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# Digital health interventions for employees

Are digital health interventions able to improve a company's performance?

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<p>The purpose of this study was to investigate the effectiveness of digital health-interventions in improving a company's workforce. Due to increasing medical expenses, employers are finding it worthwhile to invest in the health of their employees. Implementing a health intervention (a program that encourages participants to make healthy behavioural changes) often reduces medical costs and improves productivity. New technology allows interventions to be delivered digitally.</p> <p>An exploratory method of gathering secondary data was applied. This qualitative approach was well suited for gaining a broad understanding of the subject in order to assess current digital health interventions and the most significant challenges to industry.</p> <p>The results show that digital health interventions are capable of reducing employee health risks and medical expenditures, especially for high risk health groups. Significant challenges to the industry remain. An effective digital health improvement service is technologically complex and requires the incorporation of physician input and behavioural change theory. From a legal standpoint, the bureaucracy associated with regulatory bodies may slow the adoption of digital services into employee benefit offerings. Adoption is slow within the medical community and low user adoption rates may undermine benefits to the employer.</p> <p>This study concludes that due to strong correlations between employee health and performance, human resource departments should support employee health by offering health intervention programs as necessary. Digital health interventions should be closely regarded by HR departments as a potential approach to cost effectively managing the performance of the firm's human capital.</p>	
Keywords	HRM, health, digital health interventions, productivity, behavior, savings, expenses, mobile, wellbeing, performance, ROI

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## 1 Introduction

Many employers are becoming increasingly involved with the health of their employees. Some will offer to cover a significant portion of their workers' medical expenses, or compensate their gym memberships. These benefits can help attract valuable applicants. However, there is a large body of research supporting an important alternative reason: healthy employees are good for business.

Firms in the United States began offering health benefits to employees in the early 1900s. Since then, employers have become increasingly burdened as the cost of providing medical care increases faster than inflation, as well as the prevalence of medical conditions rising across all age groups. Many researchers have studied approaches of improving the health of employees to combat these costs. The results are promising. On average, money spent on improving employee health results in medical expense savings that are three times greater than the investment. In addition to those returns, healthy employees take fewer sick days and are shown to be more focused while at work, thereby being more productive. An effective route to health improvement is a wellness program, also called a health intervention, which encourages participants to make healthier decisions on factors such as diet, exercise, stress reduction, and cessation of unhealthy behaviours like smoking.

Currently, some companies are delivering health interventions to create positive changes in behaviour entirely through digital programs. The automation of digital processes is an opportunity to minimize human labour expenses. The possibility of delivering interventions at a low cost opens a door for employers to improve employee health with little investment. Some employers are currently implementing digital health improvement programs, but their effectiveness is insufficiently researched due to the newness of the technology and industry. This paper investigates the effectiveness of digital health interventions in improving a company's workforce.

The topic area will be approached from the perspective of the academic community. Recent scientific literature concerning digital health interventions will be reviewed to evaluate the state of their efficacy and progress of capabilities. The novelty of the technology warrants a closer look at what significant challenges will need to be met for the growth of the industry.

## 2 Literature Review

### 2.1 Overview

It is important to review the literature and relevant ideas in the field of human resource management to understand the importance of workforce health initiatives. This literature review will take a chronological and evolutionary perspective on the development of people management to illuminate why applications of digital health technology in the workforce is a valuable topic of research. This review is not geographically limited, but it may be recognized that most of the development and literature in this field was initiated in United States of America.

### 2.2 Historical events and research as a contextual guide

#### 2.2.1 Early human resource management

The study of how to organize large groups of people has a long history, making possible feats like the marshalling of huge armies, erecting massive pyramids and constructing extensive irrigation systems (Price 2004). Early managerial concepts have their origins in the early 1900s, when Frederick Taylor and other industrial engineers developed the principles of “scientific management” to systematize the extraction of maximum output from workers. He studied worker motions against time, sought the “one best way” to perform each task, and emphasized the importance of defining standards for performance (Varma, Budhwar & DeNisi 2008:98-99). The strict discipline and control of his ideology was not always successful in practice, and was criticized by many managers and overworked employees of the time. However, Taylor’s ideas positively influenced industrial developments like the division of tasks seen in mass production methods (Price 2004:10).

The early- to mid-Twentieth century saw the rise of American conglomerates and their domination of industries (Chandler 1962). In light of their large numbers of employees, these companies needed human resource management (HRM) to utilize them effectively. HRM was loosely defined at this time as an organizational function that manages

personnel within the organization. Its responsibilities included (Devanna, Tichy & Fombrun 1982:16):

1. Selection: recruiting qualified personnel
2. Evaluation: managing the performance appraisal process.
3. Rewards: maintaining adequate compensation and benefits packages.
4. Development: creating systems to enhance skills, promotional opportunities, and career paths.

Though still used today, the implementations of these processes were later criticized for being siloed, uncoordinated, and having little to do with each other. Their functions were largely performed on an operational level to satisfy immediate company needs. Each human resource (HR) function developed standards of its own instead of following collective guidelines (Wright & McMahan 1992)(Devanna, Tichy & Fombrun 1982:16).

### 2.2.2 HRM incorporates strategy

By the 1960s, “strategy” became a central topic in corporate America and many pioneers of business strategy pointed out its importance for making decisions. In his thesis “Structure Follows Strategy” Alfred Chandler (1962:13) defines strategy as “the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals.” Slowly, strategy was applied to HRM, a trend that manifested in strategic human resource management (SHRM).

Many consider that the earliest SHRM research was from Devanna, Tichy and Fombrun (1982). They found that many HR executives were not only using recent HR data to describe current conditions, but were scenario forecasting (projecting the future trends and needs of human resources for better decision-making). They argued that HR departments were moving into the realm of strategic planning, and that corporations must design a cohesive company philosophy so that its strategic plans can be implemented effectively in management. Devanna, Tichy and Fombrun argued that the role of the HR department is to drive organizational performance. They believed that human resource activities have a major influence on individual performance, and therefore productivity and organizational performance (Lengnick-Hall et al. 2009:69). However, much of the HRM research during this time was later criticized for lacking a strong theoretical foundation. This research was effective in describing individual functions of HRM, such as

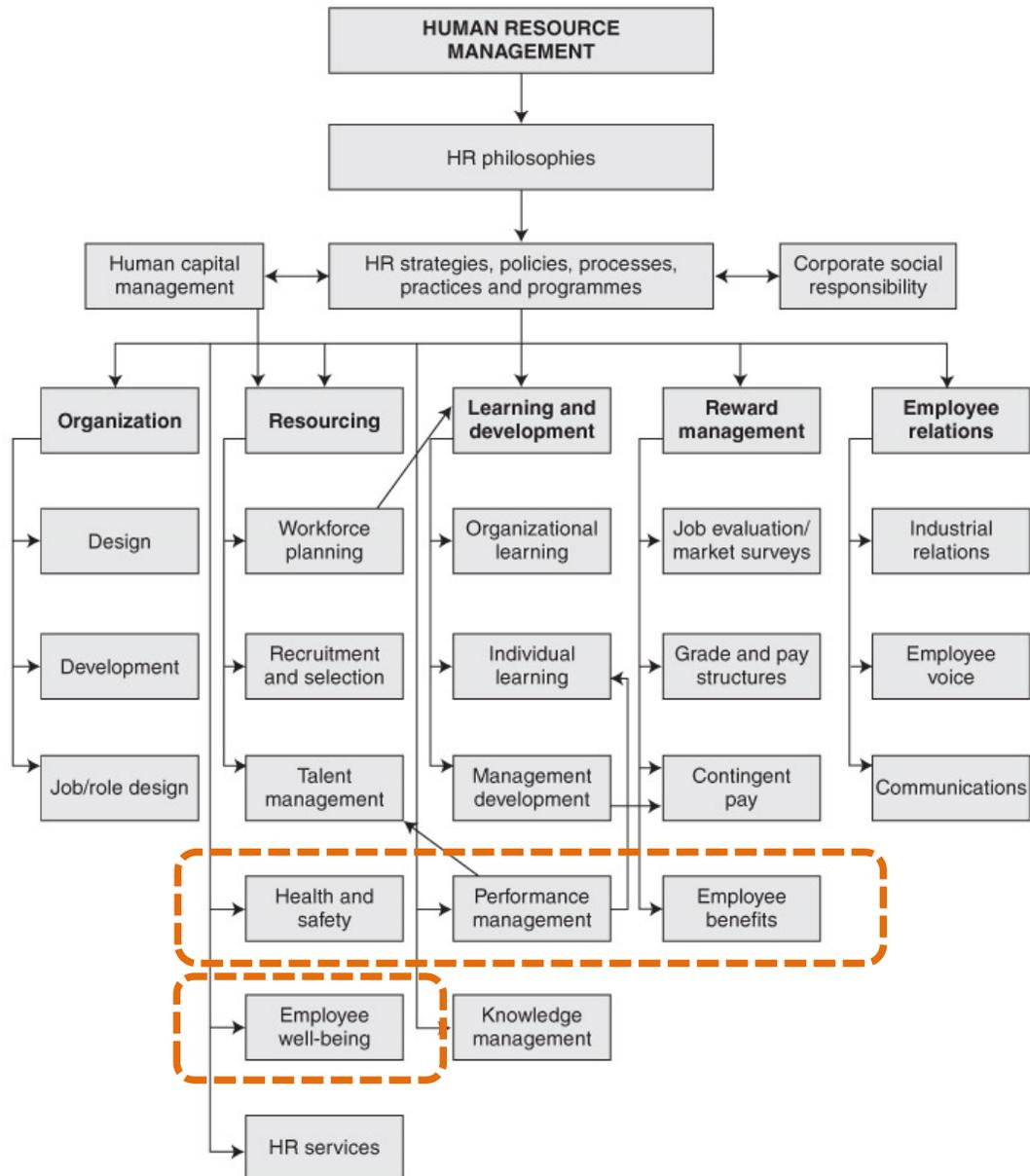
selection and evaluation, but according to some, it *still* failed to understand the why and how of relationships between business strategy and HRM practices (Wright and McMahan 1992:297).

