gov/health/diabetic/retinopathy

79 Screening programmes are included in the “Preventive examination” category.
from the modelling perspective; again, rather than to model individual effort and run particularly into calibration issues due to lack of reliable data, we assume an average level of effort to be applicable to all employees.

Despite the inherent uncertainty in the actual parameter values, there is a broad consensus on the relevant paths of effects. For smoking, which is considered a binary variable with respect to its effects on the corresponding causes of death in the GBD database (i.e. it is estimated that the actual number of cigarettes smoked per day does not play a major role in predicting illness as long as person smokes), treatment is often aimed at gradual decrease in the amount of cigarettes smoked per day, eventually reaching full cessation. Once people stop smoking, the implicit relative risk of developing a related disease decreases. In the model we therefore assume a certain probability of smoking cessation within a set time period as a result of programme participation (calibrated using literature estimates) and set the impact-counterfactual pair to be an employee at risk or not at risk in terms of smoking, weighted by the probability of smoking cessation.

Similarly, high blood pressure and high cholesterol cannot be cured immediately and our parameter estimates are therefore linked to decrease in the absolute value over time, showing the average decrease in blood pressure or cholesterol after certain amount of time. At the same time, it is impossible to model effects for any given level of blood pressure or cholesterol due to lack of data; we therefore use the overall distribution in general population, assume that it would be applicable to the workforce, and that employees participating in the treatment are randomly selected from those considered at risk. This way, we can estimate the share of employees who would, under ideal circumstances, lower their risk factors below the ‘at risk’ threshold.\footnote{For instance, assume that the distribution of blood pressure follows normal distribution with e.g. 40% of all people within given age-group and location being above the ‘at risk’ threshold. We apply this distribution to the employee base and assume that only employees at risk would be referred to the treatment, with the participating employees being randomly drawn from the ‘at risk’ part of the distribution in terms of their blood pressure levels. Lastly, it is estimated in the literature that professional treatment can reduce the blood pressure level by 2.96-8.24 mmHg in 6 months; we apply this reduction to the assumed blood pressure levels to obtain the share of employees who effectively reduce their blood pressure levels under the ‘at risk’ threshold.}

Finally, for diabetes treatment we assume that the prescription medication and regular screening processes aim mainly at reducing the risk of developing advanced stages of diabetes for individuals at risk, i.e. the intervention is essentially the same as those dealing with high blood pressure and cholesterol. The paths of effects are summarised in Table 3.

**Table 3: Smoking, cardiovascular and diabetes health modelling framework**

| Benefits | Reduced absenteeism and presenteeism rates and associated costs as a result of better health condition. |
|----------|------------------------------------------------------------------------------------------------------|
|          | Reduced risk of developing related illness.                                                         |
|          | Not included in the calculation but highly relevant: broader positive impacts on employee wellbeing. |
| Costs    | Cost of treatment and related healthcare expenditures.                                               |

\footnote{For instance, assume that the distribution of blood pressure follows normal distribution with e.g. 40% of all people within given age-group and location being above the ‘at risk’ threshold. We apply this distribution to the employee base and assume that only employees at risk would be referred to the treatment, with the participating employees being randomly drawn from the ‘at risk’ part of the distribution in terms of their blood pressure levels. Lastly, it is estimated in the literature that professional treatment can reduce the blood pressure level by 2.96-8.24 mmHg in 6 months; we apply this reduction to the assumed blood pressure levels to obtain the share of employees who effectively reduce their blood pressure levels under the ‘at risk’ threshold.}
Time lost working.

**Path**

Participation in the programme (implicitly assuming being at risk in the relevant risk factor) \(\rightarrow\) reduction in the risk factor level \(\rightarrow\) Probability of not being at risk after a given time period \(P_{t,t+1}\) \(\rightarrow\) reduced negative effects

In terms of calculation, we provide a lower and upper bound on the anticipated effects of treatment on risk factor level and combine it with parameter estimates on absenteeism and presenteeism rates. In addition, we have identified all relevant causes of death directly linked to the risk factors from the GBD database\(^8\) and combined their respective country-age-gender mortality rates attributable to the risk factor exposure to estimate the probability of death associated with being at risk in each of the risk factors.

### 5.4.4. HIV/AIDS

The intervention aimed at HIV-positive individuals is specific in a way that it is aimed at treatment rather than prevention and that it can never lead to full curing of the illness. If the treatment starts early, it can substantially extend patient’s life expectancy nearly to one of a similar, HIV-negative person and reduce other early negative health effects to a minimum, yet the treatment is a never ending continuous process and so it is difficult to evaluate from a short-term ROI perspective. In fact, treated or not, HIV results in gradual reduction of CD4 cells that protect the human body against external infections; the treatment only greatly slows this process down. Even if untreated, HIV-positive individuals can thus live many years without being hindered by the disease’s negative effects. On the other hand, once the CD4 count drops to low levels as the disease progresses towards AIDS, people become increasingly vulnerable to other diseases, increasing the time being treated and reducing overall productivity.

Hence, the HIV modelling framework must be explicitly based on patients’ pre-existing conditions in terms of CD4 counts, although the general path of effects is the same for everyone: conditional on being treated and assuming strict compliance to the treatment procedures, HIV medication reduces costs for the company by lowering probability of death and extending patients’ life expectancy, and mainly by reducing absenteeism and presenteeism rates through increasing resistance to infectious diseases.

Due to the lack of data on currently treated employees, we assume that any specified number of participants in the intervention would be randomly drawn from the CD4 cell count distribution. For each country-age-gender-CD4 category we then assume the intervention to increase life expectancy of each participant using parameter estimates from the expert literature, with counterfactual being no treatment at all. This way, we explicitly model the probability of death in the following years and then apply

\(^8\) For smoking, we assume aortic aneurysm, asbestosis, asthma, atrial fibrillation and flutter, bladder cancer, cerebrovascular disease, chronic obstructive pulmonary disease, colon and rectum cancer, esophageal-esophageal cancer, interstitial lung disease and pulmonary sarcoidosis, ischemic heart disease, ischemic stroke, kidney cancer, lip and oral cavity cancer, liver cancer, nasopharynx cancer, pancreatic cancer, peripheral vascular disease, stomach cancer, tracheal, bronchus, and lung cancer. For high blood pressure we assume aortic aneurysm, atrial fibrillation and flutter, cardiomyopathy and myocarditis, cerebrovascular disease, chronic kidney disease, endocarditis, hemorrhagic stroke, hypertensive heart disease, ischemic heart disease, ischemic stroke, peripheral vascular disease, and rheumatic heart disease. For high cholesterol, we assume cerebrovascular disease, ischemic heart disease, and ischemic stroke.
absenteeism and presenteeism rates specific to remaining years of life in the calculation. This is to reflect the fact that HIV/AIDS leads to increasingly more health difficulties as the disease progresses and the patients spend substantially more time absent due to other illnesses in the last year(s) of their life than in the previous years. The modelling framework is summarised in Table 4.

**Table 4: HIV/AIDS modelling framework**

| **Benefits**                                                                 | Lower work absence and higher productivity as a result of better health conditions and extended life expectancy.  
Not included but highly relevant: lower probability of contagion among employees and broader social impact. |
| **Costs**                                                                  | Cost of treatment and related medical expenses, time lost working.  
Sick pay (= implicit reduction in prevented costs) |
| **Path**                                                                   | Initial CD4 count determining stage of the illness -> treatment -> extended life expectancy and improved health conditions -> lower probability of death in the following years, lower absence rate, and higher productivity |

In the calculation, the assumed number of employees in each CD4 category is assigned life expectancy given no treatment, and lower and upper bound on life expectancy if treated. From this, survival and mortality rates are calculated, showing the probability of dying in the following year(s). Finally, the model assumes specific absenteeism and presenteeism rates conditional years of life left; these parameters are then weighted by the probability of death in the given year to give an overall assessment of saved costs for the firm.

### 5.4.5. Preventive health examination

Based on information from the GSK, this category includes review of current medications, height, weight, blood pressure, cholesterol, and other routine measurements, physical examination, diabetes screening, and a brief discussion regarding modifiable risk factors. In our model, we assume blood pressure, cholesterol, and diabetes screening to be only effective through subsequent treatment (included in another category) and not to have any identifiable positive effects on its own. Hence, we do not further discuss them here.

