



SCREENING PRACTICES OF A HEALTH  
INSURED POPULATION AND THE ROLE OF  
BEHAVIOURAL ECONOMICS

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University of the Witwatersrand, in fulfilment of the requirements for the degree of  
Doctor of Philosophy, branch of Community Health

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## DECLARATION

I, Leegale Adonis, declare that this thesis is my own work, unaided. It is being submitted for the degree of Doctor of Philosophy, in the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.



Leegale Adonis

On the 20<sup>th</sup> day of May 2015



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Leegale Adonis

On the \_\_\_\_\_ day of \_\_\_\_\_ 2014

## DEDICATION

This work is dedicated to my husband Mahendren Munsamy who is a brave soldier in the fight again cardiovascular diseases.

*I carry your heart with me (I carry it in my heart) I am  
never without it (anywhere I go you go, my dear; and  
whatever is done by only me is your doing, my darling)*

*I fear no fate (for you are my fate, my sweet) I want no  
world (for beautiful you are my world, my true) and it's  
you are whatever a moon has always meant and  
whatever a sun will always sing is you*

*Here is the deepest secret nobody knows (here is the  
root of the root and the bud of the bud and the sky of  
the sky of a tree called life; which grows higher than  
soul can hope or mind can hide) and this is the wonder  
that's keeping the stars apart*

*I carry your heart (I carry it in my heart)*

*EE Cummings*

## ABSTRACT

**Background:** Chronic diseases of lifestyle (CDL), cancers and Human Immunodeficiency Virus (HIV) contribute considerably to the burden of diseases in South Africa. Screening for these diseases reduces morbidity and mortality. Few data are available on national screening rates or predictors of adherence to screening guidelines and how these vary across the provinces. Given that behavioural economic theories like prospect theory and framing effect attempt to predict behaviour in set scenarios, it could be useful in assessing screening behaviour.

**Purpose:** To examine screening behaviour, predictors of adherence to screening guidelines and the role of behavioural economic principles in a privately insured population for a single insurer across all nine provinces in South Africa.

**Method:** Discovery Health provides a screening programme to a member base of approximately 2 million individuals, some of whom voluntarily join a wellness programme that incentivizes screening. Screening rates were calculated as the proportion of eligible members who had received screening tests between the periods 2007 – 2011 using Central Procedural Terminology codes from medical claims data.

**Results:** Nationwide screening rates were far below similar international population targets. Despite similar insurance coverage, there is considerable variation in screening rates between provinces. Adherence to screening guidelines was less than 50% of the eligible population. Strong predictors of screening included adherence to the wellness program and possession of a full comprehensive plan. Negative predictors of screening, on the other hand, included possession of only a hospital plan and gender. Prospect theory was able to predict the decrease in screening behaviour of those diagnosed with a chronic disease, except for breast cancer screening, in which case screening behaviour increased over time. Statistically there was no difference between cervical cancer screening rates of groups of females who received differently framed messages regarding Pap smears.

**Implication:** Utilization of population-based screening services is not only dependent on payment and availability of services. It is associated with the subject's place of residence, ability to afford a more expensive health plan, the desirability of any incentives offered, and even their potential diagnosis with another disease. Some behavioural economic theories have utility in predicting health care choices, more so than others. Although population-based policies and programs may be the foundation for promoting screening, individualized and targeted approaches focusing on the personalized risks and context may be a more effective approach to consider for future research.

## TITLES OF ORIGINAL PAPERS

- I. Adonis L, An R, Luiz J, Mehrotra A, Patel D, Basu D, Sturm R. Provincial screening rates for chronic diseases of lifestyle, cancers and HIV in a health-insured population. South African Medical Journal 2013; 103 (5): 309-312. DOI: 10.7196/SAMJ.6686
- II. Adonis L, Basu D, Luiz J. Predictors of adherence to screening guidelines for chronic diseases of lifestyle, cancers and HIV in a health-insured population in South Africa. Global Health Action 2014, 7: 23807. DOI: 10.3402/gha.v7.23807
- III. Adonis L, Basu D, Luiz J. The role of prospect theory in screening decision making in a health-insured population in South Africa. In Review
- IV. Adonis L, Basu D, Luiz J. Framing preventive care messaging and cervical cancer screening in a health-insured population in South Africa – implications for population-based communication? In Review



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## CHAPTER ONE

### 1.0 BACKGROUND

#### 1.1 Preventing Non-Communicable Diseases

In September 2011, the Minister of Health and Deputy Minister of Health hosted a summit on the Prevention and Control of Non-Communicable Diseases (NCDs) in which the reduction of mortality and morbidity from NCDs was prioritized as critical in South Africa (South African Department of Health, 2013). With this, the South African government pledged a renewed focus on prevention.

In fact, globally, the World Health Organization has called upon its member states to integrate prevention and control of NCDs into policies across all government departments (World Health Organization, 2008), given the growing number of deaths attributable to NCDs. Preventive care has received this intensified interest globally, due to the context of a growing burden of chronic diseases and the high cost of treating them. The WHO predicted that between 2005 and 2017, the proportion of deaths attributable to NCDs would increase by 17%.

Each year, NCDs cause more than 36 million deaths worldwide, representing around 63 per cent of all mortality. Four categories of NCDs are responsible for more than 80 percent of NCD deaths globally: cardiovascular diseases, cancers, diabetes, and chronic respiratory diseases (United Nations, 2012). By 2030, in the whole of the European region, the prevalence of diabetes, coronary heart disease, stroke and cancers was projected to reach an average of 3990, 4672 and 2046 cases per 100 000, respectively (Webber, 2014). It is believed that as many as 80% of cardiovascular (CVD) deaths worldwide take place in developing countries like those in sub-Saharan Africa (SSA), and even though HIV/AIDS is still the current epidemic in SSA, CVD disease threatens to become the new epidemic because of the increasing rates of these CVD risk factors (Ikem and Sumpio, 2011).

Researchers believe that in Africa, there is now compelling evidence that the major CVD risk factors are in fact on the rise, as well as the related fatal and non-fatal sequelae, which occur at significantly younger ages than seen in high-income countries (Owolabi, Mensah, Kimmel, Adu, Ramsay, Waddy, et.al., 2014). It is thus imperative that leaders in health care recognize the growing burden of non-communicable diseases and prioritize targeted interventions.

## 1.2 Burden of Non-communicable Diseases in South Africa

The Burden of Disease (BOD) Estimates 2000 study commissioned by the Medical Research Council of South Africa outlined for the first time the pattern of disease burdens in South Africa (Bradshaw et al., 2006). It determined causes of premature mortality (years of life lost or YLL) as well as the burden associated with morbidity and disability in order to establish disability-adjusted life years (DALYs). Although the authors cited several challenges in the quality and completeness of available data, the study provided a first glimpse of the highest burdens of diseases with far-reaching implications for planning and priority-setting purposes.

### 1.2.1 Causes of Death in South Africa

According to the BOD estimates, more males than females die from non-communicable diseases, with the leading causes being cardiovascular diseases and diabetes, followed by cancers and chronic respiratory diseases respectively. Overall the mortality rate per 100,000 attributable to all non-communicable diseases is 733.7 for males and 555.2 for females (Bradshaw et al., 2006). This data is represented in table 1.

**Table 1. Age-standardised death rate per 100,000 (2008)**

|                                             | Males | Females |
|---------------------------------------------|-------|---------|
| <b>All Non-communicable diseases</b>        | 733.7 | 555.2   |
| <b>Cardiovascular diseases and diabetes</b> | 327.9 | 315.2   |
| <b>Cancers</b>                              | 202.2 | 123.9   |
| <b>Chronic respiratory diseases</b>         | 86.6  | 44.5    |

Source: Normal et al., 2006

### 1.2.2 Causes of Premature Mortality

Years of life lost (YLL) is a measure of premature mortality. The BOD estimates study (Bradshaw et al., 2006), showed that South Africans are dying prematurely from the following disease categories:

- 1 HIV/AIDS
- 2 Other Infectious Diseases: tuberculosis, diarrhoeal diseases, other lower respiratory tract infections, malaria
- 3 Non Communicable Diseases: cardiovascular diseases (CVD, stroke), diabetes, cancer, mental disorders
- 4 Injuries: both intentional (homicide, suicide) and unintentional (MVA, falls, drowning, burns)

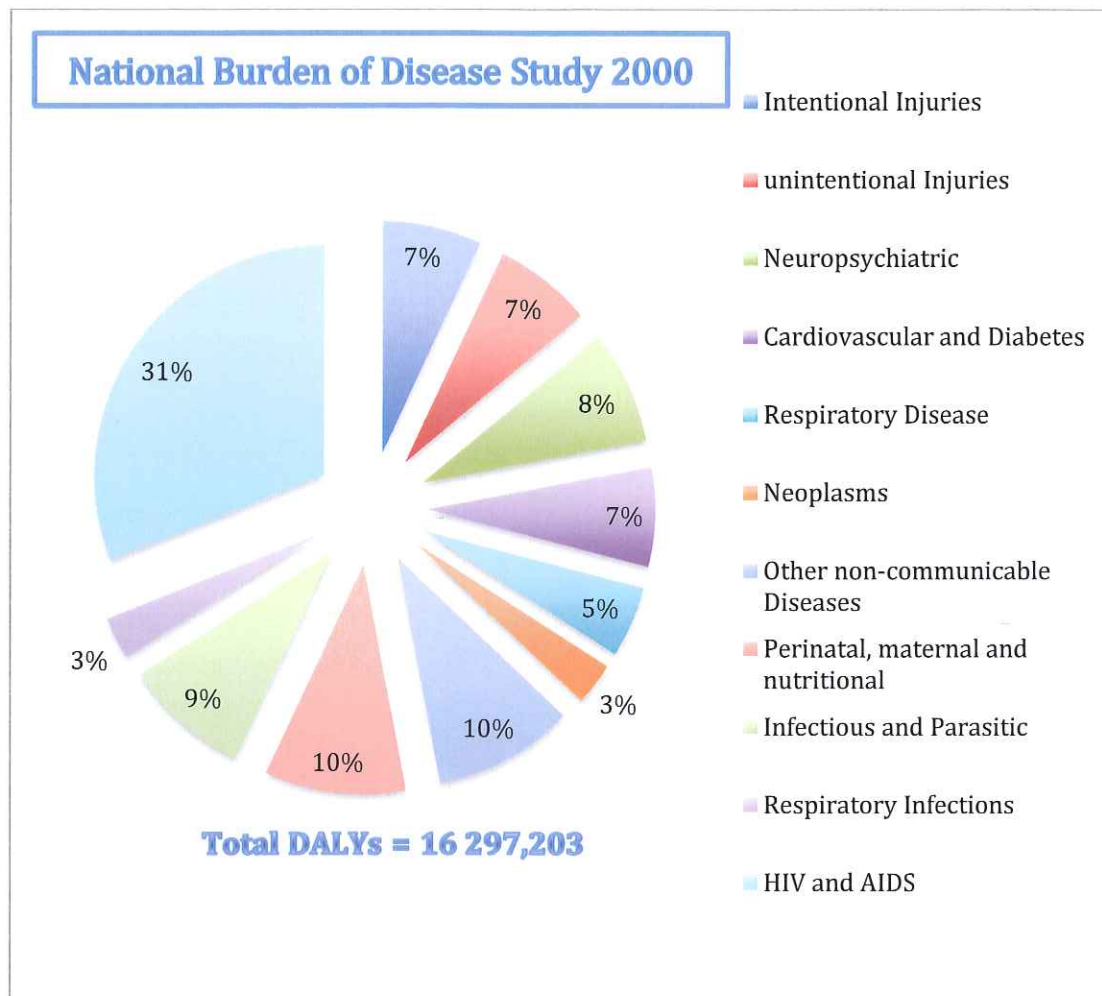
Even though HIV/AIDS and other communicable diseases remain the leading cause of premature mortality, recent evidence suggests that CVD and stroke is on the increase in South Africa (Mayosi, Flisher, Lalloo, Sitas, Tollman, and Bradshaw, 2009) as well as in the rest of the African continent (Owolabi, 2014).