The shift to an organization-wide perspective of management was further established by Wright and McMahan in 1992 (pg. 298). They defined SHRM as “the pattern of planned human resource deployments and activities intended to enable an organization to achieve its goals”, which became a widely adopted definition (Lengnick-Hall et al. 2009:69). It was a way of viewing the role of HRM in the larger organization, and implied the congruence of all HRM practices with the organization’s strategy.

Contemporary definitions of human resource management *assume* an application of strategy. Armstrong (2008) defines HRM as a “strategic and coherent approach to the management of an organization's most valued assets — the people working there, who individually and collectively contribute to the achievement of its objectives.” For comparison, his definition of SHRM is “an approach to the development and implementation of HR strategies that are integrated with business strategies and enable the organization to achieve its goals.” Due to the incorporation of strategy in modern definitions of HRM, as reflected by Armstrong’s definition, a strategic approach to managing human resources will always be implied when this paper refers to “HRM”.

### 2.2.3 The research topic in a model of HRM

Armstrong (2008) has modelled how HRM operates through human resource systems in Figure 1 below.



**Fig. 1** HRM activities, with areas of interest circled (Armstrong 2008:Chapter 1)

The model brings these together (Armstrong 2008):

- HR philosophies: the overarching values and guiding principles adopted in managing people;
- HR strategies: the direction in which HRM intends to go;
- HR policies: the guidelines defining how these values, principles and strategies should be applied and implemented in specific areas of HRM;
- HR processes: the formal procedures and methods used to put HR strategic plans and policies into effect;
- HR practices: the informal approaches used in managing people;
- HR programmes: which enable HR strategies, policies and practices to be implemented according to plan.

Highlighted in Figure 1 are the systems critical to the topic area. This literature review will discuss the relationships between health and safety, performance management, employee benefits, digital health management platforms, and how they relate to business strategy.

#### 2.2.4 The influence of health on HR strategy and practices

Health is defined by The World Health Organization as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (2006). This all-encompassing view of health will be applied in this paper, as opposed to the view held by some health practitioners that health should be defined only as the absence of disease or illness (Kazarian & Evans 2001:93). The terms “health” and “wellbeing” will be used interchangeably. When referring to health in the workplace, the definition of corporate health by Raymond Fabius et al. (2013:993) will be used, defined as “the overall integration of safety and health in the workplace, enhancing employee well-being and satisfaction and the company’s overall productivity.”

Health plays a role in performance management, which is “a range of practices an organization engages in to enhance the performance of a target person or group with the ultimate purpose of improving organizational performance” (Varma, Budhwar & DeNisi 2008:40). In practice, it is realized by setting individual and team goals which are aligned to the strategic goals of the organization, planning performance to achieve the goals,

reviewing and assessing progress, and developing the knowledge, skills and abilities of people (Armstrong 2015). Section 2.3 will cover the relationship between health and employee productivity and performance.

Another HRM practice is designing employee benefits. These are a part of employees' total compensation. Total compensation refers to all forms of financial returns and tangible services and benefits employees receive as part of an employment relationship (Armstrong 2015). A broad view considers that employee benefits are virtually *any* form of compensation other than direct wages paid to employees, including an employer's share of legally required payments (payroll taxes, unemployment compensation, and insurance), payments for time not worked (e.g. paid rest periods, paid sick leave, paid vacations, holidays, and parental leave), an employer's share of medical and medically related payments, an employer's share of retirement and savings plan payments, and miscellaneous benefit payments (such as employee discounts, severance pay, educational expenditures, and child care) (Rosenbloom 2005). Access to these benefits varies by worker and employer characteristics (Price 2004:541). For example, full-time employees are far more likely to have benefits coverage than part-time employees. The employee benefits of highest concern for the topic area are payments for time not worked due to sick leave and an employer's share of medical and medically-related payments.

Awareness of the origin of medical benefits (i.e. healthcare) is also critical for understanding the emergence of several current business challenges. Many industrialized nations protect the safety of their citizens from the consequences of economic fluctuations through government-sponsored systems. However, a system of welfare capitalism emerged in the United States in the early Twentieth century, where employers, rather than government, played a primary role in assuring the health and welfare of employees and their families. At first, relatively few workers were provided these benefits in addition to their wages. The Great Depression of the 1930s sharply revealed these inequalities. The policies that were implemented in response established the basis for the modern U.S. welfare state, where employers are subsidized by tax incentives for providing employee benefits (Dulebohn et al. 2009:87).

#### 2.2.5 The implications of rising medical costs for employers

It is still common for U.S. employers to provide medical benefits. These employers now face intensifying challenges that threaten profitability. Chronic health conditions are on

the rise across all age groups. Meanwhile, costs of healthcare coverage escalate much faster than inflation, becoming a significant economic burden for employers and forcing some to cut back on health benefits (Loeppke et al. 2009)(Hamar et al. 2015:367)(Dulebohn et al. 2009)(Yong, Saunders & Olsen 2010:5). Medical (or healthcare) costs are any direct costs incurred in the prevention or treatment of injury or disease, including health and dental insurance premiums, doctor and hospital visits, and prescription and over-the-counter drugs (Investopedia 2015). The need to control medical costs without disturbing employee health and productivity has driven numerous studies to measure the costs of providing healthcare in particular, and to push healthcare towards improved outcomes.

Further research has attempted to reduce the costs associated with managing poor health by investing in employee health. According to Dr. Ronald Loeppke, a consistent contributor to the literature on occupational health, growing evidence shows that employers get significant value from efforts to make their employees healthier (2008:96). The results of improved employee health are favourable: decreasing pharmacy and medical expenses, increasing productivity, and improvements in rates of lost work time (Loeppke et al. 2009)(Fabius et al. 2013)(Mitchell, Ozminkowski, & Serxner 2013:1142). Loeppke found that investing in the well-being of employees is an effective way of controlling the healthcare costs to the employer (2008:96).

When discussing employee productivity, two essential productivity measures are *absenteeism* and *presenteeism*. *Absenteeism* is when employees stay home due to health problems. *Presenteeism* is defined by the propensity to attend work even when sick or uncomfortable, leading to poor performance. It includes conditions such as the common cold, untreated allergies, discomfort of gastrointestinal disorders, and depression (Bierla, Huver & Richard 2013:1536)(Hemp 2004), as well as health risks that impact work performance (Loeppke et al. 2009). Presenteeism can manifest as an employee spending less time on task, a reduction in quality or quantity of work, or worsening personal condition. In the way that they both hinder productivity, absenteeism and presenteeism both contribute to what are referred to as health-related productivity costs (Loeppke et al. 2003).