Moreover, our systematic literature review discussed in the previous section shows that even preventive health examination seems not to have any positive (or negative) effects on its own on average. This is a result of potential positive effects (e.g. being aware of high blood pressure) being negated by potential negative effects (e.g. being sent for further examination despite having no issues). And since the potential broader effects of being offered preventive examination on workers mental wellbeing and engagement are not considered in our model, all interventions in this category are only included as a pure cost in the overall calculation.
Table 5: Preventive health examination modelling framework

| Benefits | None modelled |
|----------|---------------|
|          | Not modelled but highly relevant: increase in engagement and satisfaction rates, broader impacts on behaviour. |

| Costs    | Cost of medical expenses. |
|----------|----------------------------|
|          | Time lost working. |

| Path     | N/A |

5.4.6. Prenatal care

Aimed at women at any stage of pregnancy and including both outpatient care (nutritional counselling, vitamin and iron supplements, or revision of personal risk factors) as well as more complex examinations (genetic disorder screenings, ultrasound screening, or pap smear), prenatal care is implicitly aimed at both the pregnant woman and her child. Hence, it is virtually impossible to fully capture all relevant factors in the ROI calculation; despite reductions in potential (pre)birth complications and mothers’ mortality rates, a large part of the treatment is ensuring good health of the baby and indirectly relieving women from stress, both of which have significant effect on productivity at work. However, these effects cannot be reliably modelled given the lack of a clear structure of the effects and as such are not included in the ROI calculation, which underrepresents the actual return to the offered interventions.

What is left is thus broadly similar to cancer screening in terms of modelling approach; the interventions aim to prevent and/or reduce the impacts of possible complications that may affect women’s health. However, in this case we assume that the treatment would fully preclude any negative effects due to frequency and complexity of the treatment; the impact-counterfactual pair is thus a woman at full health versus possible negative effects, weighted by the probability of their occurrence. We assume the following issues to be relevant: maternal sepsis and other maternal infections, maternal hypertensive disorders, obstructed labour, indirect maternal deaths, late maternal deaths, other maternal disorders, preterm birth complications, cervical cancer.

Table 6: Prenatal care modelling framework

| Benefits | Prevented costs of (pre-)birth complications – work absence. |
|----------|------------------------------------------------------------|

| Costs    | Cost of screening and other medical expenses. |
|----------|---------------------------------------------|
|          | Time lost working. |

| Path     | Prevented costs of (pre-)birth complications weighted by the probability of their occurrence expressed in terms of savings |
|----------|------------------------------------------------------------------------------------------------------------------|
|          | Diagnosed cervical cancer (see cancer screening section) |
5.5. Limitations of the approach and issues to consider

The proposed analytical framework has some limitations that should be considered when interpreting the overall findings.

Firstly, for simplicity and modelling purposes, we assume that the employees would not get any treatment in the absence of the interventions. This is likely to be false, particularly for HIV treatment and some vaccines, which are often offered throughout state-sponsored programmes. In general, the fact that some of the employees would possibly seek alternative treatment elsewhere would slightly overstate the calculated ROI; however, these employees may arguably do so despite being offered in-house treatment for various reasons. Due to the lack of data on the overlap between the otherwise treated and actually treated subgroups, as well as relative effectiveness of the alternative treatment, we do not include such alternatives in our model.

Secondly, the available data provided by GSK do not directly specify whether programme participants are employees or their relatives. Given that only treatment of employees will provide full benefits for the company while treatment of their relatives may or may not have indirect impact on absenteeism, presenteeism, and staff turnover rates, this information is required for precise analysis. In the current version of the model, we assume that all participants are employees. Nevertheless, this has no effect on the per-intervention calculated ROI because the calculation is independent of the number of participants; the only effect is on the overall ROI across all programmes. Note that given the lack of better data, we assume all intervention participants to be employees and so the overall result is unbiased as well. Although it informs about the ROI on treating the assumed amount of employees rather than the actual ROI realised thus far.

Thirdly, the calculation also faces several challenges stemming from the unavailability of reliable and/or country-specific data. In particular, only country-wide prevalence and mortality rates were available from the Global Burden of Disease (GBD) website. For more precise results, incidence rates should be used rather than prevalence as these can be slightly misleading for illnesses that can occur more than once per year, as well as those that last for more than one year. The data also reflect prevalence rates among general population, which can arguably greatly underrepresent the actual prevalence and mortality rates of certain diseases for a subgroup of population such as the GSK employees. Specifically, HIV/AIDS is the cause of 71.24% of all deaths in the 15-49 age category in South Africa. However, the available utilisation dataset shows that no GSK employee made use of the available HIV/AIDS treatment, which is in line with studies suggesting substantially lower prevalence of HIV among high income classes in South African (see e.g. Wabiri and Taffa 201382). Hence, similarly to the vaccination prevalence data discussion, the employees are relatively more likely to die from other causes of death, particularly non-communicable diseases such as ischemic heart disease in a similar manner to e.g. GSK employees in the U.S. The overall prevalence data which cover all population subgroups in South Africa therefore underrepresent the actual threat, understating the return on investment especially for interventions against non-communicable diseases.

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82 Wabiri, N., & Taffa, N. (2013). Socio-economic inequality and HIV in South Africa. BMC public health, 13(1), 1.
diseases, as it assumes that the GSK employees are likely to die from HIV rather than non-communicable diseases.

Fourthly, the calculation implicitly assumes that all employees are equal in their probability of being ill and the resulting effects of both the illness and the intervention. This is clearly not realistic as people are inherently different in various characteristics and so some may spend more time at home while ill while others may e.g. be more likely to stop smoking when offered a help. However, the lack of more specific data essentially prevents us from further differentiating among individuals and the way the model is calibrated, i.e. using the mean effects, it provides results as if everyone were an average individual in all characteristics, which should in principle provide results very close to the more detailed framework as long as the individual parameters are normally distributed in the population.

Finally, note that in its current form, the model is calibrated to the South African data. A full set of the GBD estimates is provided as a supplement to this report which can be readily used to partially recalibrate the model to other countries. However, South Africa specific parameters obtained from other sources need to be updated in order to fully adjust the model to other countries.

5.5.1. Suggestions for future evaluation

The relevance of predictive studies based on simulation techniques must be assessed in comparison to retrospective comparative analytical studies with respect to the targeted outcomes. In particular, predictive studies are especially useful in assessing potential impacts of new or developing programmes as the comparative studies lack empirical data to work with, yet they generally cannot achieve the same level of precision in terms of the ROI calculations. That is, they can provide information on the general tendency of some programmes to be more relevant in the given settings than other interventions, yet only a well prepared retrospective study can provide a precise assessment of the actual benefits. As most of the data required for comparative study can be collected in a company setting, we therefore suggest considering a systematic and regular collection of various individual and office level data on productivity, absence, engagement, biometric information, or intervention participation. Table 7 provides a non-exhaustive list of variables that may be of interest should such a study be conducted in the future; those can be collected e.g. using an employee survey.

Table 7: Suggestions for data collection

| Company-level data                  |
|------------------------------------|
| Number of employees, employee salary |
| Interventions offered, their participation and costs |
| Other administrative costs related to interventions |

| Employee-level data |
|---------------------|
| Age, gender, education, commuting time |
| Absence in a given time period due to: health issues, annual leave, other |
| Physical and mental health profile |
5.6. The ROI of Partnership for Prevention in South Africa

As a case study, we have calibrated the tool on data from South Africa and analysed the ROI on healthcare interventions (expressed in US dollars) offered there using the available information from GSK as well as several other assumed inputs. Specifically, we calibrated country-specific prevalence and mortality rates using the GBD data described earlier and used, among others, WHO estimates on population vaccination rates to assess the likely average effect of having an employee infected with contagious disease or the productivity loss due to illness based on survey of South African employers conducted by RAND Europe. The GBD data for all countries in which GSK offers healthcare interventions are presented together with this report and can be easily pasted in the calculation tool to recalibrate it for other countries. The WHO vaccination rates are not available for all the respective countries and vaccines; those and other country-specific information need to be replaced with other appropriate data or assumed to be equal across countries.83 The attached tool is further described in Appendix D.

According to the GSK data, not all interventions offered in the South Africa have been utilised; in order to provide a conservative assessment we assume that interventions with no participation, such as interventions aimed at reducing risk of non-communicable diseases or HIV treatment, are not offered in the country. For all interventions (except for smoking) the participation rates are obtained directly from the GSK data; for smoking, we assume 25 employees to eventually participate across all three programmes in the category, a lower bound of a range obtained from the RAND Europe internal database of similar employers. Notwithstanding that the assumed number of participating employees in any intervention can be changed in the input data (see below) and the potential return on investment can thus be easily assessed.

Using the average daily wage in the pharmaceutical industry in South Africa of $102, replacements costs per employee (including time lost working as well as hiring and training costs) of $20,000, and overhead costs of implementing the interventions of $2,000, the estimated ROI is between $0.26 and $2.12, meaning that the investment is expected to be fully repaid and further bring additional net returns (the detailed results are presented in Table 8). Note that some of the data need to be updated in order to provide better estimate, particularly the replacement and administrative costs, or the employee population structure, time lost working due to participation in the intervention. The ROI estimate range denotes an interval between the lower and upper bound estimates implied by uncertainty in the inputs such as treatment length or probability of intervention success. By definition, it gives an indication of uncertainty in the calculation yet it should not be understood as a confidence interval as it is impossible to estimate the probability of the true value.