### 1.2.3. Disability Adjusted Life Years

In order to effectively gauge the enormity of a disease while taking into consideration both YLL and years lived with a disability, a composite measure called BOD was estimated. Mortality data alone tends to misrepresent the burden of some diseases, particularly unintentional injuries, chronic diseases like central nervous system disorders (CNS), respiratory diseases, some sense organ diseases and mental disorders with protracted disease spans, which negatively affect people's lives and the healthcare system.

A breakdown of the contribution of diseases to DALYS as calculated by Bradshaw (2006), is shown in Figure 1.





**Figure 1 National Burden of Disease Study 2000** (Normal et al., 2006)

The BOD estimates highlights the epidemiological transition that South Africa is undergoing in terms of the categories of diseases burdening the country. The current epidemiological transition portrays the quadruple burden of disease (infectious diseases, non-communicable diseases, HIV/AIDS and intentional and unintentional injuries). According to the BOD estimates, non-communicable diseases currently contribute 28% of the total burden of diseases in South Africa (Bradshaw et al., 2006). This has prompted researchers to urge the South African government to launch national initiatives focusing on establishing centres of excellence to promote integrative care within the health care setting (Mayosi et al., 2009).

### 1.3 Screening for Prevention

The purpose of screening is to identify individuals who are unaware of their existing disease and can benefit from treatment. Early detection of risk factors and screening

for asymptomatic diseases is recognized as integral to any comprehensive strategy to prevent cardiovascular diseases and cancers (Centres for Disease Control and Prevention, 2008). Improving access to screening as part of a package of clinical preventive services has been shown to be an evidenced-based intervention with the potential to improve risk and subsequently prevent disease (Halpin, Morales-Suárez-Varela and Martin-Moreno, 2010). In fact, screening for preventable diseases has consistently been shown to decrease morbidity and mortality, especially for breast, cervical, and colorectal cancers (Chu, Weinstein and Yee, 2001; Cutler, 2008; Sabatino, Habarta, Baron, Coates, Rimer, Kerner, et al., 2009; Weller, Patnick, McIntosh and Dietrich, 2009). The benefit derived from preventing disease lies in the prospect of reducing the risk of contracting disease in future. This benefit even has the potential to save future costs. According to Cohen (2008), some of the measures identified by the United States Preventive Services Task Force (USPSTF), such as counselling adults to quit smoking, screening for colorectal cancer, and providing influenza vaccination, have been shown to reduce mortality either at low cost or at cost savings (Cohen, Neumann and Weinstein, 2008). In addition, screening for pre-diabetes, chronic kidney disease and low bone mineral density has been found to prevent between 10,000 and 1,000,000 DALYS per intervention (Vos, Carter, Barendregt, Mihalopoulos, Veerman, Magnus, et al., 2010).

Globally chronic disease prevention and control was estimated to have had the ability to avert 36 million deaths by 2015 (Beaglehole, Ebrahim, Reddy, Voûte and Leeder, 2007). Eighteen million of these deaths could have been averted in 23 low- and middle-income countries (Lim, Gaziano, Gakidou, Reddy, Farzadfar, Lozano and Rodgers, 2007). According to Beaglehole (2007), reductions in mortality seen in randomized trials could only have been reproduced in the wider population given adequate uptake in screening programs. Given the high proportion of deaths still attributable to NCDs worldwide, it is evident that prevention efforts can and still should be strengthened.



### 1.3.1 Utilization of Preventive Screening Services

Despite incontrovertible evidence supporting the medical and economic benefits of prevention and early detection, current disease control efforts are often described as underfunded and fragmented, with services poorly utilized (Eyre, Kahn and Robertson, 2004). In an effort to address these concerns, several organizations such as the USPSTF, National Institute for Health Care Excellence (NICE) and WHO have established population-based screening recommendations through a collation of evidence-based data (Table 2). In order for screening services to be cost-effective and decrease the burden of disease, the Healthy People 2020 project has developed screening targets for some screening services, which is also depicted in Table 2 (Healthy People 2020, undated). However, despite these recommendations and targets, which have been created by reviewing a wealth of data, researchers have consistently shown that screening below recommended targets remains widespread (Biesheuvel, Weigela and Heindela, 2011; Smith, Cokkinides, Brooks, Saslow and Brawley, 2010). In a Centres for Disease Control and Prevention study of the use of clinical preventive services (Centres for Disease Control and Prevention, 2012), researchers found that:

“Tens of millions of people in the United States have not been benefitting from key preventive clinical services and that there are large disparities by demographics, geography and health care coverage and access in the provision of these services” (1).

According to this report, only 68% of adults had a cholesterol test in the preceding 5 years; approximately 1 in 5 women aged 50-74 had not had a mammogram in the preceding 2 years; and one third of adults aged 50-75 were not up to date with screening for colorectal cancer.

In South Africa, very little is known about the use of screening services for cardiovascular diseases, with some pockets of knowledge for certain cancer services (Pap smears) and HIV. The uptake of cervical cancer services in the public sector is thought to be in the region of approximately 24-30% of eligible women (Moodley,

Kawonga, Bradley and Hoffman, 2006). Population-based HIV screening was shown to be approximately 20% in 2006 (April, Walensky, Chang, Pitt, Freedberg, Losina et al., 2009) and 24.9% in 2009 (Statistics South Africa, undated). To date, no information is available for the use of screening services in the private sector. A search of the following databases: MedlinePlus, Cochrane, Global Health, PubMed, JSTOR, Scopus and SpringerLink, using the keywords, screening, chronic diseases of lifestyle, HIV and South African private sector, revealed no results.

Table 2. Current USPSTF Recommendations

| Tests                              | Frequency and age eligibility                                                                                                                                                                                                                                                                            | Targets they exist) <sup>Healthy</sup> <sub>People 2020</sub> | (where exist) <sup>Healthy</sup> |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|----------------------------------|
| <b>Cholesterol</b>                 | Once every 5 years all ages 35+; Men aged 20-35 should be screened if they are at increased risk for heart disease                                                                                                                                                                                       | 82.1 %                                                        |                                  |
| <b>Glucose</b>                     | Adults once every five years; more frequently if BP>135/80                                                                                                                                                                                                                                               |                                                               |                                  |
| <b>Pap smear</b>                   | Women aged 21-65 every 3 years. For women 30-65 years who want to lengthen screening intervals, screening with a combination of cytology and human papillomavirus testing every 5 years                                                                                                                  | 93.0%                                                         |                                  |
| <b>Mammogram</b>                   | Recommendations for 2002: screening mammography with or without clinical breast examination every 1-2 years for women aged 40 and older                                                                                                                                                                  | 81.1%                                                         |                                  |
| <b>Colorectal cancer screening</b> | For adults 50-75 years:<br>Colonoscopy every 10 years and Sigmoidoscopy once every five years<br>Faecal occult blood: yearly                                                                                                                                                                             | 70.5%                                                         |                                  |
| <b>Prostate specific antigen</b>   | Current evidence is insufficient to assess the balance of benefits and harms of screening in men less than 75 years of age. Screening may be recommended for older men, those with a family history of prostate cancer and African-American men who are at increased risk of death from prostate cancer. |                                                               |                                  |
| <b>HIV</b>                         | Counselling/screening is recommended for all adults. Frequency of tests not established.                                                                                                                                                                                                                 |                                                               |                                  |
| <b>Osteoporosis</b>                | Women 65 years and older and in younger women whose fracture risk is equal to or greater than that of a 65-year-old white women who has no additional risk factors. Consideration may be given to women at age 50 years who are post-menopausal and at increased risk.                                   |                                                               |                                  |

### 1.3.2 Some Considerations for Caution

When assessing a particular intervention it is imperative to assess both the benefits as well as the potential harms. The most important and least understood downside of cancer screening is the potential for over-detection and over-treatment because of the risk that screening will detect clinically irrelevant disease or pseudo-disease (Barrat, 2006). Prevention has to be delivered to all people at risk, often repeatedly over many years, in order to prevent some of them from developing disease (Russell, 2007). Screening tests are not 100% perfect and should ideally have a high sensitivity (the ability to correctly identify those with the disease) as well as a high specificity (the ability to correctly identify those without the disease). Goetzsche (2013) cautioned specifically about screening mammography, which was found in a review of several studies to result in over diagnosis and overtreatment of up to 30% (Gøtzsche and Jørgensen, 2013). False negatives may have the potential to delay the detection of breast and cervical cancer, but there is little evidence to help assess their psychological consequences in these or other screening programmes, although they are likely to lead to legal action being taken by individuals affected, and potentially may reduce public confidence in screening (Petticrew, 2000). Even with cause for caution, the general belief is that screening services should be offered to patients with adequate informed consent (Gøtzsche and Jørgensen, 2013; Lancet Editorial 2009), with the primary intention to minimize unnecessary harm (Ustun and Ceber, 2003).



## 1.4 Behavioural Economics

With a growing burden of non-communicable diseases and evidence confirming the benefit of screening in reducing morbidity and mortality, the question remains as to why screening services are not utilized more effectively. In the last few decades, the explanatory power of behavioural economics theory concerning human behaviour has gained favour (Stone, Morton, Hulscher, Maglione, Roth and Grimshaw et al., 2002; Fernald, Hou, and Gertler, 2008); several researchers have evaluated the effectiveness of behavioural economic approaches in changing health-related behaviours (Kraushaar and Krämer, 2009; Volpp, Levy, Asch, Berlin, Murphy, Gomez et al., 2006). Behavioural economics attempts to increase the explanatory power of standard economic theories by adding more realistic psychological foundations (Camerer, Loewenstein, and Rabin, 2004). It identifies several decision biases that often contribute to suboptimal behaviour. Camerer (2004) describes the theories of human behaviour as it applies to behavioural economics as follows:

- 1. Hyperbolic time discounting:** this is a time inconsistent model of discounting. It is postulated that humans show the preference of a reward sooner rather than later, discounting the value of the return. The utility of the present is favoured over the outcome of the future even though the future might be a worse (or better) outcome. This is often demonstrated in the utility of smoking studies (Ida, 2014) and other substance-use disorders (Chivers and Higgins, 2014). This theory can also be used to explain behaviour that contributes to for example, inadequate saving, overeating, procrastination, and poor medication adherence.
- 2. Status quo bias:** this theory is often referred to as the “accepting the same-old”, or tending-not-to-change theory. People are said to be more likely to choose the default option when given a choice. This theory has been proven in choice of Medicare options (Sinaiko, 2013) as well as other health insurance choices (Krieger and Felder, 2013) – often not to the benefit of the individual. Some further examples include inadequate retirement saving plan choices or

an aversion to changing poor eating habits.

3. **Loss aversion:** this theory describes the tendency to strongly avoid losing something already owned rather than gaining something new. This, according to Kahneman (1991), is when the disutility of giving something up is far greater than the utility associated with acquiring it (Kahneman, Knetsch and Thaler, 1991). Kahneman (1991) describes it as, for example, not being able to sell a bottle of wine once purchased 10 years ago for, say, \$10 dollars for its current price of \$200, nor being willing to spend that amount of money acquiring a new one. This phenomenon can also inadvertently contribute to poor investment decisions or not giving up time now to participate in, for example, screening tests.
4. **Overweighting of small probabilities:** this theory is evident in the large number of people playing lotteries when the chances of winning are tremendously low. Experimental studies have found that people also tend to overweight probabilities and exaggerate risk when risk is in fact low (Kusev, van Schaik, Ayton, Dent and Chater, 2009). For example, in early August of 2014, the Minister of Health placed restrictions on cross-border travel between South Africa and recent Ebola-endemic countries, sparking fear of an Ebola outbreak in South Africa. People tend to fear dying from Ebola, when in fact the risk of death in their lifetime due to a cardiovascular disease is higher than the risk of dying from Ebola.