The health of a workforce is often improved by implementing a health intervention: a plan designed to improve behavioural, environmental or educational factors related to health (Bartholomew et al. 2011). The terms “health intervention” and “wellness program” are

used interchangeably. Health interventions can be characterized along two dimensions: the method of delivery, and the focus of the intervention (Baiker, Cutler & Song 2010). The delivery method is how the intervention is carried out, including methods such as a health risk assessment (a survey or biometric test that gathers baseline self-reported health data, usually used to personalize the intervention to the participant), provision of self-help education materials, goal setting, provision of tracking tools (for tracking health metrics like bodyweight, heart rate, blood pressure, and activity frequency), group activities, and individual counselling with health care professionals. The intervention focus is where the attention of health optimization is placed, whether it be weight loss, smoking, fitness, stress management, back care, nutrition, preventive care, or alcohol consumption (Baiker, Cutler & Song 2010)(Hamar et al. 2015:368). The intervention can take place over mediums such as in person, by email, on the phone, or by smartphone app, with nurses, health advocates, or lifestyle coaches (Mitchell, Ozminkowski & Serxner 2013). In summary, health interventions are implemented in the workplace with the goal of improving employee health, thereby reducing medical costs and rates of absenteeism and presenteeism.

### 2.3 Health improvement interventions are good for business

By the 1990s, many corporations supported worksite health promotion due to evidence that it increases productivity (Lynch et al. 1990). It wasn't until later that the relationship between employee health risk and employer medical expenditures was more thoroughly examined. Today there is a large body of evidence supporting that health interventions can significantly reduce medical costs and productivity costs.

#### 2.3.1 Health interventions reduce medical costs

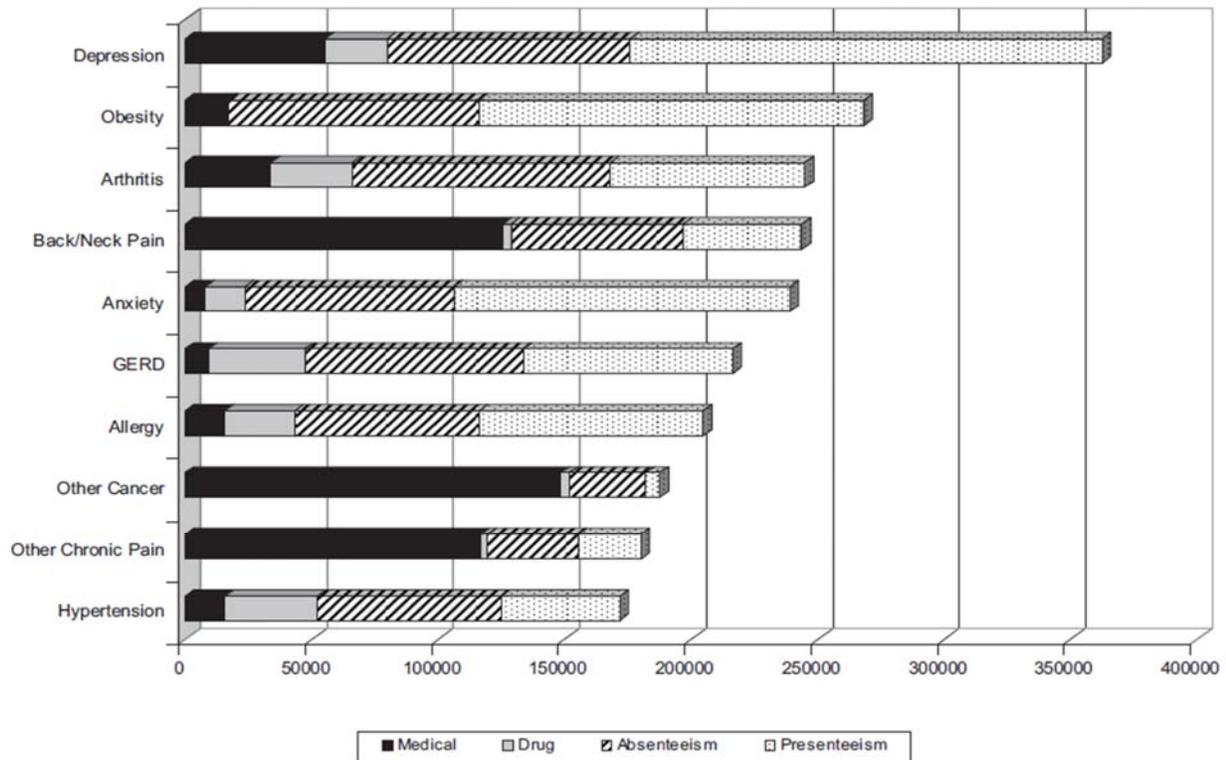
Early studies supported the intuitive relationship between employee health risk and corporate pharmaceutical costs (Musich et al. 2000)(Burton et al. 2003), demonstrating that healthy people use fewer medical services. The WHO (2015) defines a health risk as "any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury." Examples of health risks in the developed world are obesity, unsafe sex, high blood pressure, and tobacco and alcohol consumption. Burton and colleagues (2003:799) found that each new self-reported health risk over a one-year

span was associated with an average annual increase in pharmaceutical costs of \$76 per individual. Reducing individual health risk should then reduce medical costs for their employers.

The plan to reduce health risks by implementing a health intervention is called a preventive strategy (sometimes called prevention strategy). Preventive strategies aim at reducing health risk, since costs follow risks (Loeppke 2008:99). A high risk for any risk factor is associated with higher medical costs, and likewise, groups of employees with higher risk levels are more costly to the organization. Costs follow changes in risk levels over time. The goal of a health promotion program should be to move the population into low risk, low cost categories and to keep them there (Loeppke, Edington & Beg 2010). Employers implementing health interventions and preventive strategies are then able to reduce medical and drug expenditures. Similarly, by investigating the relationship between health risk and productivity, Grossmeier et al. (2015) concluded that health is a predictor of productivity and that benefits of improved health on productivity measures are cumulative over time.

Baiker, Cutler and Song (2010) summarized data from the literature on costs and savings associated with wellness programs. They found that for every dollar spent on wellness programs, medical costs fell by an average of \$3.27. Considering that U.S. employers spend an average of 9.2% of their payroll on medical coverage alone (U.S. Bureau of Labor Statistics 2015), there are significant savings that could be made in medical costs. Wellness programs also had positive effects on productivity costs. Every dollar spent on wellness programs reduced absenteeism costs by about \$2.73, as healthier employees stayed home less often. They did not examine the impact on presenteeism. They did, however, discover that wellness in the workplace also reduces turnover (pg. 308-309).

Companies may have difficulty recognizing the significance of these cost reductions because historically, categories of medical costs and absenteeism costs have been managed as separate “silos”. Approaching them separately rarely illustrates a full understanding of the impact of health on business results (Loeppke et al. 2007). Instead, medical costs and productivity costs should be measured together to assess total health-related costs (Loeppke et al. 2015:585). So with a holistic perspective that incorporates productivity measures into total health costs, where do most health-related costs come from? In a multi-employer study, Loeppke (2009) identified the top 10 health conditions by total cost, which are displayed graphically in Figure 2 (see following page).



**Fig. 2.** Top 10 health conditions by annual medical, drug, absenteeism and presenteeism costs in dollars per 1000 full time workers (Loeppke et al. 2009:423)

Figure 2 illustrates the breakdown of medical, drug, and productivity cost categories. The productivity costs of presenteeism and absenteeism far outweigh their medical-related counterparts in most categories, a trend reflected in the majority of the literature. For example, “Other Cancer” is the costliest condition when examining medical and drug spending alone, but when productivity costs are also accounted for it falls to 8<sup>th</sup> on the list. For employers who prioritize reducing their medical and drug expenditures it may be surprising to learn that the costliest health conditions may have comparatively low medical and drug expenses. The study found that for every dollar of medical and pharmaceutical costs spent, an employer lost an *additional* average of \$2.30 of health-related productivity costs (i.e. productivity costs were 2.3 times higher). Further, health-related presenteeism was shown to have a larger impact on lost productivity than absenteeism. Presenteeism was typically the biggest consequence of poor health to the employer, as

it can harshly cut individual productivity by one-third or more (Loeppke 2009:423-425)(Chang et al. 2015:765)(Hemp 2004).