83 Arguably, most of the parameters such as influenza-related absence rate do not drastically differ across countries and we therefore suggest using the default calibration. However, if better data is available, it can be used in the calculation instead by replacing the original data in the appropriate sheet/cell.
Table 8: The ROI of Partnership for Prevention in South Africa estimation results by intervention category

| Intervention category       | ROI (lower bound) | ROI (upper bound) |
|----------------------------|-------------------|-------------------|
| adult immunizations        | 4.94              | 19.68             |
| childhood immunizations    | -0.75             | -0.49             |
| cancer screening           | -0.98             | -0.98             |
| non-communicable diseases  | -                 | -                 |
| HIV                        | -                 | -                 |
| preventive examinations    | -1.00             | -1.00             |
| prenatal care              | -0.99             | -0.99             |
| smoking                    | 16.01             | 26.98             |

Looking at the detailed results, we can see that the positive overall return on investment is driven by adult vaccination and smoking interventions as suggested by the literature review. In fact, the HIV and non-communicable disease intervention categories also provide positive ROI when assuming nonzero participation but are not included as these interventions are not offered in the South Africa. For smoking and adult immunisation the figures are a result of rather low intervention cost and high expected return or high probability of positive return, or both. Contrary to that, childhood immunisation interventions provide, under the used assumptions, smaller return insufficient to provide positive ROI despite having similar probability of occurrence as adult immunisation interventions; preventive examinations seem not to provide any positive monetary effects for the employer; and while cancer screening and prenatal care may help to prevent potentially disastrous outcomes for the employees, the low probability of their occurrence and the fact that the employer in principle does not incur any healthcare-related costs, together with substantial cost of some of the interventions result in negative ROI.
Discussion

Workplace preventive health initiatives are growing in number and scope around the world, as employers increasingly realise the link between employee health and wellbeing and increased productivity and reduced absenteeism rates. In light of increasing numbers and spread of NCDs in recent years, such programmes have the potential to generate returns on these strategic investments and can reduce overall health costs. In essence, the importance of the workplace as a setting for health promotion is increasingly recognised by employers and policymakers.

This report reviewed the existing evidence on the drivers of successful preventive health programmes and how to calculate the ROI on such investments. The findings suggest that one key factor determining success is commitment from leadership and senior management, which aligns with previous work conducted by RAND Europe (see Hafner et al., 2015), where we found that organisations that understand health and wellbeing as an indicator of organisational success have generally lower levels of work impairment due to absenteeism and presenteeism among their employees. Also Steve Boorman (2009) in his review on health and wellbeing in the NHS found that organisations that discuss health and wellbeing at board level were more likely to manage productivity loss due to employee ill-health more effectively. This point goes directly to the problem of changing culture. It is perhaps not just about understanding what is driving health and wellbeing in an organisation, but also making it an organisational priority at all levels that will really help improve the health and wellbeing of staff. GSK with its Partnership for Prevention programme that applies to its global workforce and is tailored by each specific country shows clearly that health and wellbeing is taken seriously at broad and senior management level.

While companies seldom deny that preventive health and wellbeing interventions are a good thing in general, not many companies actually measure the ROI of their investments in a systematic manner. Overall, the number of pharmaceutical companies publicly highlighting that they measure systematically an ROI on their programmes is small, including GSK. This is in line with findings from work RAND Europe conducts within the Britain’s Healthiest Workplace (BHW) competition. There, from 170 surveyed UK companies from various different sectors, only around 17 per cent measure their ROI on health and wellbeing initiatives and of those, only about 3 per cent measure ROI financially (in terms of £). So a low number of companies measuring their ROI on wellbeing programmes in the pharmaceutical industry reflect broader trends in other industries. Reasons for a small number of companies calculating the ROI is given by the relative high costs involved (including time for analysis and data collection) and generally a measurement issue on how to measure the effectiveness of the interventions.
By developing an analytical framework based on existing evidence on the effectiveness of preventive healthcare interventions we aimed to help GSK to better understand the ROI on their preventive healthcare programme. Based on data provided by GSK, as well as other publicly available data sources, such as the Global Burden of Disease (GBD) data, we were able to calculate the ROI for GSK’s Partnership for Prevention programme using South Africa as a case study. The estimated ROI is between $0.26 and $2.12, meaning that the investment is expected to be fully repaid and further bring additional net returns. This clearly demonstrates the potential business case for companies such as GSK to invest globally in health and wellbeing of its workforce.
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Appendix A: Further details on the literature review

We searched for academic literature through EBSCO, drawing on four databases: Academic Search Complete, Business Source Complete, EconLit, and Social Sciences Abstracts. The final search terms were selected on the basis of several piloting rounds with the objective to capture a manageable number of studies while minimising the chance of missing any relevant papers. To that end, we searched only in abstracts and/or titles.

Inclusion and exclusion criteria were determined as follows:

- Only studies published in English included
- No magazine/periodical items included
- Studies with all publication years included
- Only studies looking at workplace interventions included
- Both peer-reviewed and non-peer reviewed sources included
- No a priori limitation on research designs and methods

As the first step, we performed a combination of searches. First, we ran a general search with no emphasis on any particular intervention or disease.

1) AB ( "health promotion" OR "health management" OR "productivity promotion" OR "productivity management" OR "health and wellness" OR "health and well-being" OR "health and wellbeing") AND AB ( workplace or worksite or work-site or work ) AND AB ( return OR ROI OR saving*) AND AB ( program OR programme )

Subsequently, we also ran two groups of searches specifically focusing on the intervention areas covered by GSK programmes. The first group replicated the search terms used for the general search #1 described above; however, in the interest of capturing a meaningful number of publications, the first and last blocks (i.e. 'health promotion’ and alternatives and ‘program’ and alternatives, respectively) were omitted. The resulting search terms were:

2a) AB ( workplace or worksite or work-site ) AND AB ( return or ROI or saving* ) AND AB ( immunisation or immunization or vaccination or vaccine )

2b) AB ( workplace OR worksite OR work-site ) AND AB ( return OR ROI OR saving* ) AND AB ( "cancer screen*" OR "cancer prevent*" )

2c) AB ( workplace or worksite or work-site ) AND AB ( return or ROI or saving* ) AND AB ( "cardiovascular
The second group of searches focusing on the specific intervention areas expand the scope beyond studies focusing narrowly on return on investment to help ensure that literature containing relevant evidence on benefits of workplace HPPs in these areas is not missed. The resulting searches were:

3a) AB ( workplace OR worksite OR work-site ) AND AB ( cost* OR effect* OR impact OR influence ) AND AB ( immunisation or immunization or vaccination or vaccine ) AND AB ( program OR programme )

3b) AB ( workplace OR worksite OR work-site ) AND AB ( cost* OR effect* OR impact OR influence ) AND AB ( "cancer screen*" OR "cancer prevent*" ) AND AB ( program OR programme )

3c) AB ( workplace OR worksite OR work-site ) AND AB ( cost* OR effect* OR impact OR influence ) AND AB ( "cardiovascular disease" or "coronary disease" or "heart disease" OR CVD ) AND AB ( program OR programme ) AND AB ( "health promotion" OR "health management" OR "productivity promotion" OR "productivity management" OR "health and wellness" OR "health and well-being" OR "health and wellbeing" )

3d) AB ( workplace OR worksite OR work-site ) AND AB ( cost* OR effect* OR impact OR influence ) AND AB diabetes AND AB ( program OR programme ) AND AB ( "health promotion" OR "health management" OR "productivity promotion" OR "productivity management" OR "health and wellness" OR "health and well-being" OR "health and wellbeing" )

3e) AB ( workplace OR worksite OR work-site ) AND AB ( cost* OR effect* OR impact OR influence ) AND AB ( HIV* OR AIDS* ) AND AB ( program OR programme ) AND AB ( screen* OR treat* )

3f) AB ( workplace OR worksite OR work-site ) AND AB ( cost* OR effect* OR impact OR influence ) AND AB ( "physical exam*" OR "preventive exam" ) AND AB ( program OR programme )

3g) AB ( workplace OR worksite OR work-site ) AND AB ( cost* OR effect* OR impact OR influence ) AND AB prenatal AND AB ( program OR programme ): 9 results

3h) AB ( workplace OR worksite OR work-site ) AND AB ( cost* OR effect* OR impact OR influence ) AND AB ( tobacco cessation or smoking cessation ) AND AB ( program OR programme ) AND AB ( "health promotion" OR "health management" OR "productivity promotion" OR "productivity management" OR "health and wellness" OR "health and well-being" OR "health and wellbeing" ): 48 results
Retrieved hits from both searches were imported to the citation manager EndNote. Duplicates were removed and all titles were screened by title and source. The results of this process are summarised in the table below. The large number of items removed after screening titles and sources was due to the fact that the search picked up numerous professional and trade magazines.