One interventionist option to minimize behaviour pitfalls as described by behavioural economic theories is the theory of asymmetric paternalism (Lowenstein, Brennan and Volpp, 2007). Lowenstein (2007) describes this theory as paternalistic in the sense that the theory attempts to assist individuals to achieve their own goals – in effect to protect themselves – as compared with conventional forms of regulation designed to prevent individuals from harming themselves. Using incentives and rewards to guide individual behaviour is essentially a mechanism of “steering” or “enticing” people (thus paternalistic) to behave in a way ultimately beneficial to their health and lives.

#### 1.4.1. Incentives

Asymmetric paternalism capitalizes on the fact that most individuals are motivated by actions that produce measurable, tangible benefits, but are much less motivated by actions that do not produce tangible progress toward a goal (Lowenstein, Brennan and Volpp, 2007). For example, the satisfaction of instant, perceived gratification of smoking a cigarette is much more appealing to smokers than the benefit of health and healthy lungs sometime in the future. If a smoker receives an immediate reward for giving up smoking, it may be easier for them to buy into the behaviour change. The concept of “nudge” as popularized in recent populous literature has become an interesting option for steering good behaviour (Thaler and Sunstein, 2008) and has been found to have some benefit for consideration (Ries, 2012; Goel, 2012). It is thus postulated that if someone receives a reward (which is immediate and tangible) for doing certain health enhancing or promoting tests, it could steer behaviour in a positive way. Thus, in principle, incentives and rewards – tangible, measurable consequences to an action, – start to play an increasingly important role in motivating certain intended behaviours and can be used to motivate healthy behaviours (Sutherland, Christianson and Leatherman, 2008; Anderson, Harrison, Cooper and Jané-Llopis, 2011). Incentives in particular have been shown to be useful in steering positive behaviour especially in the workplace setting (Kahn-Marshall and Gallant, 2012; Osilla, Van Busum, Schnyer, Larkin, Eibner and Mattke, 2012) and can thus be used to overcome behavioural biases, leading individuals to make better health choices.

#### 1.4.2 Prospect Theory

One of the cornerstones of the standard economic model (SEM) is the concept that people are rational agents and utility maximizers (Wilkinson, 2008). However, early work by psychologists like Edwards, Luce, Tversky and Kahneman identified several psychological influences that cause judgments and choices to deviate from statistical principles of utility maximization (Camerer, Loewenstein and Rabin, 2004). In particular, Kahneman describes the issue of bounded rationality – that our decision-making power is influenced by our experiences, our environment and the limited time



we have available to make these decisions (Kahneman, 2003). In fact people are thought to use decision short-cuts (also known as heuristics), which results in systematic errors or biases in judgment (Wilkinson, 2008; Kahneman, 2003; Kahneman, 2011; Altman, 2012; Diamond, 2007). Two theoretical constructs that Kahneman describes, as part of a “map of bounded rationality”, are prospect theory and framing effects, both of which guide choices.

Prospect theory dictates that perception is reference-dependence and influences choice given a prior context or previous stimuli (Wilkinson, 2008; Kahneman, 2003; Kahneman 2011; Altman 2012; Diamond, 2007). This suggests that people make choices based on their current situation, the amount of information they have at hand and their experiences either in the past or present. When people are newly diagnosed with a chronic disease or if a family member, for example, suffers a cardiac arrest, does this context or new information influence their decision making to join a wellness organization and participate in health enhancing activities? Prospect theory may then be used to further evaluate people’s behaviour in this context.

Prospect theory, has been used to describe decision making in the context of risk (Tversky and Kahneman, 1992; Levy, 1992; Barberis, 2013; Mullainathan and Thaler, 2000). According to Kahneman and Tversky, the first to describe prospect theory, the experimental evidence for prospect theory confirms the manner in which individuals make decisions in risky situations (Edwards, 1996; Wilkinson, 2008). The theory postulates that people are risk averse in choices involving certain gains, but risk seeking in choices involving certain losses. Choices are made based on values placed on the gain or loss relative to a reference point and decision weighing of the outcomes.

#### 1.4.3 Framing Effect

People are thought to respond to health messaging differently depending on how the message is framed. This is known as the framing effect: when two logically equivalent (but not transparently equivalent) statements of a problem lead decision makers to choose different options (Rothman et al., 1997; Druckman, 2001). This



implies that people respond to health messaging differently depending on how the message is framed. The framed message may focus on a subset of considerations that in turn gets the person receiving the message to focus specifically on these (and subsequently act upon it) (Druckman, 2001). Psychologically, the message alters the accessibility of the different considerations that the person then processes for importance.

Messages can either be constructed as gain-framed, focusing on the benefits of engaging in the behaviour, or loss-framed, which emphasizes the costs or consequences of not engaging in the behaviour (Gallagher et al., 2011). Several factors have been postulated as playing a role in modulating responses to health messages, including prior attitude, context and perceived efficacy of the behaviour (Gerend et al., 2007; Hull et al., 2012). One particular theory that has been used to explain framing effect is called Prospect Theory (Rothman et al., 1997). This theory states that people tend to avoid risks when faced with the potential benefits of a decision but are willing to take risks when faced with the potential costs of a decision. Based on this, researchers have surmised (and tested) that gain-framed messaging is more persuasive when advocating prevention behaviour (like sunscreen or condom use), which is risk averse; while loss-framed messaging is more effective for detection behaviour (like screening for diseases) which is thought to be higher risk due to the probability of detecting disease (Rivers et al., 2005; Bartels et al., 2010; Gallagher et al., 2011).

Evidence for framing effect on health consumer behaviour is inconsistent at best (Akl et al., 2011). Overall the evidence suggests that when risk is low (either in preventive or detection behaviour), people respond more favourably to gain-framed messages; when risk is high (preventive or detection), people respond better to loss-framed messages (Latimer et al., 2007). Most studies, however, have focused on intention to participate in a behaviour, attitude to a behaviour and self-reported behaviour (Rivers et al., 2005; Akl et al., 2011; Gainsforth et al., 2011). Few studies have assessed actual behaviour change as a measure of persuasiveness. It is well known that there is often a disconnect between people's attitude, intentions and their actual behaviour.

There is thus an important gap in the health literature on message framing to evaluate actual behaviour change as a response to gain-framed and loss-framed messages.

In order to test the effect of health message framing, it was decided to test it on Pap smear uptake. Globally, cervical cancer is the second-most common cancer among women (Everett et al., 2011). According to estimates, there are approximately 530,000 new cases and 275,000 global deaths annually (Pimenta et al., 2013; Parkin and Bray, 2011). Some 83% of cases occur in developing countries, where cervical cancer accounts for 15% of female cancers, with a risk before age 65 of 1.5%, while in developed countries it accounts for 3.6% of new cancers, with a cumulative risk (ages 0–64) of 0.8% (Parkin and Bray, 2011). Cervical cancer incidence and mortality have been reduced substantially in countries that have well-developed cervical screening programs (Pimenta et al., 2013). The recently updated United States consensus guidelines and guidelines from the Canadian Task Force on Preventive Health Care recommend that cytology exams be repeated every three years starting at age 21 or 25 respectively and should end at age 65 (Tota et al., 2014; Vesco et al., 2011). Even with several advances in the structuring and delivery of cervical cancer screening programs, not every eligible female is screened according to recommendation (DuBard et al., 2008; Hughes et al., 2008; Screening and Immunization team, 2013; Centres for Diseases Control Use of Pap smears, 2013). As a mechanism to increase participation in screening programs, sending screening invitations, reminders, and various forms of communication to eligible females has been shown to be effective (Eaker et al., 2004; Camilloni et al., 2013; Byrnes et al., 2007; Zapka and Lemon, 2004).

However, it is unclear what sort of messaging would have the greatest effect on cervical cancer screening uptake.

## 1.5 Aims

The overall aim of this study was to determine screening behaviour for certain non-communicable diseases, cancers and HIV in a health-insured population in South Africa.

### 1.5.1 Specific Aims

The specific aims were:

- To describe the uptake of screening services and any variations between the nine provinces in one calendar year.
- To determine the proportion of eligible individuals who were up to date with screening recommendations and the associated predictors of adherence to recommendations.
- To evaluate the role of prospect theory in predicting screening decision making in individuals who were diagnosed with a chronic disease or who had a family member diagnosed with a chronic disease.
- To determine the effect of health messaging framing (either gain-framed or loss-framed) on the uptake of Pap smears.

The rest of the thesis will outline the methodologies utilized for each of the specific aims, the results obtained, an overall discussion and conclusion. The structure of the thesis is a collation of four manuscripts, which were set out according to the specific aims. Final remarks on the implications of the findings as well as the strengths and limitations of this body of work will be highlighted.



## CHAPTER TWO

### 2.0 METHODOLOGY

#### 2.1 Discovery Health

The study used data from Discovery Health, the health insurance company. Discovery Holdings is an international financial services company that operates in South Africa, the United Kingdom, China and the United States. The company listed on the Johannesburg Securities Exchange in 1999 and its head office is in Sandton, Johannesburg, South Africa. It has an AA+ credit rating from Global Credit Rating. Discovery Health Medical Scheme, a subsidiary company, covers approximately 2 million lives. Discovery was established in South Africa in 1992, initially operating as a specialist risk manager in the private health insurance market. It has since expanded into a fully integrated financial services organization. In addition, through a program called Vitality, Discovery Health offers incentives to its members for engaging in healthy behaviour. Vitality is a scientific wellness programme that encourages people to be healthier and rewards them for positive health behaviour. The Vitality program offers its members incentives to perform the health-screening tests paid for by the medical aid, as well as participate in other health-enhancing behaviours like gym attendance and purchasing healthy foods at partner stores. Screening tests that are incentivized include those for certain cancers (breast, cervix, and prostate), chronic diseases of lifestyle (glucose, cholesterol, BMI, and blood pressure), and the human immunodeficiency virus (HIV). Members of Vitality pay a fee per month (approximately R120) and receive benefits, like discounts at network stores, for participating in the program. The programme forms the foundation to all Discovery Holdings' products and enables consumers to integrate their Discovery products to achieve more value. Through Vitality, Discovery's wellness programme, the company also offers consumers the Discovery Card, a Visa credit card. This card offering offers consumers additional benefits, rewards wellness and facilitates integration across Discovery's product offerings. The study population consisted of all members who were eligible for screening tests, as adapted from the USPSTF recommendations. The Vitality program uses these adapted screening recommendations to award points.



Ethical clearance for this study was provided by the Witwatersrand Human Research Ethics Committee, certificate number M120854.

## 2.2 The Data

Data were collected from the Discovery Health member claims repository using Current Procedural Terminology (CPT) codes. Data were extracted for the period 2007-2011. This time period would enable evaluation of test recommendations for a five-year period. In addition, for the evaluation of screening behaviour for those diagnosed with a chronic illness, data were extracted from the Discovery Health Chronic Illness Benefit Unit repository using International Classification of Disease (ICD) 10 criteria.