### 2.3.2 Health interventions seem to impact job performance

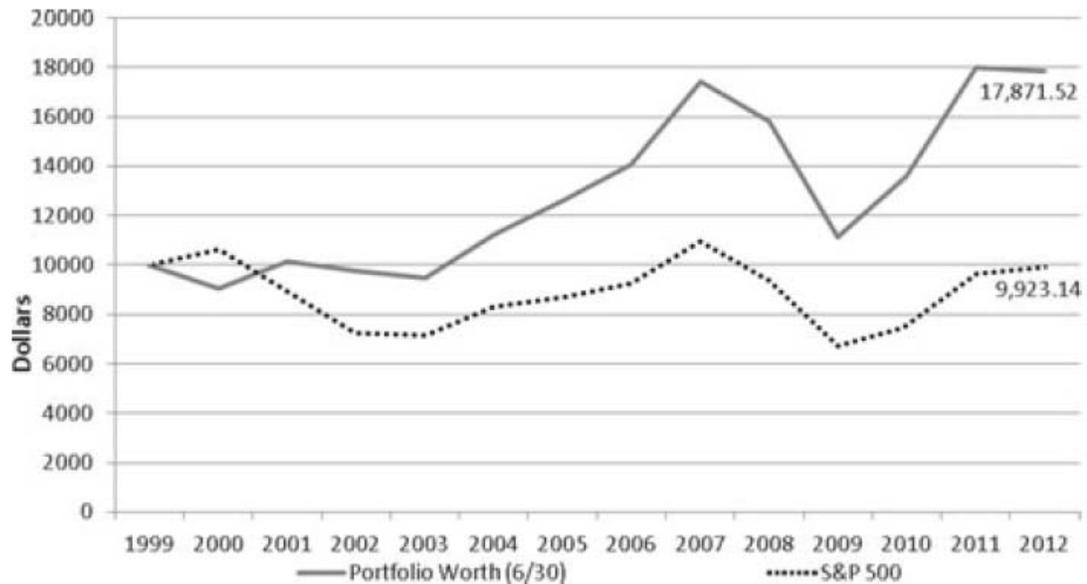
In addition to reducing costs, improving the health of employees can increase human performance resulting in better business performance (Loeppke et al. 2009:427). Some studies have assessed productivity increases from health improvement by measures such as saved work time and increased bottom line.

The relationship between exercising at work and self-reported workplace performance was investigated by Coulson, McKenna and Field (2008). In workplaces with largely sedentary occupations, exercising at lunchtime improved mood and work performance compared to non-exercise days. Findings indicate that the improved mood and performance lead to better concentration, work-based relationships, and heightened stress resilience.

A study that quantified productivity measures (Mitchell, Ozminkowski, & Serxner 2013:1146) discovered that participants in health promotion programs gained an average of about 10.3 hours in productive time annually compared to similar, nonparticipating employees. This difference is small, almost statistically insignificant. However, they note that when scaled in a company of 10,000 employees just a 10% program participation rate would save the equivalent of approximately five full-time employees' worth of work annually.

Dr Raymond Fabius and colleagues (2013) studied the effects of workplace health on the bottom line. Convinced by the growing body of evidence suggesting that the health and safety of a workforce promotes business, they tested the hypothesis by observing stock market performance of companies that won the Corporate Health Achievement Award (CHAA) between the years of 1997 and 2012. These recipients were chosen due to the CHAA's strict adherence to recognizing the healthiest, safest companies and organizations in North America. A simulation was used to track an initial investment of \$10,000 into a portfolio of the recipients as they were announced in May each year. One approach in analyzing the fund's performance was following the first 5 winners over the entire thirteen year course of the study. This portfolio (performance shown in Figure 3

below) began on July 1, 1999 and concluded on June 30, 2012. The initial \$10,000 investment had a cumulative return of 78.72% whereas the S&P had a cumulative return of -0.77% over the same time.



**Fig. 3.** Portfolio starting at first 5 winners vs. S&P 500 (Fabius et al. 2013:996).

The CHAA winners outperformed the S&P 500 in all other portfolios as well, which used a variety of approaches including weighting the investment into each award winner on the basis of their final award winning score. The positive correlation between workforce health and performance supports the suggestion that promotion of wellness is beneficial to business. A criticism of this study is that it is not clear whether the relationship is causal or if already high-performing companies are perhaps able to better manage their corporate health programs. Companies building healthy workforces may simply be “smart” to begin with. Still, the study is a compelling and important contribution to the body of evidence that healthy workforces yield greater value for their investors (Fabius et al. 2013).

### 2.3.3 Improved mental health may impact employee performance

Due to evidence that meditation can reduce psychological stress, researchers have also taken an interest in the benefits of good mental health in the workplace.

A meta-analysis of accepted literature (Grossman et al. 2004) suggests the efficiency of mindfulness-based stress reduction as an intervention for a broad range of chronic disorders and problems, as well as for coping with distress and disability. Improvements were consistently seen in standardized assessments of mental health. Interestingly, similar benefits were also found for health parameters of physical well-being such as medical symptoms and physical pain. Another study (Frew 1974) tested for hypothesized effects of meditation on worker productivity and concluded that it appeared to be positively related to productivity and job satisfaction. The data also suggested that meditators in higher levels of organizational structure level saw higher gains in productivity than those in lower levels.

Not all studies of the effects of meditation on mental health show positive results. For example, in another meta-analysis researchers found that the assessed mindfulness meditation programs resulted in moderate improvements in measures of anxiety, depression and pain. Meditators also experienced a small amount of improved stress. However, there was no evidence of improved mood or attention. Finally, when compared with other active treatments (e.g. drugs, exercise, and other behavioural therapies) the meditation programs were no better (Goyal et al. 2014: 357). Mixed results appear pervasive in this field of study, making conclusions regarding the effectiveness of meditation inconclusive.

Nonetheless, untreated mental health conditions like depression may pose a significant opportunity for employers to improve the health and productivity of employees. Depression was the costliest health-related condition for employers in Loeppke's research (2009) (refer to pg. 11). Other studies have indicated that treatment expenditures for depression may be offset by reductions in absenteeism, disability and on the job productivity losses (Burton et al. 2008). Employers may net savings from administering treatment when necessary and from promoting mental health practices, given their positive effect on measures of anxiety and depression.

A large portion of the literature on employee mental health examines standardized mental health measures. However, much like a hypothesis that decreased stress enables

creative thinking made by Frew (1974), Li-An Ho (2010) advises that potential innovation benefits should not be ignored. Innovation is necessary for a company's long term survival (Cunningham & Harney 2012:478) and a mindfulness practice may encourage creative thinking. Examining middle and top managers from listed technological companies in Taiwan, Ho found that their meditation experiences significantly and positively influenced their self-directed learning readiness, their company's innovative capability, and organizational performance. Measures of innovativeness had a direct impact on financial and market performance (2010:113).

Literature often supports the benefits of mental health practices (Ho 2010), but the sometimes conflicting results of mindfulness-based wellness interventions indicate that mindfulness meditation alone may not suffice in a wellness program (Berkel et al. 2014). Physical and mental health appear to be interrelated, and the results of most studies examining the influence of exercise on a person's mental status have been unanimous: exercise tends to improve mood state and desirable emotions, while reducing anxiety, depression, and other forms of undesirable mental states (Anshel, Brinthaup & Kang 2010). Employers may see better results from health interventions that include focus on exercise and physical health rather than focusing solely on mental health.

#### 2.4 Shortcomings in the literature

Some researchers are concerned by potential biases influencing the largely optimistic literature on health interventions. Musich, Adams and Edington (2010) point out that most studies lack an adequate comparison or control group and are unable to control for possible selection bias, where if the healthiest employees were most likely to enrol in voluntary wellness programs, a comparison of participants and nonparticipants might suggest that the programs are improving health more than they really are. This bias is reduced in interventions that have a higher participation rates. Baiker, Cutler and Song (2010:2-5) recognize the potential for publication bias in the literature. Studies finding high returns from wellness programs may be more likely to be published.