| Return/ROI searches only                  |        |
|------------------------------------------|--------|
| Search 1 (general)                       | 137    |
| Search 2a (immunization)                 | 21     |
| Search 2b (cancer)                       | 7      |
| Search 2c (CVD)                          | 12     |
| Search 2d (diabetes)                     | 7      |
| Search 2e (HIV/AIDS)                     | 11     |
| Search 2f (physical)                     | 11     |
| Search 2g (prenatal)                     | 5      |
| Search 2h (smoking)                      | 31     |
| Search 3a (immunization)                 | 45     |
| Search 3b (cancer)                       | 32     |
| Search 3c (CVD)                          | 38     |
| Search 3d (diabetes)                     | 14     |
| Search 3e (HIV/AIDS)                     | 31     |
| Search 3f (physical)                     | 7      |
| Search 3g (prenatal)                     | 9      |
| Search 3h (smoking)                      | 48     |
| **Total returns**                        | **466**|
| Duplicates removed by EndNote            | 63     |
| Duplicates manually removed              | 12     |
| **Total unique hits**                    | **391**|
| Removed after title screen              | 170    |
| **Remaining after title screen**         | **221**|

As the next step, 20% of all abstracts were simultaneously reviewed by two researchers to ensure inter-rater reliability, with the rest split between the two researchers. This process resulted in the exclusion of 55 items. Subsequently, remaining available full texts were screened to pass a judgment on whether the study meets the inclusion criteria. Again, 20% of these were double-screened by both researchers for internal consistency, with the remained divided between them. This step resulted in the exclusion of 12 items, as summarized in the table below. The remainder of available texts was reviewed in full by the research team and used to populate a data extraction template.

| Hits before abstract screen              |        |
|-----------------------------------------|--------|
|                                         | 221    |
The searches described above did not yield all the necessary information to construct the ROI framework presented in Chapter 5. To close the small number of remaining data gaps, in intervention areas where insufficient data was collected through the formal literature review, additional follow-up searches were conducted, for instance by relaxing the search terms and inclusion criteria to include interventions from other settings.
Appendix B: Overview of studies used to inform the development of the calculation tool

| Area       | Outcomes covered                                                                 | Relevant studies                                                                 |
|------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Vaccination| Vaccination rates; sick leave hours, knowledge; beliefs, and behaviour around influenza prevention | Olsen et al. (1998),84 Cook (2014),85 Bourgeois et al. (2008)86                    |
| Cancer     | Screening rates; knowledge about risk factors; perceived susceptibility, severity, benefits and barriers to screening; compliance with guidelines | Ma et al. (2012),87 Campbell et al. (2002),88 Tilley et al. (1999)89             |
| Smoking    | Smoking status; prevalence of oral neoplasia; self-efficacy to cope with          | Gomel et al. (1993),90 Uplap et al. (2011),91 Campbell et al. (2002),92 Naito et al. (2008),93 Sorensen et al. (1998),94 Glasgow |

84 Olsen, G.W., Burris, J.M., Burlew, M.M. et al. (1998). Absenteeism among employees who participated in a workplace influenza immunization program. Journal Of Occupational And Environmental Medicine / American College Of Occupational And Environmental Medicine, 40(4), 311-316.
85 Cook, M. A. (2014). Workplace-based vaccination promotion: An examination of employers’ views and practices and an evaluation of a pilot intervention. (74), ProQuest Information & Learning, US.
86 Bourgeois, F. T., Simons, W. W., Olson, K> et al. (2008). Evaluation of influenza prevention in the workplace using a personally controlled health record: randomized controlled trial. Journal Of Medical Internet Research, 10(1), e5-e5.
87 Ma, G. X., Yin, L., Gao, W. et al. (2012). Workplace-based breast cancer screening intervention in china. Cancer Epidemiology, Biomarkers & Prevention: A Publication Of The American Association For Cancer Research, Cosponsored By The American Society Of Preventive Oncology, 21(2), 358-367.
88 Campbell, M. K., Tessaro, I., DeVellis, B. et al. (2002). Effects of a Tailored Health Promotion Program for Female Blue-Collar Workers: Health Works for Women. Preventive Medicine, 34(3), 313.
89 Tilley, B. C., Vernon, S. W., Myers, R. et al. (1999). The Next Step Trial: impact of a worksite colorectal cancer screening promotion program. Preventive Medicine, 28(3), 276-283.
90 Gomel, M., Oldenburg, B., Simpson, J. M. et al. (1993). Work-Site Cardiovascular Risk Reduction: A Randomized Trial of Health Risk Assessment, Education, Counseling, and Incentives. American Journal of Public Health, 83(9), 1231-1238.
91 Uplap, P., Mishra, G., Majumdar, P. et al. (2011). Oral Cancer Screening at Workplace in India-One-year Follow-up. Indian Journal Of Community Medicine: Official Publication Of Indian Association Of Preventive & Social Medicine, 36(2), 133-138.
92 Campbell, M. K., Tessaro, I., DeVellis, B. et al. (2002). Effects of a Tailored Health Promotion Program for Female Blue-Collar Workers: Health Works for Women. Preventive Medicine, 34(3), 313.
93 Naito, M., Nakayama, T., Okamura, T. et al. (2008). Effect of a 4-year workplace-based physical activity intervention program on the blood lipid profiles of participating employees: the high-risk and population strategy for occupational health promotion (HIPOP-OHP) study. Atherosclerosis, 197(2), 784-790.
94 Sorensen, G., Stoddard, A., Hunt, M. K. et al. (1998). The effects of a health promotion- health protection intervention on behavior change: The WellWorks Study. American Journal of Public Health, 88(11), 1685-1690.
smoking urges et al. (1995), Bertera (1993), Sorensen et al. (2016), Bhiri et al. (2015), Hwang et al. (2012), Terry et al. (2011), Gottlieb and Nelson (1990), Osilla et al. (2012), Ekpu and Brown (2015), Cahill and Lancaster (2014), 323a Chung, Janer et al. (2002)

CVD/diabetes BMI, blood pressure, body fat, physical activity, cholesterol, blood glucose, Framingham risk score, heart rate, diet, alcohol intake, waist circumference, self...

Gomel et al. (1993), Bourgeois et al. (2008), Campbell et al. (2002), McHugh and Suggs (2012), Colkesen et al. (2011), Farag et al. (2010), Racette et al. (2009), Naito et al. (2008), Muto et al. (2006), Muto and Yamauchi

95 Glasgow, R. E., Terborg, J. R., Hollis, J. F. et al. (1995). Take heart: results from the initial phase of a worksite wellness program. American Journal Of Public Health, 85(2), 209-216.
96 Bertera, R. L. (1993). Behavioral risk factor and illness day changes with workplace health promotion: two-year results. American Journal Of Health Promotion: AJHP, 7(5), 365-373.
97 Sorensen, G., Pednekar, M., Cordeira, L. S. et al. (2016). Effects of a worksite tobacco control intervention in India: the Mumbai worksite tobacco control study, a cluster-randomised trial. Tobacco Control.
98 Bhiri, S., Maatoug, J., Zammit, N. et al. (2015). A 3-Year Workplace-Based Intervention Program to Control Noncommunicable Disease Risk Factors in Sousse, Tunisia. Journal Of Occupational And Environmental Medicine / American College Of Occupational And Environmental Medicine, 57(7), e72-e77.
99 Hwang, G., Jung, H., Yi, Y. et al. (2012). Smoking cessation intervention using stepwise exercise incentives for male workers in the workplace. Asia-Pacific Journal of Public Health, 24(1), 82-90.
100 Terry, P. E., Seaverson, E. L. D., Staufacker, M. J. et al. (2011). The effectiveness of a telephone-based tobacco cessation program offered as part of a worksite health promotion program. Population Health Management, 14(3), 117-125.
101 Gottlieb, N. H., and Nelson, A. (1990). A systematic effort to reduce smoking at the worksite. Health Education Quarterly, 17(1), 99-118.
102 Osilla, K. C., Van Busum, K., Schnyer, C. et al. (2012). Systematic Review of the Impact of Worksite Wellness Programs. Am J Manag Care. 2012;18(2):e68-e81
103 Ekpu, V. U. and Brown, A. K. (2015). The Economic Impact of Smoking and of Reducing Smoking Prevalence: Review of Evidence. Tobacco Use Insights, 8, 1-35.
104 Cahill, K. and Lancaster, T. (2014) Workplace interventions for smoking cessation. Cochrane Database Syst Rev. Feb 26(2):CD003440.
105 Chung, M., Melnyk, P., Blue, D. et al. (2009) Worksite Health Promotion: The Value of the Tune Up Your Heart Program. Population Health Management 12(6): 297-305.
106 Janer, G., Sala, M. and Kogevinas, M. (2002). Health promotion traits at worksites and risk factors for cancer. Scandinavian Journal of Work, Environment & Health, 28(3), 141-157.
107 Gomel, M., Oldenburg, B., Simpson, J. M. et al. (1993). Work-Site Cardiovascular Risk Reduction: A Randomized Trial of Health Risk Assessment, Education, Counseling, and Incentives. American Journal of Public Health, 83(9), 1231-1238.
108 Bourgeois, F. T., Simons, W. W., Olson, K> et al. (2008). Evaluation of influenza prevention in the workplace using a personally controlled health record: randomized controlled trial. Journal Of Medical Internet Research, 10(1), e5-e5.
109 Campbell, M. K., Tesaro, I., DeVellis, B. et al. (2002). Effects of a Tailored Health Promotion Program for Female Blue-Collar Workers: Health Works for Women. Preventive Medicine, 34(3), 313.
110 McHugh, J. and Suggs, L. S. (2012). Online tailored weight management in the worksite: Does it make a difference in biennial health risk assessment data? Journal of Health Communication, 17(3), 278-293.
111 Colkesen, E. B., Ferket, B. S., Tijssen, J. G. P. et al. (2011). Effects on cardiovascular disease risk of a web-based health risk assessment with tailored health advice: a follow-up study. Vascular Health And Risk Management, 7, 67-74.
112 Farag, N. H., Moore, W. E., Thompson, D. M. et al. (2010). Evaluation of a community-based participatory physical activity promotion project: effect on cardiovascular disease risk profiles of school employees. BMC Public Health, 10, 313-313.
113 Racette, S. B., Deusinger, S. S., Inman, C. L. et al. (2009). Worksite Opportunities for Wellness (WOW): Effects on cardiovascular disease risk factors after 1 year. Preventive Medicine, 49(2/3), 108-114.
114 Naito, M., Nakayama, T., Okamura, T. et al. (2008). Effect of a 4-year workplace-based physical activity intervention program on the blood lipid profiles of participating employees: the high-risk and population strategy for occupational health promotion (HIPOP-OHP) study. Atherosclerosis, 197(2), 784-790.
The return of investment for preventive healthcare programmes