### 2.2.1 Sampling

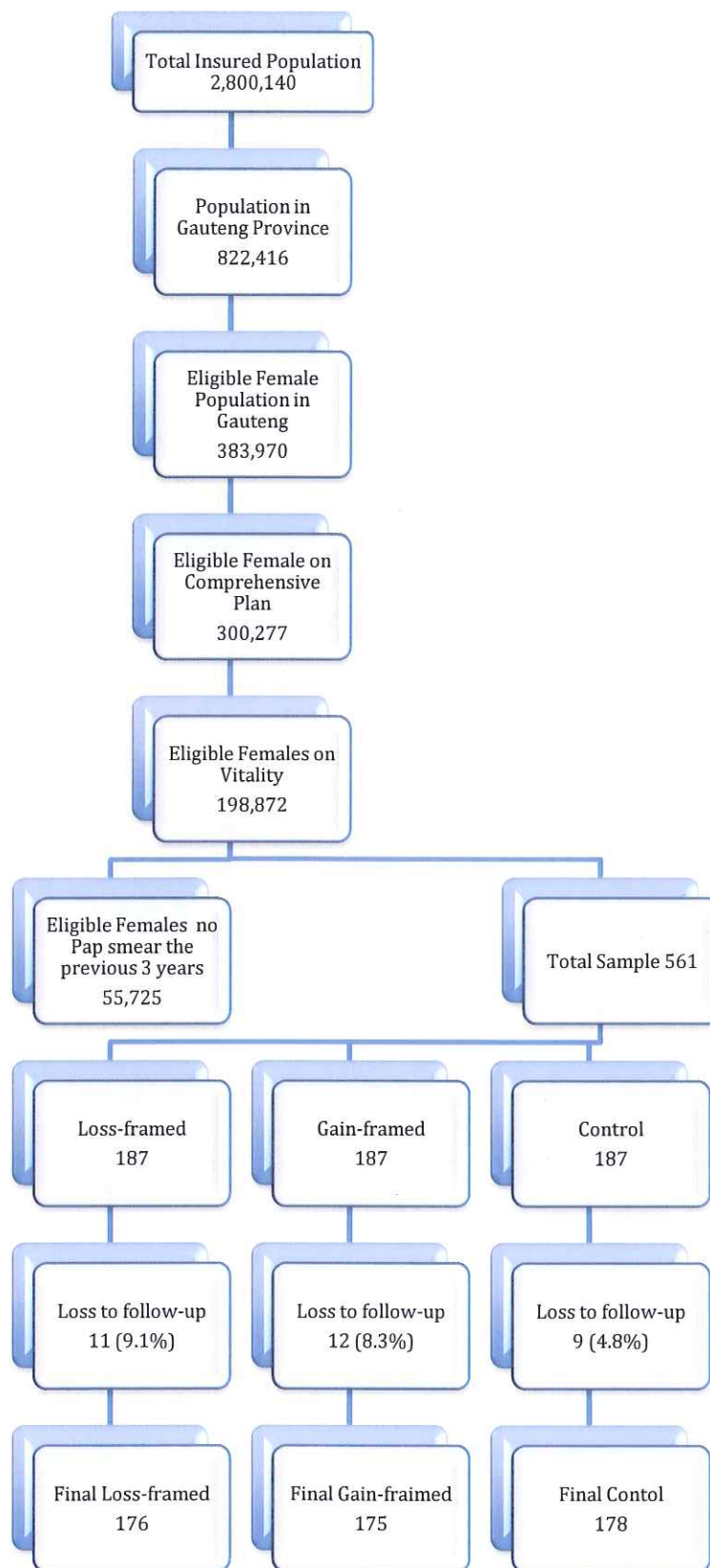
For the uptake of services evaluation, the study population consisted of all members of the medical aid as at the end of 2011. This consisted of a total of 1 889 447 members.

To evaluate the proportion of members up to date with screening recommendations as well as the predictors of screening behaviour, a random 1% sample of 170,141 members, not stratified across any variables, was generated from the health insurance member database.

The same 1% sample of 170,471 members was used to evaluate screening behaviour in those diagnosed with a chronic disease or those who had a family member diagnosed with a chronic disease, in order to evaluate the role of prospect theory in screening behaviour.

For the effect of health message framing on the uptake of Pap smears, the sampling strategy undertaken was a prospective longitudinal randomized control study. The sample was stratified by province to only include Gauteng Province (where the largest proportion of health-insured members reside), age (females 21–65 years), plan type, (Comprehensive plan type only) and wellness plan status (belonging to Vitality). A structured email was sent to eligible females in August 2013 and again three months later in November 2013. Females randomly received a loss, gain, or neutral-framed email. This stratification is based on earlier work by the authors that showed marked

variation between use of services across provinces and predictors of screening associated with provincial location, plan type, and wellness plan membership (Adonis et al., 2013; Adonis et al., 2014). Sample stratification is illustrated in Figure 2.



**Figure 2 Sample stratification for eligible females receiving health messages**

To be eligible, females had to have had no Pap smear in the preceding three years (2012, 2011, and 2010). The neutral framed message served as the control group, consisting of 187 females, with the intervention groups of gain- and loss-framed messages consisting each of 187 females, constituting a total sample size of 561. The sample size was calculated according to a Pap smear screening prevalence of 17% amongst the unexposed (Adonis et al., 2013) and an expected uptake of 25% amongst the exposed. Sample size was calculated using Open Epi Version 2 (Open Epi Results from OpenEpi, Version 2, open source calculator—SSCohort). Examples of the framed messages, loss, gain, and neutral, are shown in Table 3.



**Table 3 Example of health messages emailed to eligible females**

| <b>Loss-framed</b>                                                                                                                                                                                                                                                                                                                               | <b>Gain-framed</b>                                                                                                                                                                                                                                                                                                                                              | <b>Neutral-framed</b>                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dear <member name>                                                                                                                                                                                                                                                                                                                               | Dear <member name>                                                                                                                                                                                                                                                                                                                                              | Dear <member name>                                                                                                                                             |
| One in 35 women in South Africa has a risk of getting cervical cancer.                                                                                                                                                                                                                                                                           | Regular Pap smears are essential to your health and wellbeing.                                                                                                                                                                                                                                                                                                  | It is currently recommended that women have a Pap smear at least once every three years.                                                                       |
| It is currently recommended that women have a Pap smear at least once every three years. If you don't have regular Pap smears, you won't be able to detect early cervical cancer or changes in cervical cells that can lead to cancer. This means that you may only detect the cancer when it is too late. This can lead to bad health outcomes. | It is currently recommended that women have a Pap smear at least once every three years.<br><br>A Pap smear is the best way to detect cervical cancer or changes in cervical cells that can lead to cancer. Early detection of abnormal cells and early intervention can lead to better health outcomes and increases your chances of a better quality of life. | Schedule a Pap smear with your general practitioner or gynaecologist now. The procedure only takes a few minutes and you will have your results in a few days. |
| Speak to your general practitioner or gynaecologist about the benefits and risks of a Pap smear. The procedure only takes a few minutes and you will have your results in a few days.                                                                                                                                                            | Speak to your general practitioner or gynaecologist about the benefits and risks of a Pap smear. The procedure only takes a few minutes and you will have the results in a few days.                                                                                                                                                                            |                                                                                                                                                                |

## 2.3 Statistical Methods

### 2.3.1 Uptake of Services

The evaluation of uptake of screening services was a cross-sectional descriptive analysis of the annual screening rate of all eligible medical aid members in 2011 across the nine provinces. The mean screening rate for each test was compared between the provinces using the student's t-test for unpaired samples with Gauteng as the baseline. Variation between provinces was described using ratios of differences. All analyses were conducted using STATA 12.0 (StataCorp, College Station, Tx).

### 2.3.2 Predictors of Adherence of Screening Recommendation

For the predictors of adherence to screening guidelines, the study was a cross-sectional study conducted from 2007-2011. The dependent variables were adherence to the Discovery screening recommendations. These recommendations were classified as follows: receipt of a cholesterol test in the previous five years; receipt of a glucose test in the previous five years; receipt of a Pap smear in the previous three years; receipt of a mammogram in the previous two years; receipt of a colon cancer test (faecal occult blood test, sigmoidoscopy, or colonoscopy) in the previous five years; receipt of a prostate specific antigen (PSA) test in the previous year; receipt of an HIV test in the previous year; and receipt of a bone scan in the previous year. The following independent variables were studied: sociodemographic factors, such as age and gender; plan type (comprehensive plan: the best benefit package, with higher premiums; core plan: only in-hospital benefits, with the lowest premiums; saver plan: between the comprehensive plan and the core plan in terms of benefits and premiums); Vitality status (belonging to the wellness program); and province of residence. The estimated prevalence for undergoing a screening test during the 2007-2011-study period, with corresponding 95% confidence intervals (CIs) for each screening test, was calculated. An analysis of the association of the study variables with screening adherence was performed using the chi-squared test statistic and Student's t-test, where applicable. Multivariate logistic regression was used to



determine which variables were independent predictors of screening for cholesterol, glucose, Pap smears, mammograms, PSA, colorectal cancer, osteoporosis, and HIV. The adjusted odds ratio (OR) and its 95% confidence interval (CI) were calculated to measure the strength of the association. A logistic regression multivariate model was built using the forward modelling method. All statistically significant variables (whose bivariate tests were significant) were selected for the multivariate analysis. Calculations were done using the STATA program (Stata Corporation 12.0), and statistical significance was set at  $p < 0.05$  ( $p$  values are two-tailed).

### 2.3.3 The Role of Prospect Theory on Screening Behaviour

The design of the study evaluating the role of prospect theory on screening decision making was a longitudinal case-control study tracked over time between 2008-2011. To assess individual-level decision making on screening for tests covered in the screening benefit, eligibility criteria included all individuals over 18 years of age diagnosed with any chronic disease in 2008, captured on the Chronic Illness Benefit as per ICD10 classifications. Chronic diseases included in the analyses are outlined in Appendix I. Controls included all individuals over 18 years not diagnosed with any chronic disease in 2008. Furthermore, for household-level decision making, eligibility criteria for cases included any family member within a household where a family member has been diagnosed with a chronic disease in 2008, compared to controls where no family member was diagnosed with a chronic disease in 2008. The outcome variable assessed was screening rate (for glucose, cholesterol, HIV, mammography, Pap smears, PSA, colorectal cancer and osteoporosis screening) for all cases and controls at two separate points in time (2008 and 2011). The screening rate was calculated as the number of screening tests per eligible population in 2008 and again in 2011. The difference in screening rate over time was compared between cases and controls using the difference-in-difference methodology. This method attempts to take into consideration pre-existing differences between cases and controls that may exist during a general time trend. It assumes that whatever happened to the control group over time is what would have happened to the cases group in the absence of treatment (i.e. chronic disease diagnosis). The statistical difference in mean screening rate over time between cases and controls was calculated using Student's t-tests for matched

pairs with a significance level set at  $p < 0.5$  (two-tailed). All data were calculated using the STATA program (Stata Corporation 12.0).

#### 2.3.4 The Effect of Health Message Framing on Pap Smear Uptake

Pap smear uptake in each message-framing category was calculated as the proportion of eligible females who received the message and had a Pap smear in the six-month study period with corresponding 95% confidence intervals (CIs). Data were collected from the health insurance database using Current Procedural Terminology (CPT) codes. Description of age was done using median and interquartile ranges (IQR) for non-normally distributed data. Analysis of differences for Pap smear uptake between message categories was done using the Kruskal Wallis test for skewed categorical variables. Further stratifications by age category were done to determine if any differences between Pap smear uptakes might occur for the different framed messages at different age categories, namely 21–30 years, 31–40 years, and 41–65 years. Logistic regression was performed to determine if any differences in Pap smear uptake occurred for gain-framed or loss-framed messages when compared to neutral messages.

Calculations were done using the STATA program (Stata Corporation 12.0), and statistical significance was set at  $p < 0.5$  ( $p$  values are two-tailed).