There is a lack of discussion about ideological and political ideas impacting health promotion activities. For example, who should be taking action when it comes to health promotion: the individual, company, or state? Companies may be incentivized to provide health benefits, but are they partly responsible for managing health? If so, the degree to

which they should provide the means to achieve positive health also comes into question. After all, the broad, idealized definition of health by the WHO as a state of complete physical, mental and social wellbeing (WHO 2006) is a largely subjective measure. It also describes health as an ideal state, which a number of authors have deemed unattainable (Kazarian & Evans 2001:93). Seedhouse (1997:136) proposes that an ideal state of health varies according to the individual; that “a person’s (optimum) state of health is equivalent to the state of the set of conditions which fulfill or enable a person to work to fulfil his or her realistic chosen and biological potentials.” According to this definition, health promotion should provide interventions necessary to bring individuals to this state. Still, the question of who should burden the provision of the intervention is a problem skirted by most authors. With no stakeholder assuming responsibility, it lands on the individual by default. In discussing total population health enhancement, Loeppke (2008) argues that it is ultimately about personal responsibility and how to support the person to become their own best coach for health management. He underlines the importance of investing in a culture of health on the individual, employer, community and national level. These arguments may need to be further discussed before a large population can move toward optimum health as defined by Seedhouse (1997).

## 2.5 Digital delivery method of health interventions

With the reported benefits of health interventions in mind, the literature on digitally delivered interventions will be researched. Many of the common elements of a health intervention (e.g. a health risk assessment, provision of education materials, goal setting, provision of tracking tools, and coaching) can be delivered via digital channels, including mobile technology and the internet. The potential for the internet as a channel for disseminating persuasive health communications at a low cost and broad reach was discussed in the internet’s still-formative years (Cassell, Jackson and Cheavront 1998:77), but at the time, the level of communication technologies severely limited the efficacy of internet-based tools. It could be argued that these technological challenges have since been met. If digital health interventions are able to deliver effective health interventions at a low cost, then organizations implementing them stand to gain from the resulting improved productivity of their employees and significantly reduced expenditures. The sections following the methodology will explore the efficacy, impact, and future of digital health interventions.

### 3 Methodology

#### 3.1 Research Design

Appropriate research design is key to yielding quality results. Research designs can be broadly classified as exploratory or conclusive. Exploratory research is used in instances where the subject of the study cannot be measured in order to find a conclusive result, or where the process of measurement cannot realistically represent particular qualities. It can be used to better define a problem, identify courses of action, or gain insights and understanding. Exploratory research can make use of qualitative or quantitative techniques. Qualitative methods are unstructured or semi-structured to gain deeper insight into a problem or uncover trends in opinions. Quantitative methods are formally structured, and generate numerical data to formulate facts or patterns with statistics and create results that are easier to measure. Conclusive research often uses a structured approach with a quantitative methodology in order to describe specific phenomena, to test specific hypotheses, or to examine specific. Conclusive research designs may be either descriptive, where the objective is to describe something, or causal, where the objective is to find evidence of cause-and-effect relationships (Malhotra & Birks 2007)(Cooper & Schindler 2008).

The research objective was insight into the question: *Are digital health-interventions capable of improving a company's workforce?* This study defines "capable" of improving a workforce as able to have a significant effect on employee health (as measured by reductions in health risks), reductions in medical expenditures, or improved employee productivity. Data was collected, organized, and reassembled into a logical procession of ideas and arguments.

The information needed was a description and assessment of digital health interventions, including their capabilities, effects on participants, and, if a significant gap between current capabilities and current offering to the user exists, a definition of the relevant problem areas for further investigation. The digital health intervention industry is currently heavily fragmented due to its newness. Therefore, the nature of the investigation was well suited to a qualitative exploratory approach in the form of gathering secondary data.

Another factor supporting this approach was that the problem areas were not yet defined, and gathering secondary data was a cost effective method of gaining a broad understanding of a subject (Cooper & Shindler 2008). Conversely, a quantitative approach would face significant measurement challenges. Due to the sensitivity of health data and high standards of data privacy, it was impractical to obtain large and standardized sets of data for health-risk studies.

### 3.1.1 Data Collection

Data collection was a two-stage process. First, data from secondary research was gathered into a literature review to assess the topic and to understand changes in relevant academic perspectives over time. The findings were used to influence the design of the second stage of data collection. Constraints were placed on what would be considered acceptable secondary research. Data concerning digital health interventions must be:

1. From a credible published journal, industry publication, or relevant non-fiction material.
2. Published within the last decade (January 2006 or later)
3. Contributing to answering the research question by investigating at least one of the following: digital health intervention services, platforms, or programs; digital intervention influences on physical or mental health markers; digital health intervention return on investment; relevant use cases; challenges to digital health interventions; and workforce applications.

### 3.2 Limitations

A significant limitation on this study was its inability to procure subjects for qualitative interviews that were to provide primary data. Semi-structured interviews were to be held with companies working in the wellness-prevention and health-coaching services field to gain insight into the research question from inside the industry. Interview requests were sent to 21 companies from November 24, 2015 to February 29, 2016. Most requests received no response and 2 were declined, citing that the interview subject matter concerned sensitive or proprietary information.

The sensitivity of health data may be a limitation on secondary research. Difficulties in gathering health data due to strict attitudes towards data privacy may cause results to be less accurate.

Few studies examining digital health interventions *and* their effects on specific work-related measures, like productivity, exist at this time. The majority observe changes in biological factors of participants, like weight, blood pressure, or insulin response. Answering the research question may require some assumptions due to the relatively small number of studies observing the effects of digital health interventions in the workplace.

Finally, many of the sources in this study note a significant likelihood for selection bias when observing the effects of health interventions. First, the candidate screening process is based on available information which may not be complete and participants begin experiments from a wide range of health baselines. More importantly, participants are voluntary. This lack of randomization acknowledges that participants are not representative of the total population.

## 4 Discussion of digital health interventions

### 4.1 Overview

Developing an engaging health intervention that integrates personalization, involves self-determined goals, teaches relevant material and encourages progress is a difficult feat. Still more difficult is to deliver this consistently on a large scale with reasonable costs. However, digital health interventions are receiving attention because the scalability and cost effectiveness inherent to digital services are attractive in light of ever-increasing medical costs. A digital health intervention is a health intervention delivered by a digital medium, like a mobile phone or web service. The basic components of the intervention plan, like a preliminary health risk screening and personalization, are still necessary for a successful intervention (Hamar et al. 2015)(Baiker, Cutler & Song 2010). Digital interventions could take advantage of opportunities offered by automation, scalability, low cost, tracking, possibilities of immediate feedback, and personalization through machine learning (Diamandis & Kotler 2015). The newness of the research area means the amount of existing literature is limited, but the outlook of the industry is generally positive. The following sections explore the general field of digital health interventions before examining their use in the workplace.

The widespread use of mobile technologies poses a significant opportunity for implementing health interventions on a large scale. The Pew Research Center (2015a)(2015b) reported that 90% of American adults owned a mobile phone and 64% of American adults owned a smartphone in 2014. Global mobile phone users in 2014 were predicted to number 4.65 billion people (Statista 2015), and 3G service coverage was available to an estimated 69% of the world's population (ITU 2015). In addition to their ubiquity, the mobility and capabilities of mobile devices make them a particularly appropriate medium for providing individual level support for health (Free et al. 2013). Their mobility grants interventions the ability to deliver relevant messages and information at times when the user needs them. Although technological capabilities vary between phone models, many can offer access to interactive health services. Digital interventions can make use of SMS messages, email, mobile phone applications (often referred to as apps), web-based services, and cloud services. Though text messaging has been effectively used for intervention delivery (Free et al. 2013:2), the use of mobile apps is increasing as they allow for more complex services.

The supply of health intervention services is growing. An annual study on mobile health applications (mHealth apps) by the think tank Research 2 guidance (2015) found increasing numbers of newcomers publishing mHealth apps. Major app stores saw more than 3 billion mHealth app downloads in 2015 from about 45,000 mHealth publishers (developers of these applications). Note that these apps made up 5% of all published apps on Google Play, iTunes and Microsoft Phone Store. This new market made possible by digital health technology will likely be disruptive to existing medical markets. A disruptive technology is any innovation that creates a new market and interrupts or transforms the normal progress of an existing one (Diamandis & Kotler 2015:9).

#### 4.1.1 Delivery of digital health interventions

New digital delivery methods of health interventions are tested as the technology becomes available. For example, mobile applications and email updates are taking the place of SMS messaging. The extended abilities of newer technologies allow the incorporation of more of the key elements that assist in the success of health interventions.