| Physical exam | Mortality; morbidity; workdays lost due to short-term disability |
|---------------|---------------------------------------------------------------|
| Serxner et al. (2001),130 Hunt and Habeck (1993),131 Burton et al. (2002),132 Krogbøll et al. 2012,133 Si et al. 2014134 |

115 Muto, T., Hashimoto, M., Haruyama, Y. et al. (2006). Evaluation of a workplace health promotion program to improve cardiovascular disease risk factors in sales representatives. International Congress Series, 1294, 131-134.

116 Muto, T. and Yamauchi, K. (2001). Evaluation of a multicomponent workplace health promotion program conducted in Japan for improving employees’ cardiovascular disease risk factors. Preventive Medicine: An International Journal Devoted to Practice and Theory, 35(6), 571-577.

117 Sorensen, G., Stoddard, A., Hunt, M. K. et al. (1998). The effects of a health promotion- health protection intervention on behavior change: The WellWorks Study. American Journal of Public Health, 88(11), 1685-1690.

118 Glasgow, R. E., Terborg, J. R., Hollis, J. F., Severson, H. H., & Boles, S. M. (1995). Take heart: results from the initial phase of a work-site wellness program. American Journal Of Public Health, 85(2), 209-216.

119 Ebunlomo, E. O., Hare-Everline, N. and Weber, A. (2015). Development of a Comprehensive 12-Week Health Promotion Program for Houston Airport System. Texas Public Health Journal, 67(1), 11-13.

120 Conn, V. S., Hafdahl, A. R., Cooper, P. S. et al. (2009). Meta-analysis of workplace physical activity interventions. American Journal of Preventive Medicine, 37(4), 330-339.

121 Bachar, J. J., Lefler, L. J., Reed, L. et al. (2006). Cherokee Choices: a diabetes prevention program for American Indians. Preventing Chronic Disease, 3(3), A103-A103.

122 Bertera, R. L. (1993). Behavioral risk factor and illness day changes with workplace health promotion: two-year results. American Journal Of Health Promotion: AJHP, 7(5), 365-373.

123 Bhiri, S., Maatoug, J., Zammit, N. et al. (2015). A 3-Year Workplace-Based Intervention Program to Control Noncommunicable Disease Risk Factors in Sousse, Tunisia. Journal Of Occupational And Environmental Medicine / American College Of Occupational And Environmental Medicine, 57(7), e72-e77.

124 Cahalin, L. P., Myers, J., Kaminsky, L. et al. (2014). Current trends in reducing cardiovascular risk factors in the United States: focus on worksite health and wellness. Progress In Cardiovascular Diseases, 56(5), 476-483.

125 Osilla, K. C., Van Busum, K., Schnyer, C. et al. (2012). Systematic Review of the Impact of Worksite Wellness Programs. Am J Manag Care. 2012;18(2):e68-e81

126 Cobic, L. J., Vos, T. and Veereman, J. L. (2010). Cost-effectiveness of interventions to promote fruit and vegetable consumption. Plos One, 5(11), e14148-e14148.

127 Dalziel, K. and Segal, L. (2007). Time to give nutrition interventions a higher profile: cost-effectiveness of 10 nutrition interventions. Health Promotion International, 22(4), 271-283.

128 Rongen, A., Robroek, S. J. W., van Lenthe, F. J. et al. (2013). Workplace health promotion: A meta-analysis of effectiveness. American Journal of Preventive Medicine, 44(4), 406-415.

129 Janer, G., Sala, M. and Kogevisnas, M. (2002). Health promotion traits at worksites and risk factors for cancer. Scandinavian Journal of Work, Environment & Health, 28(3), 141-157

130 Serxner, S., Gold, D., Anderson, D., & Williams, D. (2001). The impact of a worksite health promotion program on short-term disability usage. Journal Of Occupational And Environmental Medicine / American College Of Occupational And Environmental Medicine, 43(1), 25-29.

131 Hunt, H. A. and Habeck, R. V. (1993). The Michigan Disability Prevention Study: Research Highlights. W.E. Upjohn Institute for Employment Research, Staff Working Papers: 93-18.

132 Burton, W. N., Chen, C., Conti, D. J. et al. (2002). The value of the periodic executive health examination: experience at Bank One and summary of the literature. Journal Of Occupational And Environmental Medicine / American College Of Occupational And Environmental Medicine, 44(8), 737-744.

133 Krogbøll, L. T., Jørgensen, K. J., Gronhøj Larsen, C. et al. (2012). General health checks in adults for reducing morbidity and mortality from disease. The Cochrane Library.
| Prenatal care | Maternal and postnatal mortality and morbidity | Hutcheon et al (2011),135 Dolea and AbouZahr (2003),136 Billano et al. (2014),137 WHO (2011),138 von Dadelszen and Magee (2014),139 Knight et al. (2000)140 |
| HIV/AIDS | Mortality rate, incidence rate, virological outcomes, weight | Van der Borght et al. (2009),141 Fielding et al. (2008),142 Charalambous et al. (2007),143 George (2006)144 |

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134 Si, S., Moss, J. R., Sullivan, T. R. et al. (2014) Effectiveness of general practice-based health checks: a systematic review and meta-analysis. Br J Gen Pract 2014; DOI: 10.3399/bjp14X676456
135 Hutcheon, J. A., Lisonkova, S. and Joseph, K. S. (2011). Epidemiology of pre-eclampsia and the other hypertensive disorders of pregnancy. Best practice & research Clinical obstetrics & gynaecology, 25(4), 391-403.
136 Dolea, C. and AbouZahr, C. (2003) Global burden of hypertensive disorders of pregnancy in the year 2000. Evidence and Information for Policy (EIP), World Health Organization, Geneva, July 2003.
137 Bilano V. L., Ota E., Ganchimeg T. et al. (2014) Risk Factors of Pre-Eclampsia/Eclampsia and Its Adverse Outcomes in Low-and Middle-Income Countries: A WHO Secondary Analysis. PLoS ONE 9(3): e91198.
138 WHO (2011) WHO recommendations for Prevention and treatment of pre-eclampsia and eclampsia. Geneva: World Health Organization.
139 Von Dadelszen, P. and Magee, L.A. (2014) Pre-eclampsia: An Update. Curr Hypertens Rep 16:454
140 Knight, M., Duley, K.M., Henderson-Smart, D.J. et al. (2000) Antiplatelet agents for preventing and treating pre-eclampsia. Cochrane Database of Systematic Reviews, Issue 2.
141 Van der Borght, S. F., Clevenbergh, P., Rijckhorst, H. et al. (2009). Mortality and morbidity among HIV type-1-infected patients during the first 5 years of a multicountry HIV workplace programme in Africa. Antiviral Therapy, 14(1), 63-74.
142 Fielding, K. L., Charalambous, S., Stenson, A. L. et al. (2008). Risk factors for poor virological outcome at 12 months in a workplace-based antiretroviral therapy programme in South Africa: a cohort study. BMC Infectious Diseases, 8, 93-93.
143 Charalambous, S., Innes, C., Muirhead, D. et al. (2007). Evaluation of a workplace HIV treatment programme in South Africa. AIDS, 21(Suppl 3), S73-S78.
144 George, G. (2006). Workplace ART programmes: Why do companies invest in them and are they working? African Journal of AIDS Research (AJAR), 5(2), 179-188.
## Appendix C: Parameters used in the ROI calculation