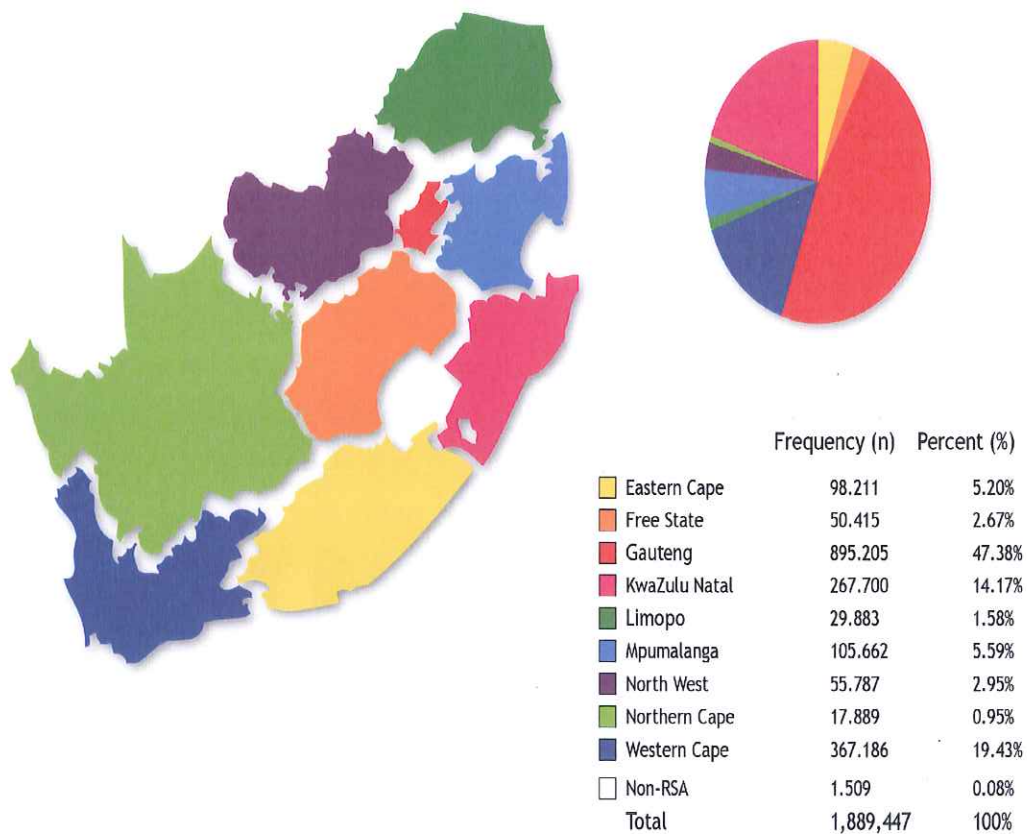


## CHAPTER THREE

### 3.0 RESULTS

#### 3.1 Uptake of Services

Screening rates for a total of 1 889 447 members for the year 2011 was evaluated. Distribution of the study sample by province is represented in Figure 3. The provincial screening rates are shown in Table 4.



**Figure 3. Provincial distribution of membership**

Gauteng had the highest annual screening rate for cholesterol at 27.5% of eligible insured members, while the lowest was 13.4 % in Northern Cape. Gauteng also had significantly higher screening rates for cholesterol with other provinces between 0.93 (Western Cape) to 0.49 (Northern Cape) times lower than Gauteng ( $p < 0.001$ ). The variations in screening rates are shown in Table 5. KwaZulu Natal had 0.84 times lower screening for cholesterol than Gauteng. The highest annual screening rate for glucose was 29.7% (Mpumalanga) although this was not significantly different from Gauteng with 29.6% ( $p = 0.97$ ). The lowest screening rate for glucose was in the Northern Cape (17.5%). Differences in glucose screening were up to 0.59 times lower in Northern Cape compared to Gauteng.

Prostate cancer screening had the highest uptake of the preventive screening tests. Around 37.7% of males over 50 years old had had a PSA in Gauteng as opposed to a low of 25.6% of males in the Northern Cape. Gauteng had the highest screening rate for prostate cancer of all of the provinces ( $p < 0.001$ ). Screening rates for prostate cancer ranged between 0.90 to 0.68 times lower in other provinces compared to Gauteng.

The Western Cape had the highest cervical cancer screening rates ( $p < 0.001$ ) with 23.1% of all eligible females having had a Pap smear, as opposed to, only 13.1% of females in Northern Cape. Western Cape screening rate for cervical cancer was 1.03 times higher than Gauteng while screening was 0.55 times lower in Limpopo than in Gauteng.

The highest screening rate for breast cancer was in Gauteng ( $p < 0.001$ ), with 17% of eligible females having had a mammogram while the lowest screening rate (9.4%) was in Northern Cape. The variation in mammographies ranged from 0.95 to 0.60 times lower in the other provinces compared to Gauteng.

For HIV screening, Gauteng province had the highest screening rates ( $p < 0.001$ ) with 12.8% of members having taken the test. On the other hand, the lowest rate of HIV screening was found in the Northern Cape, where only 4.8% of members had been tested in 2011. The variation in HIV screening was largest among all screening tests. Northern Cape had up to 0.38 times lower screening rates than Gauteng.

Colorectal cancer screening is currently not part of the paid screening benefit and the screening rate for colorectal cancer is lower than all other tests. The Eastern Cape (0.7%) achieved the highest rate ( $p < 0.001$ ) among members, while the lowest screening rate (0.2%) was in Limpopo. Eastern Cape's screening rate was 1.17 times higher than Gauteng and 3.5 times higher than Limpopo.

Osteoporosis screening, which is also not part of the screening benefit, was highest in Gauteng ( $p < 0.001$ ), with 7.9% of members undergoing screening, and lowest in the Northern Cape (2.2%). The variation in screening for osteoporosis was between 0.82 to 0.28 times lower in the other eight provinces than Gauteng.

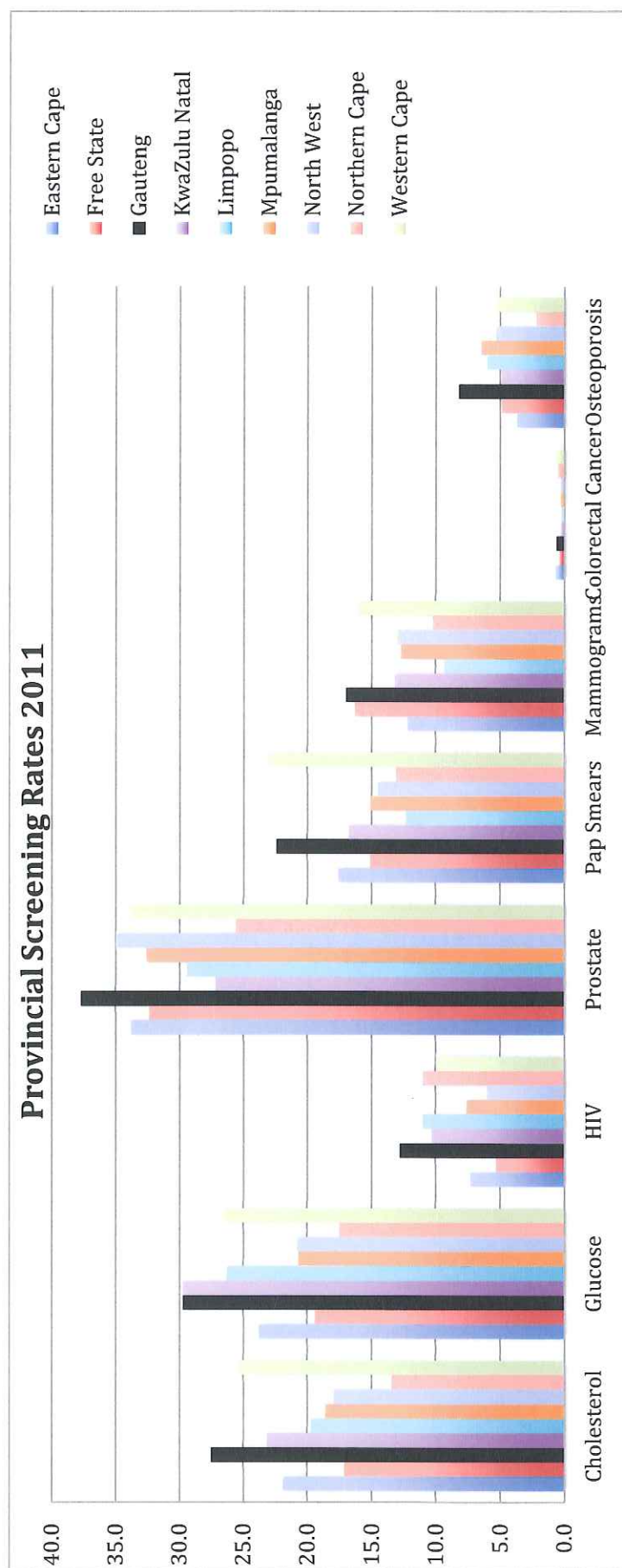
All provincial screening rates are presented in Figure 4, with Gauteng province shown in black. National screening rates for each screening test are depicted in Appendix II according to how much they ranged from the national average (either below or above). The scale was calculated as the range between the average and lowest level divided by 2 to provide the categories of: (1) much lower than national average, (2) lower than national average, (3) national average; and the range between the average and highest level divided by two to provide the categories: (4) higher than national average, and (5) much higher than national average.

Table 4. Provincial screening rates for Discovery Health members

|                               | Cholesterol | Glucose            | HIV   | Prostate | Pap smear | Mammogram | Colorectal Cancer | Osteoporosis |
|-------------------------------|-------------|--------------------|-------|----------|-----------|-----------|-------------------|--------------|
| National Average <sup>§</sup> | 20.5        | 23.8               | 8.2   | 31.9     | 16.7      | 13.3      | 0.4               | 5.7          |
| Eastern Cape                  | 21.9        | 23.8               | 7.3   | 33.8     | 17.5      | 12.1      | 0.7*              | 5.8          |
| Free State                    | 17.1        | 19.4               | 5.2   | 32.3     | 15.1      | 16.2      | 0.4               | 5.8          |
| Gauteng                       | 27.5*       | 29.6               | 12.8* | 37.7*    | 22.4      | 17.0*     | 0.6               | 7.9*         |
| KwaZulu-Natal                 | 23.2        | 26.3               | 10.2  | 27.2     | 16.9      | 13.2      | 0.3               | 4.9          |
| Limpopo                       | 19.7        | 20.7               | 11.0  | 29.4     | 12.3      | 9.4       | 0.2               | 6.0          |
| Mpumalanga                    | 18.6        | 29.7 <sup>NS</sup> | 6.7   | 32.6     | 15.1      | 12.6      | 0.3               | 6.5          |
| North West                    | 17.9        | 20.5               | 5.9   | 34.9     | 14.5      | 13.0      | 0.3               | 5.3          |
| Northern Cape                 | 13.4        | 17.5               | 4.8   | 25.6     | 13.1      | 10.2      | 0.4               | 2.2          |
| Western Cape                  | 25.5        | 26.6               | 9.9   | 33.8     | 23.1*     | 16.1      | 0.6               | 5.4          |

\*Significant difference in screening rate when comparing Gauteng to other provinces/or compared to Gauteng (p < 0.001)  
<sup>NS</sup> No significant difference in screening rate when compared to Gauteng (p=0.97)  
<sup>§</sup> Average of Discovery Health Members within each province





**Figure 4 Graphical presentation of provincial screening rates**

Table 5. Variation in screening rates between Gauteng and the other provinces

| Ratio by which Province is Lower (Higher) than Gauteng |             |         |      |          |           |           |                   |              |  |
|--------------------------------------------------------|-------------|---------|------|----------|-----------|-----------|-------------------|--------------|--|
|                                                        | Cholesterol | Glucose | HIV  | Prostate | Pap Smear | Mammogram | Colorectal Cancer | Osteoporosis |  |
| Eastern Cape                                           | 0.78        | 0.80    | 0.57 | 0.90     | 0.78      | 0.71      | (1.17)            | 0.73         |  |
| Free State                                             | 0.62        | 0.66    | 0.41 | 0.86     | 0.67      | 0.95      | 0.67              | 0.73         |  |
| KwaZulu-Natal                                          | 0.84        | 0.89    | 0.80 | 0.72     | 0.75      | 0.78      | 0.50              | 0.62         |  |
| Limpopo                                                | 0.72        | 0.70    | 0.86 | 0.78     | 0.55      | 0.55      | 0.33              | 0.76         |  |
| Mpumalanga                                             | 0.68        | 1.00    | 0.52 | 0.86     | 0.67      | 0.74      | 0.50              | 0.82         |  |
| North West                                             | 0.65        | 0.69    | 0.46 | 0.78     | 0.65      | 0.76      | 0.50              | 0.67         |  |
| Northern Cape                                          | 0.49        | 0.59    | 0.38 | 0.68     | 0.58      | 0.60      | 0.67              | 0.28         |  |
| Western Cape                                           | 0.93        | 0.90    | 0.77 | 0.90     | (1.03)    | 0.95      | 1.00              | 0.68         |  |

### 3.2 Predictors of Up to Date with Screening Recommendation

To evaluate the proportion of people who were up to date for the different tests, a cross-sectional study for the period 2007-2011 was conducted consisting of a random 1% sample of 170, 471 members.