Mobile applications may offer the software capabilities needed for more complex interventions. Many smartphones are able to access digital health platforms in the form of mobile apps. These platforms assemble distant digital content and services into a coherent access platform. They provide the access to and structure upon which a universe of services can operate (Meyer 2000:135). A mobile app may act as a digital platform that integrates services like health education information, personalized physical activity programs, goal progress tracking, and connection to the broader user community. As of 2015, there were over 160,000 mobile health apps published on major app stores, and many of them acted as platforms that can integrate data collected from the user by wearable hardware (Research 2 guidance 2015).

Wearable hardware uses sensors to monitor real time participant biometrics, like heart rate and skin temperature (Research2guidance 2014:37). The sensors are usually inside an unobtrusive package like a sporty wrist watch. Useful data is often either presented on the device itself or communicated to a smartphone application. The ability of a digital health intervention to easily use the data for tracking participant progress gives digital delivery methods a significant advantage. However, though wearable sensors are common in fitness communities they are not so widespread to assume that the average user

will own one, so many digital health interventions still rely on self-reported data. Self-reported data can be less reliable but is still useful for motivating and rewarding the participant at appropriate moments to maintain their progress towards health goals. Industry publications expect the rise of wearable hardware to continue (Research 2 guidance 2015).

#### 4.1.2 Implications of scalability

Digital services can take advantage of automation: the technique of making a process or a system operate automatically (Merriam-Webster 2016). Automation can significantly reduce resource requirements and costs by taking the place of human labour, thereby allowing an automated system to be applied in large numbers. When digital systems are able to operate efficiently on a large scale, they can be said to be scalable. When a service is turned into code and then hosted on a digital platform in a high volume, its price approaches zero because of sheer scale (Diamandis & Kotler 2015:14). This cost efficiency can be applied to automated health interventions or health-coaching platforms that attract enough users. An automated self-management program that offers a relationship and personalized feedback may be essential for dealing with large populations faced with chronic disease (Watson et al. 2012:13). Block et al. (2015) echoed this idea when, in their automated intervention for type 2 diabetics, they recognized that the ability to reach millions of people by digital means is realistic when resource requirements are extremely low.

Scalability also suggests the capability to help users in developing countries where health professionals are few. An analysis of the global economic burden of untreated mental health conditions assessed that there will never be enough highly trained professionals to treat all patients globally with one-to-one therapy (Jones et al. 2014:1603-1605). In low-income countries, there is roughly one mental health worker for every 100,000 people. Mobile phones, however, are prevalent. An effective digital mental health intervention could help make up for this shortage of mental health professionals. The ratio of phone subscribers to mental health care workers in these countries is more than 8,000 to 1 (Jones et al. 2014:1605). Technology innovations that provide greater access to psychological therapies could positively affect large populations.

### 4.1.3 Significant use cases

As discussed, people with high risk health factors stand to gain the biggest improvements from health interventions, in terms of health improvement and cost reductions. Some digital health services target such high risks in adults suffering from (or at risk of suffering from) diabetes and cardiovascular disease (CVD) in attempt to reduce staggering costs. The American Diabetes Association (2015) found that in 2012, diabetes cost Americans \$176 billion in direct medical costs and an additional \$69 billion in reduced productivity. CVD is also associated with high expenses (Widmer et al. 2015). The large industries that support patients in managing these conditions are at risk of being heavily disrupted by services that support patients digitally. Digital health interventions are also useful for health improvements like weight loss, healthy dietary choices, and smoking cessation.

## 4.2 Reviewing efficacy

### 4.2.1 Positive results in digital health interventions

Digital health tools are useful for providing diabetes patients with simple ways to keep track of their blood glucose levels and other self-reported data, such as carbohydrates ingested, medication administered, and physical activity (Salber & Niksch 2015). Physicians and other members of the care team can often access this data. Salber and Niksch anticipate that these tools will continue to improve as clinical studies demonstrate their efficacy and the Food and Drug Administration (FDA) approves more services (2015).

Two such FDA-approved digital platforms for diabetes management are WellDoc, Inc and Glooko (Salber & Niksch 2015). WellDoc developed BlueStar, an app offering a coaching system and physician communication with the patient to promote self-management and medication adherence. Real time analytics of patient data are used for personalized treatment. It has been approved as a benefit claim for employees of several large companies including RiteAid, Ford Motor Company, and Dexcom. Glooko helps patients manage their glucose levels by allowing the wireless transfer of glucose readings from supported devices to a mobile phone logbook. Reports of the readings can be easily read by patients and physicians to enhance understanding of events that may trigger abnormal glucose levels.

To address cardiovascular disease, an employer-initiated digital health intervention allowed researchers to analyse changes in CVD markers of 30,974 participants (Widmer et al. 2016). Changes in weight were one of the observed markers. Significant improvements in weight loss and blood pressure were demonstrated with increasing levels of digital health intervention usage, with the biggest improvements in the users with the highest participation rate. The study demonstrates the success of digital health improvement in a large community to reduce CVD risk factors. The correlation between participation (demonstrated by frequency of app logins) and health improvements suggests that participation and user engagement are vital to success. A similar study using a smaller group of cardiovascular rehabilitation patients observed the benefits of assigning patients to a personal health assistant on their smartphones (Widmer et al. 2015). Compared to control groups, patients showed reduced blood pressure and weight both during rehabilitation, and three months afterwards. With these risk factors reduced these groups also displayed a 38% reduction in rehospitalizations (pg. 283), which represent a large portion of the costs related to CVD.

Even though modern software is capable of providing complex health tools, studies have demonstrated that simpler digital technology can also be effective in enhancing health interventions. Vervloet et al. (2014) showed that real-time medication monitoring combined with SMS message reminders increased long term type 2 diabetes treatment adherence. In another case, a fully automated behavioural intervention for persons with prediabetes was delivered over a combination of email, web, and mobile phone (Block et al. 2015), and was effective in improving markers of glycemic control and body weight.

Interventions with a focus on smoking cessation have also been effective when delivered by SMS (Fjeldsoe, Marshall & Miller 2009)(Free et al. 2011) and mobile phone app. There are several advantages that mobile phone-based smoking cessation interventions have over most current treatment services. Mobile phone-based smoking cessation interventions can be delivered anytime, particularly when the participant is experiencing a craving, and they require minimal direct contact and low resource requirements (Whittaker et al. 2012). There is some concern regarding the quality of smoking cessation apps available on online stores. A review of those available on iTunes (Abrams et al. 2011) found that apps listed at the time rarely followed established guidelines for quitting, such as pharmacotherapy, counselling, or a quit line. In comparing a smartphone app to SMS messages for smoking cessation support, Buller et al. (2014) found that the app under review was effective but did not move smokers to quit as quickly as techniques

using SMS. It may be that within the constraints of the simpler text messaging system, a greater focus on the content and use of behavioural change techniques was demanded.

#### 4.2.2 The importance of behavioural change theory

Success of a digitally delivered intervention may not be as limited by technological factors as by its content, whether it be incorporation of behavioural change theory or ability to retain a participant. Webb et al. (2010) showed that behavioural science can be applied to digital health interventions to increase effectiveness. They conducted a meta-analysis of 85 interventions where the primary components of the intervention were delivered via internet. More extensive use of behavioural change theory was associated with increases in effect. Interventions that incorporated more behavioural change techniques, defined as specific strategies used in the intervention to promote behaviour change, also tended to have larger effects compared to interventions that incorporated fewer techniques. The study supports that success rate may hinge on the content of the intervention rather than technological limitations of the medium itself.

In Research 2 Guidance's most recent publication on mHealth apps (2015), they explore app publisher attitudes toward behaviour change by noting which features are implemented in apps promising behavioural change. Dashboards were the most implemented feature by mHealth app publishers in 2015 (60%) followed by reminders (49%) and a channel to a doctor (41%). Gamification in the form of badges or leaderboards is a popular trend in mobile apps. Surprisingly, it appears to be largely ineffective for mHealth (Research 2 Guidance 2015).