### Table 10: Calibration parameters

| Parameter                                                  | Value   | Source               |
|------------------------------------------------------------|---------|----------------------|
| % males among employees                                    | 50%     | User input           |
| % of employees aged 15-49                                  | 81%     | User input           |
| % of employees aged 50-69                                  | 16%     | User input           |
| % of employees aged 70+                                    | 3%      | User input           |
| Workdays in a year                                         | 250     | User input           |
| Average daily wage                                         | $102    | User input           |
| Daily sickness pay (%)                                     | 100%    | User input           |
| No. of days of illness with full pay                       | 3       | User input           |
| Absenteeism due to child illness (as % of absence due to own illness) | 70%     | User input           |
| Administrative costs (overheads)                           | $10,000 | User input           |
| Average replacement cost per employee                      | $10,000 | User input           |
| Absenteeism: Diphtheria                                    | 100%    | Assumed              |
| Absenteeism: Haemophilus influenzae type b                  | 100%    | Assumed              |
| Absenteeism: Hepatitis A                                   | 100%    | Assumed              |
| Absenteeism: Hepatitis B                                   | 100%    | Assumed              |
| Absenteeism: HPV                                           | 0%      | Assumed              |
| Absenteeism: Influenza                                     | 40%     | Akazawa et al. (2003), Shanzer et al. (2011) |
| Absenteeism: Measles, Mumps, Rubella                       | 100%    | Assumed              |
| Absenteeism: Meningococcal                                 | 100%    | Assumed              |
| Absenteeism: Pertussis (whooping cough)                    | -       | Assumed              |
| Absenteeism: Pneumococcal                                  | 100%    | Assumed              |
| Absenteeism: Polio                                         | 60%     | Assumed              |
| Absenteeism: Rabies                                        | 100%    | Assumed              |
| Absenteeism: Rotavirus                                     | -       | Assumed              |
| Absenteeism: Tetanus                                       | 100%    | Assumed              |

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145 Akazawa, M., Sindelar, J. L., & Paltiel, A. D. (2003). Economic Costs of Influenza-Related Work Absenteeism. Value in Health, 6(2), 107-115.

146 Schanzer, D. L., Zheng, H., & Gilmore, J. (2011). Statistical estimates of absenteeism attributable to seasonal and pandemic influenza from the Canadian Labour Force Survey. BMC infectious diseases, 11(1), 90.
| Disease                  | Absenteeism | Presenteeism |
|-------------------------|-------------|--------------|
| Tuberculosis            | 100% Assumed| 0% Assumed   |
| Typhoid                 | 100% Assumed| 0% Assumed   |
| Varicella               | 100% Assumed| 0% Assumed   |
| Yellow fever            | 100% Assumed| 0% Assumed   |
| Zoster                  | 0% Assumed  | 20% Assumed  |
| Diphtheria              | 0% Assumed  | 0% Assumed   |
| Haemophilus influenza type b | 0% Assumed | 0% Assumed   |
| Hepatitis A             | 0% Assumed  | 20% Assumed  |
| Hepatitis B             | 0% Assumed  | 20% Assumed  |
| HPV                     | 2% Assumed  | 0% Assumed   |
| Influenza               | 20% Assumed | 0% Assumed   |
| Measles, Mumps, Rubella | 0% Assumed  | 0% Assumed   |
| Meningococcal           | 0% Assumed  | 0% Assumed   |
| Pertussis (whooping cough) | 0% Assumed | 0% Assumed   |
| Pneumococcal            | 0% Assumed  | 0% Assumed   |
| Polio                   | 20% Assumed | 0% Assumed   |
| Rabies                  | 0% Assumed  | 0% Assumed   |
| Rotavirus               | 0% Assumed  | 0% Assumed   |
| Tetanus                 | 0% Assumed  | 0% Assumed   |
| Tuberculosis            | 0% Assumed  | 0% Assumed   |
| Typhoid                 | 0% Assumed  | 0% Assumed   |
| Varicella               | 0% Assumed  | 0% Assumed   |
| Yellow fever            | 0% Assumed  | 0% Assumed   |
| Zoster                  | 5% Assumed  | 0% Assumed   |

Absence:

- Breast cancer (hours per year, low) 66.2
- Cervical cancer (hours per year, low) 115.6
- Colorectal cancer (hours per year, low) 243.5
- Skin cancer (hours per year, low) 17.8
- Breast cancer (hours per year, high) 185.9
- Cervical cancer (hours per year, high) 137.1
- Colorectal cancer (hours per year, high) 282.8
- Skin cancer (hours per year, high) 99.1

Vaccination effectiveness:

- Hepatitis A/B (Bi-Valent) 95%
- Hepatitis A 95%
- Hepatitis B 95%
- Human Papillomavirus (HPV) 93%
- Influenza 45%
- Measles, Mumps, Rubella (MMR) 95%
- Meningococcal 85%
- Pneumococcal 55%

References:

147 Yabroff, K. R., Davis, W. W., Lamont, E. B., Fahey, A., Topor, M., Brown, M. L., & Warren, J. L. (2007). Patient time costs associated with cancer care. Journal of the National Cancer Institute, 99(1), 14-23.

148 http://www.cdc.gov/
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| Vaccination effectiveness: Rabies         | 100% |
| Vaccination effectiveness: Tetanus (Td/Tdap) | 100% |
| Vaccination effectiveness: Typhoid        | 72%  |
| Vaccination effectiveness: Varicella      | 90%  |
| Vaccination effectiveness: Zoster         | 51%  |
| Vaccination effectiveness: Polio          | 95%  |
| Vaccination effectiveness: Yellow Fever   | 95%  |
| Treatment length Hepatitis A/B (Bi-Valent) (days, low) | 14   |
| Treatment length Hepatitis A (days, low)  | 30   |
| Treatment length Hepatitis B (days, low)  | 14   |
| Treatment length Human Papillomavirus (HPV) (days, low) | -    |
| Treatment length Influenza (days, low)    | 3    |
| Treatment length Measles, Mumps, Rubella (MMR) (days, low) | 5    |
| Treatment length Meningococcal (days, low) | 7    |
| Treatment length Pneumonia (days, low)    | 7    |
| Treatment length Rabies (days, low)       | 0    |
| Treatment length Tetanus (Td/Tdap) (days, low) | 14   |
| Treatment length Typhoid (days, low)      | 7    |
| Treatment length Varicella (days, low)    | 5    |
| Treatment length Zoster (days, low)       | 14   |
| Treatment length Polio (days, low)        | 2    |
| Treatment length Yellow Fever (days, low) | 5    |
| Treatment length Hepatitis A/B (Bi-Valent) (days, high) | 60   |
| Treatment length Hepatitis A (days, high) | 60   |
| Treatment length Hepatitis B (days, high) | 30   |
| Treatment length Human Papillomavirus (HPV) (days, high) | -    |
| Treatment length Influenza (days, high)   | 10   |
| Treatment length Measles, Mumps, Rubella (MMR) (days, high) | 12   |
| Treatment length Meningococcal (days, high) | 21   |
| Treatment length Pneumonia (days, high)   | 14   |
| Treatment length Rabies (days, high)      | 1    |
| Treatment length Tetanus (Td/Tdap) (days, high) | 30   |
| Treatment length Typhoid (days, high)     | 14   |
| Treatment length Varicella (days, high)   | 7    |
| Treatment length Zoster (days, high)      | 28   |
| Treatment length Polio (days, high)       | 5    |
| Treatment length Yellow Fever (days, high) | 30   |
| Relative risk (compared to no-screening group): breast | 0.85/0.68 |

Centers for Disease Control and Prevention

Nelson, H. D., Tyne, K., Naik, A., Bougatsos, C., Chan, B. K., & Humphrey, L. (2009). Screening for breast cancer: an update for the US Preventive Services Task Force. Annals of internal medicine, 151(10), 727-737.