More than 38% of the insured members were aged 18-35 years and 33.3% belonged to the 36-50 years of age category; both categories had a 52% female distribution.

Over 64% of the Discovery Health membership belonged to the Vitality program. The plan types were divided as follows: 40% of the participants were insured through the comprehensive plan, 42% were insured through the saver plan, and 16% were insured through the core plan. The highest proportion of members resided in the better-resourced provinces, as follows: 43% in Gauteng, 18% in Western Cape, and 13% in KwaZulu-Natal. These results are depicted in Table 6.

**Table 6. Characteristics of the study sample for up to date for individual tests**

| Variables                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      | Percentage (%) |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------|
| <b>Age groups (range of years)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 18-35                | 38.5           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 36-50                | 33.3           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 51-60                | 14.5           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | >60                  | 13.7           |
| <b>Gender</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Male                 | 48             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Female               | 52             |
| <b>Wellness program membership</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Vitality members     | 64.3           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Non-Vitality members | 35.7           |
| <b>Plan type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | *Core                | 16.6           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | **Saver              | 42.7           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ***Comprehensive     | 40.6           |
| <b>Provincial distribution of health insurance membership</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Gauteng              | 43.4           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Western Cape         | 18.6           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | KwaZulu-Natal        | 13.5           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Eastern Cape         | 12.8           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Mpumalanga           | 4.4            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | North West           | 2.3            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Free State           | 2.3            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Limpopo              | 1.3            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Northern Cape        | 0.9            |
| <p>* Unlimited private hospital coverage • Essential coverage for chronic medicine • Coverage for medical emergencies when travelling in and outside South Africa. Contributions per month: Main member = \$153.41; Adult dependent = \$120.68; Child = \$61.25.</p> <p>**Unlimited private hospital coverage • Essential coverage for chronic medicine • A Medical Savings Account • Coverage for medical emergencies when travelling in and outside South Africa. Contributions per month: Main member = \$206.14; Adult dependent = \$162.27; Child = \$82.39.</p> <p>*** Unlimited private hospital coverage • A choice of a high or no Medical Savings Account and an unlimited Above Threshold Benefit • Comprehensive coverage for chronic medicine • Coverage for medical emergencies when travelling in and outside South Africa. Contributions per month: Main member = \$350.68; Adult dependent = \$331.59; Child = \$70</p> |                      |                |



In this sample data, 40.9% of eligible adults were up to date with their cholesterol tests, while, only 16.6% had taken a glucose test in the preceding five years. The cervical screening rate was 11.7% in the previous three years, while the breast cancer-screening rate was 7.9% in the previous two years. The prostate cancer-screening rate was 20.6% in the previous year. Just over 2.2% of eligible females had been screened for osteoporosis in the previous year. Only 1.1% of all members aged 50 years and over had been screened for colorectal cancer in the previous five years. The HIV screening rate was 8.7% in the previous year. These, data, together with eligibility criteria, appear, in Table 7.

**Table 7. Proportion of members up to date for individual screening tests**

| Tests<br>(Eligibility criteria<br>for Screening<br>Program)                                  | Adapted recommendation as per<br>Discovery Health screening<br>program                                                   |                            | Proportion of<br>eligible<br>members<br>who screen<br>(%) | Confidence<br>interval |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------------------------------------------|------------------------|
| <b>Cholesterol<br/>(Adults <math>\geq 18</math><br/>years, n = 20<br/>859)</b>               | Adults once every five years                                                                                             |                            | 40.9                                                      | 40.25-41.56            |
| <b>Glucose<br/>(Adults <math>\geq 18</math><br/>years, n = 21<br/>517)</b>                   | Adults once every five years                                                                                             |                            | 16.6                                                      | 16.01-17.07            |
| <b>Pap smear<br/>(Females <math>\geq 16</math><br/>years,<br/>n = 2529)</b>                  | Once every three years                                                                                                   |                            | 11.7                                                      | 10.5-12.9              |
| <b>Mammogram<br/>(Females <math>\geq 35</math><br/>years, n = 827)</b>                       | Once every two years                                                                                                     |                            | 7.9                                                       | 6.1-9.8                |
| <b>Colorectal cancer<br/>screening<br/>(Adults <math>\geq 50</math><br/>years, n = 4963)</b> | For adults 50 years and older:<br>Colonoscopy and Sigmoidoscopy:<br>once every five years<br>Faecal occult blood: yearly |                            | 1.1                                                       | 0.8-1.4                |
| <b>Prostate specific<br/>antigen<br/>(Males <math>\geq 50</math><br/>years, n = 107)</b>     | Yearly                                                                                                                   | Mean<br>2007-<br>2011      | 27.4                                                      | 25.6-29.2              |
|                                                                                              |                                                                                                                          | In the<br>previous<br>year | 20.6                                                      | 12.8-28.3              |
| <b>HIV<br/>(Adults <math>\geq 18</math><br/>years, n = 20<br/>859)</b>                       | Yearly                                                                                                                   | Mean<br>2007-<br>2011      | 5.4                                                       | 5.1-5.7                |
|                                                                                              |                                                                                                                          | In the<br>previous<br>year | 8.7                                                       | 8.1-9.3                |
| <b>Osteoporosis<br/>(Females <math>\geq 60</math><br/>years, n = 46)</b>                     | Yearly                                                                                                                   | Mean<br>2007-<br>2011      | 6.6                                                       | 5.2-7.9                |
|                                                                                              |                                                                                                                          | In the<br>previous<br>year | 2.2                                                       | 1.7-2.7                |

### 3.2.1 Factors Associated with being Up to Date with Screening

Health insurance members were 67% more likely to have had a cholesterol test in the preceding five years if they belonged to Vitality (OR=1.67), more than 3.5 times more likely if they had a comprehensive plan (OR=3.53), and 42% more likely if they lived in Gauteng province (Gauteng OR=1.42). Comprehensive plan type was also a positive predictor for having had a glucose test in the preceding five years, with members being almost twice as likely to have undergone that screening (OR=1.9). The negative predictors of glucose tests were gender (males were 22% less likely to have had a glucose test [OR=0.88]) and core plan type (core plan members were 22% less likely [OR=0.78]).

Females who were members of Vitality were 78% more likely to have had a Pap smear compared to non-Vitality members (OR=1.78); moreover, they were 89% more likely to have had the test if they lived in Northern Cape province (OR=1.89). Female core plan holders were 56% less likely to be up to date with their Pap smear tests (OR=0.44). Female Vitality members were 89% more likely to be up to date with mammography screening (OR=1.89) and females with a comprehensive plan type were almost three times more likely to be up to date with mammography screening (OR=2.99). Core plan type was a negative predictor of mammography screening; females holding that type of plan were 66% less likely to be up to date with mammography screening (OR=0.44).

Males over 50 years who were members of Vitality were 45% more likely to have had a prostate cancer screening test (OR=1.45) and 2.26 times more likely to have had that test if they owned a comprehensive plan (OR=2.26).

The only positive predictor of colorectal cancer (CRC) screening was province of residence, where members were more than 50% more likely to have had CRC screening if they lived in KwaZulu-Natal (OR=1.54) with no negative predictors.

Overall, members of Vitality were more than three times more likely to have had an HIV test (OR=3.2) and they were 27% less likely to have had an HIV test if they owned a core plan (OR=0.73).

Osteoporosis screening decreased by 40% for every 10-year increase in age (OR=0.6).

Table 8 shows all of the predictive variables, their odds ratios, and the corresponding confidence intervals.



**Table 8. Factors associated with preventive screening**

| Adjusted OR (CI)                                                                                                                                                                                                                                                                                           |                                                            |                                                |                                                      |                                              |                                                |                                                      |                                                |                                              |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------|------------------------------------------------------|----------------------------------------------|------------------------------------------------|------------------------------------------------------|------------------------------------------------|----------------------------------------------|-----------------|
|                                                                                                                                                                                                                                                                                                            | Cholesterol                                                | Glucose                                        | Pap smear                                            | Mammogram                                    | PSA                                            | CRC                                                  | HIV                                            | Bone Scan                                    |                 |
| Age                                                                                                                                                                                                                                                                                                        | Per 10year increase: 1 (ref) 1.04 (1.03-1.04)              | Per 10year increase: 1 (ref) 1.3 (1.29-1.35)   | Not Significant                                      | Per 10year increase: 1 (ref) 1.42(1.16-1.74) | Per 10year increase: 1 (ref) 1.29 (1.16-1.44)  | Not Significant                                      | Per 10year increase: 1 (ref) 0.73 (0.69-0.76)  | Per 10year increase: 1 (ref) 0.6 (0.39-0.92) |                 |
| Gender                                                                                                                                                                                                                                                                                                     | Female: 1 (ref) 1.14 (1.08-1.21)<br>Male: 0.88 (0.82-0.96) | Female: 1 (ref) 0.88 (0.82-0.96)               | -                                                    | -                                            | -                                              | Not significant                                      | Not significant                                | -                                            |                 |
| Vitality member                                                                                                                                                                                                                                                                                            | Non-member: 1 (ref) 1.67 (1.57-1.76)                       | Non-member: 1 (ref) 1.22 (1.13-1.31)           | Non-member: 1 (ref) 1.78 (1.4-2.3)                   | Non-member: 1 (ref) 1.89 (1.13-3.17)         | Non-member: 1 (ref) 1.45 (1.20-1.73)           | Not significant                                      | Non-Member: 1 (ref) 3.2 (2.75-3.73)            | Not significant                              |                 |
| Plan Type                                                                                                                                                                                                                                                                                                  | Core                                                       | 1.56 (1.44-1.68)                               | 0.78 (0.69-0.86)                                     | 0.44 (0.17-1.12)                             | Not Significant                                | Not Significant                                      | 0.73 (0.63-0.98)                               | Not significant                              |                 |
|                                                                                                                                                                                                                                                                                                            | Saver                                                      | 1 (ref)                                        | 1 (ref)                                              | 1 (ref)                                      | 1 (ref)                                        | 1 (ref)                                              | 1 (ref)                                        | 1 (ref)                                      |                 |
|                                                                                                                                                                                                                                                                                                            | Comprehensive                                              | 3.53 (3.27-3.80)                               | 1.9 (1.73-2.12)                                      | Not significant                              | 2.99 (1.72-5.24)                               | 2.26 (1.6-3.1)                                       | Not Significant                                | 0.85 (0.73-0.98)                             | Not significant |
| Province                                                                                                                                                                                                                                                                                                   | Eastern Cape: 1 (ref) 1.42 (1.26-1.61 0.84)                | Eastern Cape 1 (Ref) Gauteng: 0.99 (0.82-1.14) | Eastern Cape: 1 (ref) Northern Cape 1.89 (0.65-5.54) | Not Significant                              | Eastern Cape: 1 (ref) Gauteng 1.22 (0.83-1.79) | Eastern Cape: 1 (ref) KwaZulu-Natal 1.54 (0.49-4.88) | Eastern Cape: 1 (ref) Gauteng 1.32 (0.99-1.77) | Not significant                              |                 |
| Adjusted Odds Ratios using multivariate logistic regression model, adjusted for age, gender, Vitality member, plan type and Province of residence<br>OR: Odds Ratio; CI: Confidence interval; Comp: Comprehensive Plan Type; Ref: Reference value; PSA: Prostate Specific Antigen; CRC: Colorectal cancer; |                                                            |                                                |                                                      |                                              |                                                |                                                      |                                                |                                              |                 |