#### 4.2.3 Return on investment from digital health interventions

Investigating the return on investment from implementing a digital health intervention is a quantitative approach to measuring its efficacy. The treatment of a large high-risk population with a digital health intervention was recently studied by Wenqing Su and colleagues (2015). Adults with prediabetes and CVD risk factors used Prevent, a digital behavioural counselling service that promotes a healthy diet and physical activity. Based on the costs of the program and the costs of managing diabetes, a simulated return on investment found the break-even (the point at which returns have become equal to in-

vestment costs) at 3 years. "At 3, 5, and 10 years, estimated return on investment averaged \$9, \$1,565, and \$7,918 for the population with prediabetes and \$96, \$1,512, and \$6,651 for the population at risk for cardiovascular disease" (pg. 3). The percentage of ROI was found to be 39%, 64%, and 101% of program investment on the population with prediabetes was recouped at year 1, 2, and 3, respectively. For the population with risk factors for cardiovascular disease, 48%, 75%, and 107% of the investment was recouped at year 1, 2, and 3, respectively. Years 5 and 10 were not calculated for ROI percentage. This demonstrates the capability of Prevent, in particular, to generate positive returns over time. The increase in ROI over time indicates that still greater returns are likely to be generated as time passes, as demonstrated by the large net returns seen at years 5 and 10. It also supports the findings of other researchers that the returns from reducing health risks are cumulative over time, since costs follow risks (Loeppke 2008:99)(Loeppke, Edington & Beg 2010)(Grossmeier et al. 2015).

More research is needed to be able to compare the efficacy of digital vs non digital health interventions based on ROI. Baiker, Cutler and Song's meta-analysis of costs and savings associated with wellness programs (2010)(refer to pg. 10) discovered that for every dollar businesses spent on wellness programs (not specifically digital), medical costs fell by an average of \$3.27. Using the same method as Su et al. (2015), this is a 327% return on investment, an ROI just over three times greater than the 107% ROI for Prevent users at year 3. Comparing ROI may provide a consistent approach to comparing the effectiveness of different services but variables like time must be consistent. Many intervention studies can track changes in health risk markers like body weight and blood pressure, but experiments estimating dollar figures from health improvement are still speculative and are measured under inconsistent parameters (like time) that make comparison difficult. More research would be useful for companies to determine which health interventions are likely to generate the largest returns.

#### 4.3 Significant challenges for the industry remain

Challenges hindering the success of digital health tools can be broadly categorized into technical, legal, and adoption challenges.

On a technical level, some digital interventions are limited by high research costs and high software development costs. For those aspiring to help manage chronic disease,

professionals recommend that services for patients be evidence-based and technologically innovative. The costs associated with developing services to these standards can be prohibitive (Widmer et al. 2015:288). Gathering the health data that many services require to be effective poses a challenge as well. Self-reported data may be inconsistent and inaccurate, while the hardware used to accurately measure biological markers may be cost prohibitive to users. Obtaining health data from secondary sources is difficult because these sources are often accountable for disclosing their data responsibly (or not at all).

The Boston Consulting Group (Rose et al. 2014) reported that data privacy remains a top issue for most consumers around the world, with health and genetic information being especially sensitive for consumers in developed countries. This puts a large responsibility on digital health service providers to keep user data secure. Legal consequences may apply to those that don't maintain sufficient security. Another legal hurdle for health intervention providers are requirements for regulatory oversight. For example, WellDoc, Inc needed FDA approval before employees using the service could receive reimbursement for the program as part of their employee benefits (Salber & Niksch 2015:199). Slow responses from regulators and inconsistent reimbursement patterns may threaten services helping employers.

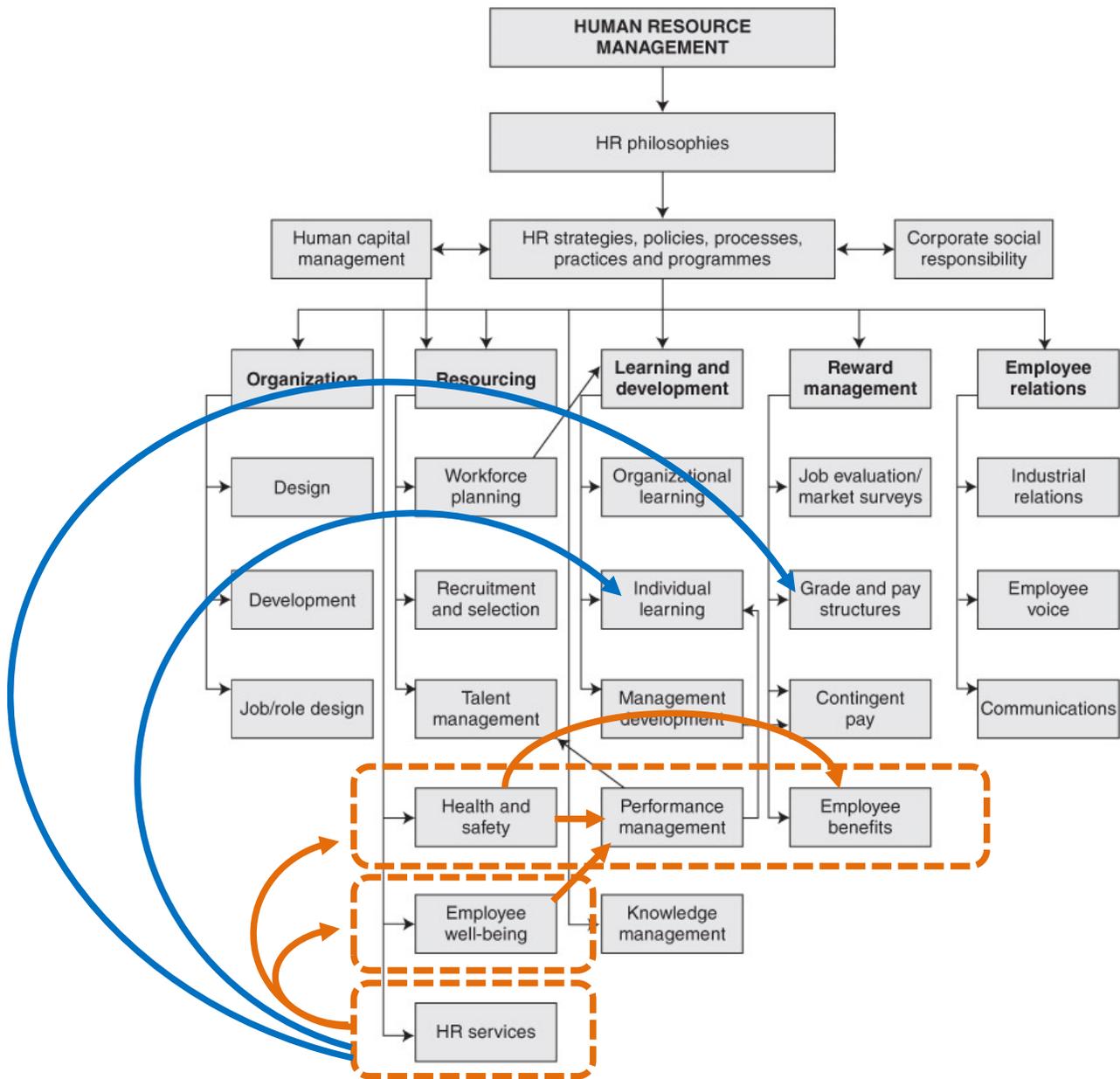
Adoption of digital health interventions has two distinct challenges in the medical community and with users. Adoption of digital tools by traditional suppliers of medical services has been slow. Physicians have concerns around reimbursement, data overload, and clinical outcomes of digital health interventions. Thoughtful integration into existing clinical databases and record keeping would promote participation (Watson et al. 2012:13). Further scientific validation of digital health intervention outcomes would be advantageous (Salber & Niksch 2015:199). User adoption also determines the extent to which a digital health intervention can be effective. A limitation acknowledged by Su (2015) and Widmer et al. (2015) is that many studies demonstrating the success of wellness programs are using voluntary participants and effectively ignore adoption rates. When applied in reality, lack of adoption may negate benefits to the employer. A study of a digital mental health intervention in the workplace (Muuraiskangas 2016) was completely undermined by a lack of adoption when the lack of time, the lack of perceived benefits, and the lack of perceived need prevented employees from actively using the app under review. The potential for cost savings for employers may be greatly hindered

due to lack of employee involvement in the health intervention, or attrition from it altogether (Alkhalidi et al. 2016).