149 Nelson, H. D., Tyne, K., Naik, A., Bougatsos, C., Chan, B. K., & Humphrey, L. (2009). Screening for breast cancer: an update for the US Preventive Services Task Force. Annals of internal medicine, 151(10), 727-737.
| Parameter                                                                 | Value     | Source                                                                 |
|-------------------------------------------------------------------------|-----------|------------------------------------------------------------------------|
| Cancer screening (by age group)                                         | /1.12     |                                                                        |
| Relative risk (compared to no-screening group): pap smear                | 0.65      | Peirson et al. (2013)                                                  |
| Relative risk (compared to no-screening group): FOBT                     | 0.32      |                                                                        |
| Relative risk (compared to no-screening group): sigmoidoscopy            | 0.53      | Brennen et al. (2014)                                                  |
| Relative risk (compared to no-screening group): colonoscopy              | 0.84      | Bretthauer (2011)                                                      |
| Relative risk (compared to no-screening group): skin                     | 1.00      | Assumed                                                                |
| Smoking abstinence rate (6 months, low): Tobacco Addiction Counseling    | 0.168     | Cahill & Lancaster (2014)                                              |
| Smoking abstinence rate (6 months, low): Nicotine replacement therapy    | 0.191     | Tobacco, T. C. P. G. T. (2008)                                         |
| Smoking abstinence rate (6 months, low): Other Smoking Cessation         | 0.188     | Tobacco, T. C. P. G. T. (2008)                                         |
| Smoking abstinence rate (6 months, high): Tobacco Addiction Counseling   | 0.298     | Tobacco, T. C. P. G. T. (2008)                                         |
| Smoking abstinence rate (6 months, high): Nicotine replacement therapy   | 0.321     | Tobacco, T. C. P. G. T. (2008)                                         |
| Smoking abstinence rate (6 months, high): Other Smoking Cessation        | 0.285     | Tobacco, T. C. P. G. T. (2008)                                         |
| Smoking absenteeism                                                     | 0.5%      | RAND Europe research                                                   |
| Smoking presenteeism                                                    | 1.7%      | RAND Europe research                                                   |
| Blood pressure treatment effect (6 months, mmHg, low)                   | 2.96      | Racette et al. (2009)                                                 |
| Blood pressure treatment effect (6 months, mmHg, high)                  | 8.24      | Racette et al. (2009)                                                 |
| High blood pressure absenteeism                                          |           | RAND Europe research                                                   |
| High blood pressure presenteeism                                         |           | RAND Europe research                                                   |
| High cholesterol treatment effect (6 months, mmol/L, low)               | 0.07      | Diabetes Prevention Program Research Group (2002)                      |
| High cholesterol treatment effect (6 months, mmol/L, high)              | 0.26      | Diabetes Prevention Program Research Group (2002)                      |
| High cholesterol presenteeism                                            |           | Diabetes Prevention Program Research Group (2002)                      |
| Anticipated reduction in diabetes incidence (6 months, low), varies by age and gender | 48%      | Diabetes Prevention Program Research Group (2002)                      |
| Anticipated reduction in diabetes incidence (6 months, high)            | 66%       | Diabetes Prevention Program Research Group (2002)                      |

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150 Peirson, L., Fitzpatrick-Lewis, D., Ciliska, D., & Warren, R. (2013). Screening for cervical cancer: a systematic review and meta-analysis. Systematic reviews, 2(1), 1.
151 Brenner, H., Stock, C., & Hoffmeister, M. (2014). Effect of screening sigmoidoscopy and screening colonoscopy on colorectal cancer incidence and mortality: systematic review and meta-analysis of randomised controlled trials and observational studies. Bmj, 348, g2467.
152 Bretthauer, M. (2011). Colorectal cancer screening. Journal of internal medicine, 270(2), 87-98.
153 Cahill, K., & Lancaster, T. (2014). Workplace interventions for smoking cessation. The Cochrane Library.
154 Tobacco, T. C. P. G. T. (2008). A clinical practice guideline for treating tobacco use and dependence: 2008 update: a US public health service report. American journal of preventive medicine, 35(2), 158-176.
155 Racette, S. B., Deusinger, S. S., Inman, C. L., Burlis, T. L., Hightstein, G. R., Buskirk, T. D., ... & Peterson, L. R. (2009). Worksite Opportunities for Wellness (WOW): effects on cardiovascular disease risk factors after 1 year. Preventive medicine, 49(2), 108-114.
156 Diabetes Prevention Program Research Group. (2002). Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl j Med, 2002(346), 393-403.
| High), varies by age and gender | Diabetes absenteeism |
|---------------------------------|----------------------|
| Diabetes presenteeism           | RAND Europe research |
| HIV: life expectancy (untreated), >350 CD4 cells, varies by age and gender | 8 Assumed |
| HIV: life expectancy (untreated), 201-350 CD4 cells, varies by age and gender | 4 |
| HIV: life expectancy (untreated), 50-200 CD4 cells, varies by age and gender | 1.9 |
| HIV: life expectancy (untreated), <50 CD4 cells, varies by age and gender | 0.8 Zwahlen and Egger (2006)<sup>157</sup> |
| HIV: life expectancy (treated, low), >350 CD4 cells, varies by age and gender | 19.1 |
| HIV: life expectancy (treated, low), 201-350 CD4 cells, varies by age and gender | 17.8 |
| HIV: life expectancy (treated, low), 50-200 CD4 cells, varies by age and gender | 16.5 |
| HIV: life expectancy (treated, low), <50 CD4 cells, varies by age and gender | 15.1 |
| HIV: life expectancy (treated, high), >350 CD4 cells, varies by age and gender | 29.3 Johnson et al. (2013)<sup>158</sup> |
| HIV: life expectancy (treated, high), 201-350 CD4 cells, varies by age and gender | 27.5 |
| HIV: life expectancy (treated, high), 50-200 CD4 cells, varies by age and gender | 24.3 |
| HIV: life expectancy (treated, high), <50 CD4 cells, varies by age and gender | 22.5 Meyer-Rath et al. (2015)<sup>159</sup> |
| HIV: Absenteeism (days per year), >350 CD4 cells | 7 |
| HIV: Absenteeism (days per year), 201-350 CD4 cells | 2 |
| HIV: Absenteeism (days per year), 50-200 CD4 cells | 12 |
| HIV: Absenteeism (days per year), <50 CD4 cells | 0 |

<sup>157</sup> Zwahlen, M., & Egger, M. (2006). Progression and mortality of untreated HIV-positive individuals living in resource-limited settings: Update of literature review and evidence synthesis. Geneva: UNAIDS.

<sup>158</sup> Johnson, L. F., Mossong, J., Dorrington, R. E., Schomaker, M., Hoffmann, C. J., Keiser, O., ... & Garone, D. B. (2013). Life expectancies of South African adults starting antiretroviral treatment: collaborative analysis of cohort studies. PLoS Med, 10(4), e1001418.

<sup>159</sup> Meyer-Rath, G., Pienaar, J., Brink, B., van Zyl, A., Muirhead, D., Grant, A., ... & Vickerman, P. (2015). The Impact of Company-Level ART Provision to a Mining Workforce in South Africa: A Cost–Benefit Analysis. PLoS Med, 12(9), e1001869.
Appendix D: Calculation tool manual

The ROI tool calculates annual net return on investment (i.e. the net benefit per US$ invested) on healthcare interventions offered by the South African GSK entity to employees and their dependants. The calculated return should be interpreted as a conservative estimate as a result of arguably understated prevalence and mortality rates for some of the diseases, possible side-effects of the offered treatment, and the broader social impact that is not included in the model. In addition, the return on investment figures do not include effects such as increased employee engagement, which can improve employee productivity but is extremely difficult to monetise. Moreover, since some of the interventions do not require recurring investments but yield long-time benefits, the return on investment would be higher considering a longer time period. Besides return on investment output, the tool provides a concise summary of relevant diseases/risk factors and their baseline prevalence, vaccination, screening and/or treatment rates in the country. Changing input parameters (see below), the tool can be used for sensitivity analysis or to calculate RoI for interventions offered by other GSK entities. By default, the tool calculates benefits over a 5-year period after the intervention, using annual discounting specified in the input data (2% by default).

Using the tool

The spreadsheet consists of two main sheets – ‘RoI’ and ‘Input Data’ – and several hidden sheets with formulas for ROI calculation in the background. The hidden sheets can be shown at any time by right-clicking the nameplate of one of the visible sheets and selecting the ‘Unhide’ option as shown on Figure 1.

Figure 2: Showing hidden sheets with calculations
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The first sheet ‘RoI’ contains the main output information: selected country, number of people covered, aggregate return on investment, and RoI by intervention category as shown in Figure 3. The output data are automatically updated when the input data (see below) are changed. Note that because the aggregate RoI is weighted by the number of participants in each intervention, the average of results by category is different than the overall result.

The low and high estimates represent the lower and upper bounds of estimation results and stem from a degree of uncertainty in the inputs, for instance the average treatment length or likelihood of intervention success. Further, any intervention with no participants is assumed to not be offered and therefore has no resulting RoI.

**Figure 3: ‘RoI’ sheet - output data**

Below the tabulated data, the numbers are represented graphically as shown in Figure 4. In the graph, the orange bars represent the mid-point estimate of the RoI by intervention category (category numbers correspond to those in the table above) and the transparent light yellow bars show size of the intervals between the lower and upper bounds.