### 3.2.2 Up to Date with Recommendations for Age and Gender

The proportion of members up to date for recommended tests given their specific age and gender is presented in Table 9. Four different life-year categories were calculated to evaluate female recommendations and two different age categories for males. Only between 0.33% of females (aged 41-50 years) and 2.21% of females (16 years-35 years) were up to date for their specified screening tests. Only 0.97% males aged 41-50 years were up to date for their screening and 2.96% males 18-40 years were up to date for their screening tests.

**Table 9. Proportion up to date with recommended tests for age and gender**

| Age category               | Total number eligible | Recommended screening tests for age group                  | Number up to date with screening tests | Proportion up to date |
|----------------------------|-----------------------|------------------------------------------------------------|----------------------------------------|-----------------------|
| <b>Females 16-18 years</b> | 1942                  | Pap Smears                                                 | 43                                     | 2.21%                 |
| <b>Females 19-35 years</b> | 22663                 | Pap Smears, Cholesterol, Glucose, HIV                      | 501                                    | 2.21%                 |
| <b>Females 36-40 years</b> | 6922                  | Pap Smears, Cholesterol, Glucose, HIV, Mammogram           | 89                                     | 2.29%                 |
| <b>Females 41-50 years</b> | 10871                 | Pap Smears, Cholesterol, Glucose, HIV, Mammogram, Glaucoma | 36                                     | 0.33%                 |
| <b>Males 18-40 years</b>   | 26537                 | Cholesterol, Glucose, HIV                                  | 775                                    | 2.95%                 |
| <b>Males 41-50 years</b>   | 9990                  | Cholesterol, Glucose, HIV, Glaucoma                        | 97                                     | 0.97%                 |

### 3.3 Screening Decision Making in the Face of an NCD Diagnosis

#### 3.3.1 Individual Screening Behaviour

Baseline screening rates tended to be higher for most screening tests in individuals who were diagnosed with a chronic disease compared to those without a chronic disease. HIV testing was the only test where baseline-testing results were not higher in chronic disease patients compared to non-chronic disease patients.

Individuals who had been diagnosed with a chronic disease increased their screening for cholesterol by only 0.3%, whereas those without a chronic disease screened 6.2% more between 2008 and 2011. The net difference-in-difference screening rate for cholesterol is thus 5.9% lower in 2011 for cholesterol compared to 2008.

Glucose screening similarly decreased over time, as those with a chronic disease only increased their screening rate by 1.6% compared to a 7.6% increase in those without a chronic disease. The net screening rate was thus 6.0% lower over time.

HIV screening decreased overall by 1.4% between those who have a chronic disease diagnosis and those who do not. Chronic disease sufferers increased their HIV screening rate by 3.5%, but because non-chronic disease sufferers increased their screening rate by 4.9%, the net screening rate overall decreased.

Colorectal cancer screening decreased over time for both those who have a chronic disease diagnosis and those who do not. Chronic disease sufferers screened 4.5% less over time for colorectal cancer compared to those without a chronic disease, who screened 0.3% less. The overall screening rate was 4.2% lower between 2008 and 2011.

Those with a chronic disease diagnosis screened 1.1% less over time for prostate cancer compared to those without a chronic disease, who screened 7.9% more. The net screening rate resulted in a 9.0% decrease in screening for prostate cancer.

Cervical cancer screening increased by 1.0% for those with a chronic disease compared to a 1.5% increase for those without a chronic disease. This resulted in a net decrease in Pap smears by 0.5%.

Screening for breast cancer was the only screening test that resulted in a net increase of 0.27% over time when compared to the screening rate for those who have a chronic disease diagnosis and those who do not. Those with a chronic disease screened 0.07% more compared to those without a chronic disease, who screened 0.2% less.

Osteoporosis screening decreased over time by 2.1% between 2008 and 2011 when comparing those suffering from a chronic disease and those who do not. These results are depicted in Table 10.



**Table 10. Screening rates of individuals diagnosed with a chronic disease**

|                                    | Individuals        | Screening Rate 2008 (N) | Screening Rate 2011 | Difference | Difference-in-Difference | p-value |
|------------------------------------|--------------------|-------------------------|---------------------|------------|--------------------------|---------|
| <b>Cholesterol Screening</b>       | Chronic Disease    | 29.1% (N=6483)          | 29.4% (N=6176)      | 0.3        | -5.9                     | <0.001  |
|                                    | No Chronic Disease | 17.1% (N=6613)          | 23.3% (N= 6765)     | 6.2        |                          |         |
| <b>Glucose Screening</b>           | Chronic Disease    | 28.1% (N=6483)          | 30.5% (N=6176)      | 1.6        | -6.0                     | <0.001  |
|                                    | No Chronic Disease | 17.3% (N=6613)          | 24.9% (N= 6765)     | 7.6        |                          |         |
| <b>HIV Screening</b>               | Chronic Disease    | 4.4% (N=6483)           | 7.9% (N=6176)       | 3.5        | -1.4                     | <0.001  |
|                                    | No Chronic Disease | 6.9% (N=6613)           | 11.8% (N= 6765)     | 4.9        |                          |         |
| <b>Colorectal Cancer Screening</b> | Chronic Disease    | 1.3% (N=2863)           | 0.6% (N=3027)       | -4.5       | -4.2                     | <0.001  |
|                                    | No Chronic Disease | 0.5% (N=6613)           | 0.2% (N= 6765)      | -0.3       |                          |         |
| <b>Prostate Cancer Screening</b>   | Chronic Disease    | 37.5% (N=1324)          | 36.4% (N=1411)      | -1.1       | -9.0                     | <0.001  |
|                                    | No Chronic Disease | 21.9% (N=473)           | 29.8% (N= 600)      | 7.9        |                          |         |
| <b>Pap Smears</b>                  | Chronic Disease    | 17.5% (N=3455)          | 18.5% (N=3278)      | 1.0        | -0.5                     | <0.001  |
|                                    | No Chronic Disease | 22.2% (N=3673)          | 23.7% (N= 3700)     | 1.5        |                          |         |
| <b>Mammograms</b>                  | Chronic Disease    | 18.57% (N=2546)         | 18.64% (N=1411)     | 0.07       | 0.27                     | <0.001  |
|                                    | No Chronic Disease | 15.6% (N=1732)          | 15.4% (N= 1984)     | -0.2       |                          |         |
| <b>Bone Scans</b>                  | Chronic Disease    | 8.7% (N=840)            | 8.2% (N=977)        | -0.5       | -2.1                     | <0.001  |
|                                    | No Chronic Disease | 6.3% (N=174)            | 7.9% (N= 240)       | 1.6        |                          |         |

### 3.3.2 Family Member Screening Behaviour

Screening rates in 2008 tended to be higher for most screening tests in individuals who had a family member diagnosed with a chronic disease compared to those without a family member diagnosed with a chronic disease. HIV and Pap smear testing were the only tests where baseline-testing results were not higher among individuals with a family member diagnosed with a chronic disease compared to those without a family member diagnosed with a chronic disease.

Individuals with a family member who has been diagnosed with a chronic disease increased their screening for cholesterol by 0.6%, whereas those without a family member with a chronic disease screened 6.6% more between 2008 and 2011. The net difference-in-difference screening rate for cholesterol is thus 6.0% lower for cholesterol screening.

Glucose screening similarly decreased over time, as those who have a family member diagnosed with a chronic disease only increased their screening rate by 3.2% compared to a 8.1% increase in those who have no family members with a chronic disease. The net screening rate was thus 4.9% lower over time.

HIV screening decreased overall by 1.4% between those who have a family member with a chronic disease diagnosis and those who do not. Family members who have a chronic disease sufferer in the household increased their HIV screening by 3.5%, but family members with no chronic disease sufferers in the household increased their screening rate by 4.8%, thereby decreasing the net screening rate overall.

Colorectal cancer screening decreased over time for both those who have a chronic disease sufferer on their membership or in their household as well as those who do not. Family members of chronic disease sufferers screened 0.6% less overtime for colorectal cancer whereas those without a chronic disease sufferer screened 0.3% less. The overall screening rate was thus 0.3% lower between 2008 and 2011.

Those family members with another member diagnosed with a chronic disease screened 0.9% more over time for prostate cancer compared to those without a family member with a chronic disease, who screened 9.5% more. The net screening rate resulted in a 8.6% decrease in screening for prostate cancer when comparing those with a family member with a chronic disease compared to those without a family member diagnosed with a chronic disease.

Pap smears increased by 0.2% for those with a family member with a chronic disease compared to a 2.6% increase for those without a family member diagnosed with a chronic disease. This resulted in a net decrease of 2.4% in cervical cancer screening. Screening for breast cancer, once again, was the only screening test that resulted in a net increase of 0.7% over time when comparing the screening rate for those who have a family member diagnosed with a chronic disease and those who do not. Family members with a chronic disease increased their screening rate for breast cancer by 1.8%, whereas those without a family member diagnosed with a chronic disease only increased their screening rate by 1.1% over time.

Osteoporosis screening decreased over time by 3.4% between 2008 and 2011 when comparing those who suffer from a chronic disease and those who do not. These results are outlined in Table 11.