Many researchers have recognized the need for engagement to increase adoption and retain participants. Loepke and colleagues (2013:263) assert that education and engagement are key elements to managing individual health behaviours and health risks. Personalization and self-determined goals can help keep individuals engaged, and therefore more proactive and compliant in the long term (Hamar et al. 2015)(Baiker, Cutler & Song 2010). The appropriate behaviours to increase an individual's wellbeing in the short term should be personalized, *as well as* the self-determined long term direction of the intervention to keep users engaged in the long term maintenance of their health goals. Extrinsic and intrinsic rewards and a supportive culture can also support engagement and long term healthy behaviour (Scheppingen et al. 2014:543-545)(Baiker, Cutler & Song 2010)(Loepke et al. 2015:594)(Hamar et al. 2015:368). Digital health interventions will need to be engaging enough to overcome adoption challenges in order to effectively improve the health of large populations.

#### 4.4 The place of digital health interventions in a workforce

Digital health interventions are still relatively new and companies may find it helpful to review where they fit into the structure of human resource management and how they can benefit the organization. The main difference between digital health interventions and health interventions in general is the delivery medium. However, this difference is not significant when it comes to defining structure. Digital health interventions should fit into the structure of HRM in largely the same way as other forms of health interventions. Referring back to Armstrong's (2008) visual representation of HRM activities we can address the points of interest.



**Fig. 4** HRM activities, with areas of interest highlighted (Armstrong 2008:Chapter 1).

Orange indicates currently relevant. Blue indicates areas of potential future relevance.

Human resource managers may find that digital health interventions are useful for supporting the HR processes and programmes that ultimately develop their human capital. Wellness programs improve the health, safety, and wellbeing of their employees. HR departments would likely be responsible for the implementation and management of a

digital wellness program. The reviewed literature demonstrates that healthy employees are productive employees, and it has been argued that employee well-being and health have a direct impact on performance. Links have been added to Figure 4 to represent relationships more accurately. A link from health and safety to employee benefits has been added. Some digital health interventions like WellDoc, Inc have been approved by regulatory agencies to be covered by employee benefits. From an internal perspective, managing employee health risks should dramatically reduce the costs of offering the benefits without cutting them.

The influence of digital health interventions may affect further areas in the future. Companies may try new approaches to incentivizing health-improving behaviour. For example, extrinsic rewards like increased pay proportionate to the improved health markers might be offered as a way of encouraging the reduction of health risks. Health intervention adherence rates may be directly incorporated into pay structure this way. Education tools are also an important part of improving an employee's health. By choosing to participate in a wellness program, the learning and development of an employee would be expanded from job duties to include health-related material as well.

This paper predicts that the currently fragmented industry of digital health intervention providers will see several large players emerge to dominate a significant portion of the market. Winners will be those who overcome major legal and regulatory challenges together with adoption challenges. Employers will be inclined to provide approved services to their employees because of easier integration into their benefits packages, giving services approved by regulatory bodies the advantage. Successful services will also need to solve a twofold adoption challenge. The health intervention must be engaging enough to attract and retain users. The second challenge is the integration of health data from the intervention into the existing databases used by physicians. The first digital health interventions to leap these hurdles would be likely to garner favour from employers and gain a dominant market share.

A return to the definition of HRM may help to determine why or why not digital health interventions are useful for an organization. It has been stated that the role of the HR department is to drive organizational performance, and that human resource activities have a major influence on individual performance and therefore productivity and organizational performance (Lengnick-Hall et al. 2009:69). HRM has also been defined as a "strategic and coherent approach to the management of an organization's most valued

assets — the people working there, who individually and collectively contribute to the achievement of its objectives” (Armstrong 2008). HR departments are responsible for managing the performance of employees. This requires managing a multitude of factors like training, pay structure, job fit, and most certainly, supporting employee health. By improving productivity on the job and reducing absenteeism, organizational performance should increase as a result. Reduced medical expenditures should further assist organizations in their pursuit of profit maximization. In these ways, digital health interventions should be considered by organizations as an approach to achieving their objectives with greater efficiency and reduced cost.

## 5 Conclusion

Employers have developed a vested interest in the health of their employees. Several societal and economic factors are behind this. While chronic health conditions are on the rise, costs of healthcare coverage also escalate and employers find themselves increasingly burdened by medical costs. Improving the health of their employees results in decreasing pharmacy and medical expenses, increasing productivity, and improvements in rates of lost work time. It has become clear that investing in the well-being of employees is a viable way to controlling increasing healthcare costs.

The health of a workforce is often improved by implementing a health intervention. Studies quantifying the results of health improvement show promising results. To illustrate, a meta-analysis found that for every dollar spent on wellness programs, medical costs fell by an average of \$3.27. Other studies demonstrate a positive correlation between focus on workforce health and bottom line performance, supporting that efforts to promote wellness are beneficial for business. However, causality is difficult to establish. Poor mental health is associated with extremely high productivity costs and a significant opportunity lies in treating conditions like anxiety and depression in order to reduce absenteeism, disability, and productivity losses.

This research finds that digital health interventions may be able to improve health on a large scale and at low cost. Early studies suggest that they are capable of reducing employee health risks and medical expenditures, especially for high health risk groups such as diabetes patients and workers at risk of cardiovascular disease. Research quantifying return on investment for diabetes and CVD patients using a digital health intervention showed cumulative positive returns beginning at 3 years of treatment. Interventions for behaviour change like smoking cessation have shown to be highly effective when delivered digitally to mobile devices.

Significant technical, legal, and adoption challenges to the industry remain. A comprehensive digital health improvement service is technologically complex and requires the incorporation of physician input and behavioural change theory to be effective. From a legal standpoint, employers wishing to integrate digital services into their benefit plans will likely need approval of these services by regulatory bodies. The adoption challenge is twofold. The sharing of health data with physicians would be an important step towards

managing health on a large scale, but the medical community is slow to integrate third party health data into their practices. Secondly, the health intervention must be engaging and effective enough to overcome typically low adoption rates by users.

These challenges are worthy of addressing because the payoffs are substantial. Digital health services that overcome adoption challenges have potential to be disruptive and gain a significant market share in the massive medical marketplace. They also have potential to improve the health of not just employees, but users around the world. The scalability and low resource requirements of digital health services make them essential for dealing with large populations faced with chronic disease, and for users with poor physical or mental health in developing countries where health professionals are fewer.

This review of secondary research concludes that digital health interventions should be carefully considered by organizations as an approach to achieving their objectives with greater efficiency and reduced cost. By improving productivity on the job and reducing absenteeism, organizational performance should increase and reduced medical expenditures should improve the bottom line. However, more research is needed to demonstrate improved health outcomes from digital health interventions. Research investigating whether they are more or less effective than conventional methods is limited. Conventional interventions have shown overwhelmingly positive results but digital health interventions may still have limited efficacy. When implemented in the workplace, low adoption rates seen in some studies are alarming, and may undermine the benefits of offering the intervention.

Some of the peer reviewed literature covered by this paper used techniques like randomized trials to improve validity and reliability. However, a persistent caveat recognized by most studies is that selection bias may influence results. Participation in health interventions is voluntary, and this assumes a predisposition of participant's openness towards behaviour change. It also ignores the adoption problem. The reductions in health risks seen in many studies will be diluted by a workforce that does not have 100% participation rate.

The research process was faced with significant challenges. The research aimed to compare and contrast the perspectives of the academic community to those working in the industry. Unfortunately, no qualitative interviews were conducted despite requesting numerous interviews with employees, researchers, and board members of companies

providing digital health intervention services. Being limited to perspectives found in secondary sources has limited the results of this study. An additional challenge was the difficulty in making comparisons between studies that quantified the effectiveness of digital health interventions. Even when comparing similar metrics like ROI, parameters like the timeframe over which returns were observed were inconsistent. The degree of health risk change is also relative to baseline health. Larger changes should be observed in groups initially categorized as high health risk groups, whereas the conditions of healthy individuals may only increase marginally.

HR departments are responsible for managing the performance of employees so that they can most effectively achieve business objectives. Because of the strong correlations between employee health and performance, HR should support employee health by offering health intervention programs as necessary. Health is ultimately a personal responsibility and the role of the employer should be to support the individual to become their own best coach for health management. The efficacy of digital health interventions is likely to increase over time as the discussed industry challenges are met, and should be closely regarded by HR departments as a potential approach to cost effectively managing employee health.

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