The data in sheet ‘RoI’ are updated automatically and the formulas should not be altered in any way.
The sheet ‘Input Data’ contains all inputs to be changed by the user. Specifically, cells with green background contain mostly GSK unit specific data and should be updated with country-specific GSK information. Some of the cells with green background then define broader model parameters such as annual discount rate or the assumed period of calculated return for interventions with lasting effects. Cells with light orange background are intervention-specific assumed data that can be changed by the user. Those correspond mostly to intervention participation and costs. Finally, data with white background come from the GSK database or external sources and should not be manipulated with unless when adjusting the parameters to another country.\textsuperscript{160}

Starting from the left (see Figure 5), the sheet contains employee and cost related data such as the age and structure of the workforce or the average daily wage. Again, as soon as any of the data with the green or orange background is changed, the results shown in the ‘RoI’ sheet are updated. The cells to be updated are:

- Age structure
- Gender structure
- Number of workdays in a year, excluding public holidays and weekends. Alternatively, annual leave allowance can further be subtracted.
- Average or median daily wage across all GSK employees in the country
- Daily sickness pay (in % of the default salary) paid after the first (in the next cell specified) number of days of a long-term absence.

\textsuperscript{160} In order to allow easy operability (changing aggregate input parameters in a single sheet), the actual age-gender intervention participation is calculated using the proportion of the age-gender subgroup in the total GSK unit workforce and the total intervention participation, rather than using the actual participation statistics. That is, assuming that the input data specify e.g. that a particular GSK unit has 80% of employees aged 15-49, 52% of employees are female, and there are 100 participants in influenza vaccination in total, the model will assume that there are 42 women aged 15-49 participating in influenza vaccination intervention although the real data may show that the number is e.g. higher because women are more likely to get vaccinated than men. Should the user prefer to use the actual data instead, the number of participants for each age-gender subgroup can be specified directly in the calculation sheet (see below).
• Absenteeism due to child illness as a % of adult absence. This represents the possible need to stay home with sick children; for simplicity, we assume that children are on average treated for as long as adults, yet only part of that time the related worker actually needs to be absent from work.
• Employees infected as a direct result of being in touch with an infected person in the organisation.
• Administrative costs across all interventions (i.e. costs beyond the standard per-patient costs of intervention), ideally including all per-patient costs for non-employee patients.
• Replacement costs per employee, including administrative as well as opportunity costs (i.e. essentially time lost working) as a result of an average employee leaving the firm.
• Time spent participating in interventions if participating during the work hours.
• Annual discount rate
• Number of years to calculate return for (for interventions with effects lasting over several years)

Figure 5: Part of the country-specific GSK data to be updated by the user

| Country             | South Africa          |
|---------------------|-----------------------|
| Country code        | ZAF                   |
| Interventions launch date | 8/3/15             |
| People covered      | 1,393                 |
| - no. of employees  | 668                   |
| - no. of dependants | 725                   |
| Age structure       |                       |
| 15-49               | 80.9%                 |
| 50-69               | 15.9%                 |
| 70+                 | 3.2%                  |
| % Male              | 50%                   |
| Workdays in a year  | 250                   |
| Average daily wage  | $102                  |
| Daily sickness pay (%) | 100%               |
| Days of full sickness pay | 3                |
| Absenteeism due to child illness (% of adult absence) | 70% |
| Employees infected  | 5                     |

Following to the right, intervention-specific data on costs and participation can be specified and the detailed ROI results per intervention are shown (see Figure 6). Data in cells with white background are automatically extracted from the available data provided by GSK while data in cells with orange background can be changed. Only the latter data are used in the actual calculation. The user can therefore see the actual participation and costs and use the right column to assess the effects of possible changes.
Finally, to the far right there are several additional input parameters, both assumed and obtained from the literature (Figure 7). The parameters that can be adjusted are:

- % of time treated spent absent (e.g. for influenza, employees are assumed to stay home only 40% of the time being ill while for most of the other illnesses we assume that their conditions do not allow them to go to work at all).
- Assumed presenteeism – for illnesses with 100% absenteeism, presenteeism is 0% by definition. Otherwise, presenteeism is the productivity loss while being present at the workplace.
- Absence due to cancer treatment – the data were obtained from a peer-reviewed study but may be changed to see the impact on the RoI.

Figure 7: Other input parameters
For precise calculation, the number of participants should only be limited to workers and the cost of treating their dependants should be added to the Administrative costs in the cell C50.

The other, by default hidden sheets contain the actual formulas for RoI calculation and differ by intervention category. The last two sheets, ‘Data’ and ‘Utilisation’ contain country-specific data obtained mainly from the Global Burden of Disease (GBD) database and data obtained from GSK; those are automatically extracted in the formulas and need to be updated when using the tool for another country or when new utilisation data are available. The GBD data are provided as a part of this report and can otherwise be downloaded at http://ghdx.healthdata.org/gbd-data-tool (also referenced in the RoI spreadsheet).

To recalibrate the tool for another country, simply delete all data in columns J-Z in the ‘Data’ sheet (while keeping the column headers) and paste new data from the provided files using the copy and paste functions.

The ROI formulas work on the principle described in the methodological report, below is a brief overview of the calculation for vaccination interventions (see also Figure 8).

From the left, employees are distributed by gender and age group (selected according to the GBD cut-offs). For each subgroup, the number of participants in the particular intervention is obtained using a proportional distribution of the total assumed number of employees participating with respect to age and gender structure of the firm. Following are data obtained from the GBD database, population vaccination rate, vaccine effectiveness, and other parameters set in the ‘Input Data’ sheet. Those are then multiplied to obtain baseline and actual costs, the difference of which denotes savings stemming from the intervention. The formulas to determine baseline and actual costs in vaccination interventions are described in Table 1.

Finally, in order to calculate the overall ROI for each particular intervention (i.e. not the aggregate ROI across multiple interventions), costs and benefits per participant are calculated using a simple division of the overall costs and benefits by the number of participants.

Figure 8: Calculation of RoI for vaccination interventions
| Baseline | Baseline | Actual costs | Actual costs | Benefit | Benefit | ROI (low) | ROI (high) | Benefits (low) | Benefits (high) | Costs |
|---------|---------|--------------|--------------|---------|---------|-----------|-----------|----------------|----------------|-------|
| $ 63.56 | $ 271.15 | $ 22.47      | $ 32.83      | $ 41.08 | $ 238.30 | $ 19.33   | $ 2.13     | $ 12.33        | $ 41.08         | $ 238.30 | $ 19.33 |
| $ 114.48| $ 487.92 | $ 65.64      | $ 82.92      | $ 50.79 | $ 405.61 | $ 57.98   | $ 0.88     | $ 7.00         | $ 16.95         | $ 159.20 | $ 19.33 |
| $ 23.09 | $ 90.65  | $ 10.35      | $ 23.73      | $ 2.73  | $ 66.92  | $ 18.33   | $ 0.14     | $ 3.46         | $ 2.73          | $ 66.92  | $ 19.33 |
| $ 33.71 | $ 59.97  | $ 19.94      | $ 21.89      | $ 0.23  | $ 32.02  | $ 19.33   | $ 0.32     | $ 1.66         | $ 0.23          | $ 32.02  | $ 19.33 |
| $ -     | $ -      | $ -          | $ -          | $ -     | $ -      | $ -       | $ -        | $ -            | $ -             | $ -     | $ -    |
| $ -     | $ -      | $ -          | $ -          | $ -     | $ -      | $ -       | $ -        | $ -            | $ -             | $ -     | $ -    |
| $ -     | $ -      | $ -          | $ -          | $ -     | $ -      | $ -       | $ -        | $ -            | $ -             | $ -     | $ -    |
| $ -     | $ -      | $ -          | $ -          | $ -     | $ -      | $ -       | $ -        | $ -            | $ -             | $ -     | $ -    |
| $ 2.74  | $ 5.57   | $ 17.10      | $ 17.24      | $ 14.36 | $ 11.67  | $ 16.97   | $ 0.85     | $ 0.69         | $ 14.36         | $ 11.67  | $ 16.97 |
| $ 2.41  | $ 4.89   | $ 17.09      | $ 17.21      | $ 14.88 | $ 12.32  | $ 16.97   | $ 0.86     | $ 0.73         | $ 14.88         | $ 12.32  | $ 16.97 |
| $ -     | $ -      | $ -          | $ -          | $ -     | $ -      | $ -       | $ -        | $ -            | $ -             | $ -     | $ -    |
| $ -     | $ -      | $ -          | $ -          | $ -     | $ -      | $ -       | $ -        | $ -            | $ -             | $ -     | $ -    |
| $ -     | $ -      | $ -          | $ -          | $ -     | $ -      | $ -       | $ -        | $ -            | $ -             | $ -     | $ -    |
| $ -     | $ -      | $ -          | $ -          | $ -     | $ -      | $ -       | $ -        | $ -            | $ -             | $ -     | $ -    |