**Table 11. Screening rate for individuals who have a family member diagnosed with a chronic disease**

|                                    | Family Members     | Screening Rate 2008 (N) | Screening Rate 2011 | Difference | Difference-in-Difference | p-value |
|------------------------------------|--------------------|-------------------------|---------------------|------------|--------------------------|---------|
| <b>Cholesterol Screening</b>       | Chronic Disease    | 30.2% (N=5211)          | 30.8% (N=5173)      | 0.6        | -6.0                     | <0.001  |
|                                    | No Chronic Disease | 18.0% (N=5053)          | 24.6% (N=6765)      | 6.6        |                          |         |
| <b>Glucose Screening</b>           | Chronic Disease    | 28.3% (N=5211)          | 31.5% (N=5173)      | 3.2        | -4.9                     | <0.001  |
|                                    | No Chronic Disease | 17.8% (N=5053)          | 25.9% (N=4976)      | 8.1        |                          |         |
| <b>HIV Screening</b>               | Chronic Disease    | 4.2% (N=5211)           | 7.6% (N=5173)       | 3.5        | -1.4                     | <0.001  |
|                                    | No Chronic Disease | 6.6% (N=5053)           | 11.4% (N=4976)      | 4.8        |                          |         |
| <b>Colorectal Cancer Screening</b> | Chronic Disease    | 1.3% (N=2464)           | 0.7% (N=2448)       | -0.6       | -0.3                     | <0.001  |
|                                    | No Chronic Disease | 0.5% (N=852)            | 0.2% (N=843)        | -0.3       |                          |         |
| <b>Prostate Cancer Screening</b>   | Chronic Disease    | 36.5% (N=1142)          | 37.4% (N=1139)      | 0.9        | -8.6                     | <0.001  |
|                                    | No Chronic Disease | 23.6% (N=402)           | 33.1% (N=398)       | 9.5        |                          |         |
| <b>Pap Smears</b>                  | Chronic Disease    | 18.1% (N=2760)          | 18.3% (N=2741)      | 0.2        | -2.4                     | <0.001  |
|                                    | No Chronic Disease | 22.7% (N=2815)          | 25.3% (N=2763)      | 2.6        |                          |         |
| <b>Mammograms</b>                  | Chronic Disease    | 18.5% (N=2125)          | 20.3% (N=2106)      | 1.8        | 0.7                      | <0.001  |
|                                    | No Chronic Disease | 15.6% (N=1432)          | 16.7% (N=1510)      | 1.1        |                          |         |
| <b>Bone Scans</b>                  | Chronic Disease    | 9.3% (N=742)            | 7.8% (N=734)        | -1.5       | -3.4                     | <0.001  |
|                                    | No Chronic Disease | 7.0% (N=157)            | 8.9% (N=156)        | 1.9        |                          |         |

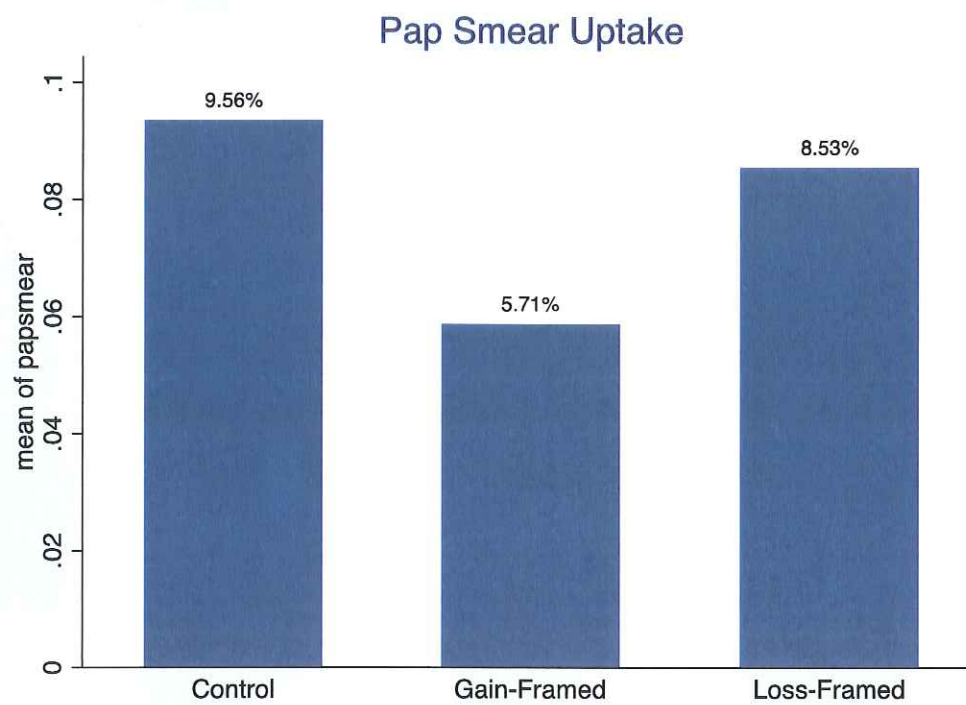


### 3.4 Effect of Health Message Framing on Pap smear Uptake

From the initial sample of 561 females aged 21–65 years a total of 32 were lost to follow-up (5.7%). This resulted in a final total of 529 females included in the analysis. Of the initial 187 females in the control group, 4.8% (N = 9) were lost to follow-up, resulting in a final total of 178. In the gain-framed sample, 8.33% (N = 12) were lost to follow-up, resulting in a final total of 175. The loss-framed sample had a 9.10% (N = 11) loss to follow-up, resulting in the final total of 176. The losses to follow-up figures were as a result of members defaulting on their medical insurance. These figures are shown in the sample flow diagram in Figure 1.

The median age for the final study sample of 529 females was 42.8 years (IQR: 26.8–58.8). The Pap smear screening rate for the total sample was 87.9% (CI: 7.6–8.2). The average age of the females in the control, gain-framed, and loss-framed samples were 42.9 (IQR: 25.9–59.9), 43.3 (IQR: 28.3–58.3), and 42.3 (IQR: 25.3–59.3) respectively. The screening rate in the control group was 9.56% (CI: 9.27–9.85), 5.71% (CI: 5.48–6.98) in the gain-framed group and 8.53% (CI: 8.24–8.81) in the loss-framed group. Screening rates for each group are depicted in Figure 5. Statistically there was no difference between the screening rates of the groups ( $p = 0.81$ ), with Ranksum values of 47928.50 in the control group, 45345.50 in the gain-framed group, and 46911.50 in the loss-framed group.

When the sample was further stratified by age to evaluate whether there were any differences in screening rates across the different age groups, no significant differences were found for age groups 21 to 30 ( $p = 0.4$ ), age groups 30 to 40 ( $p = 0.86$ ) and aged 40 to 65 ( $p = 0.9$ ). These data are outlined in Table 12.



**Figure 5** Proportion of Pap smear uptake for message groups

**Table 12: Descriptive and statistical association of sample and health message**

|                                                              | Control<br>(Neutral)            | Gain-framed                     | Loss-frames                     |
|--------------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|
| <b>Sample Size<br/>(Number)</b>                              | 178                             | 175                             | 176                             |
| <b>Age, Median<br/>(IQR)</b>                                 | 42.9 (25.9-<br>59.9)            | 43.3 (28.3-58.3)                | 42.3 (25.3-59.3)                |
| <b>Screening Rate<br/>(CI)</b>                               | 9.56% (9.27–<br>9.85)<br>N = 35 | 5.71% (5.48–<br>6.98)<br>N = 11 | 8.53% (8.24–<br>8.81)<br>N = 16 |
|                                                              | Ranksum (P-value = 0.8123)      |                                 |                                 |
| <b>Difference in<br/>Screening Rate<br/>(Kruskal-Wallis)</b> | 47928.50                        | 45345.50                        | 46911.50                        |
| <b>Age Group<br/>21–30 years</b>                             | N = 21                          | N = 18                          | N = 28                          |
| <b>Chi-squared (P-<br/>value)</b>                            | 1.645 (p=0.4)                   |                                 |                                 |
| <b>Age Group<br/>31–40 years</b>                             | N = 60                          | N = 59                          | N = 53                          |
| <b>Chi-squared (P-<br/>value)</b>                            | 0.978 (p=0.6)                   |                                 |                                 |
| <b>Age Group<br/>41–65 years</b>                             | N = 105                         | N = 107                         | N = 105                         |
| <b>Chi-squared (P-<br/>value)</b>                            | 0.12 (p=0.9)                    |                                 |                                 |

According to the logistic regression analyses, females were about 43% less odds (OR = 0.57) to have a Pap smear if exposed to a gain-framed message, compared to a neutral message, although this finding was non-significant ( $p = 0.2$ ). When receiving a loss-framed message, females were only 22% (OR = 0.88) less likely to have a Pap smear compared to a neutral-framed message. This finding was also not significant ( $p = 0.7$ ). These findings are depicted in Table 13.

**Table 13: Logistic regression of Pap smears for different health messages compared to neutral message**

| Pap smear<br>Comparator:<br>Neutral message | Odds Ratio | 95% Confidence<br>Interval | P-value | Probability<br>> Chi2 |
|---------------------------------------------|------------|----------------------------|---------|-----------------------|
| <b>Gain-framed<br/>message</b>              | 0.57       | 0.26–1.29                  | 0.2     | 0.37                  |
| <b>Loss-framed<br/>message</b>              | 0.88       | 0.43–1.82                  | 0.7     |                       |



## CHAPTER FOUR

### 4.0 DISCUSSION

#### 4.1 Screening Behaviour

Much variation exists in this health-insured population between the provinces for most of the tests. Greater uptake of screening services occurred in the better-resourced provinces of Gauteng and the Western Cape. Limpopo and Northern Cape had 0.33 and 0.38 times lower screening rates than Gauteng for some of the screening tests. This is consistent with other findings where geographical areas with greater resources achieved better uptake of screening services (Schumacher, 2008).

Screening rates for chronic diseases of lifestyle in this population varied from 30% to up to 50% lower in the provinces of Northern Cape and Limpopo compared to Gauteng and the Western Cape. Cancer screening ranged from 45% to 5% lower in some provinces compared to Gauteng. The rate of HIV screening in the provinces of Free State, North West and Northern Cape was more than half the rate in that in Gauteng. The variation in utilization of screening services in this medically insured population might not be uncommon. Even among medical aid members where the costs of screening tests are paid for or in settings where screening facilities are easily accessible, researchers have found a poor uptake of services (Mobley, 2009; DuBard, 2008). This confirms previous findings that access alone is not the only driver of health care utilization disparities (Long, 2004). Several individual factors as well as provider factors have been shown to play a role in inequitable preventive service usage (Richardson, 2007; Damiani, 2012). Further research is required to understand the factors that steer inequitable use of preventive services across the nine provinces in this health-insured population.

## 4.2 Determinants of Screening

Overall, screening rates in this population are far behind comparable international populations. For example, recent 2012 United States of America findings established that 68% of US adults had a cholesterol test in the preceding 5 years (Centres for Disease Control and Prevention, 2012) and some European countries (Germany, Netherlands, England and Italy) manage to screen between 61% and 79% of females over 50 years for breast cancer biennially (Biesheuvel, 2011).

For this health-insured population, belonging to a wellness program that provides incentives for performing screening tests is a strong predictor of whether a person will undergo cholesterol testing, Pap smears, mammograms, prostate cancer screening, and HIV tests. The use of economic incentives has shown promising results directing patients towards health-enhancing behaviours (Volpp, 2008; Fernald, 2008). Positive incentives that reward behaviour, rather than negative incentives that are punitive if certain goals are not achieved, tend to achieve greater success (Voigt, 2010). Financial incentives can effectively increase the use of preventive services, like mammography screening, Pap smears, and colorectal cancer screening (Stone, 2001) although incentives tend to be more effective for simpler behaviours, like influenza vaccinations, than complex behaviours (Volpp, 2008; Kane, 2012). The type of incentive does not seem as important as the nature of the incentive (i.e. how relevant the incentive is to the person) and researchers are still unsure what size of incentive has the best outcome (Kane, 2012). In this study's population, Vitality members receive discounts at stores for goods like electronic equipment, books, airline flights, car rentals, and discounted holidays. Exposure to incentives in this population may further perpetuate the inequitable use of preventive care services.

The comprehensive plan is one of the most expensive plan types offered by this health insurer, possibly making it affordable for a more affluent part of the membership. This plan type was associated with cholesterol, glucose, Pap smears, mammograms, prostate and cancer. In this population, the finding of a positive association between the

comprehensive plan type and some of the screening tests is similar to the findings from other studies that have shown a positive correlation with income level (and level of education), and rates of cervical cancer and prostate cancer screening in particular (Ortiz, 2010; Richardson, 2007; Schumacher, 2008). The tests that had the strongest correlations with the comprehensive plan were cholesterol, mammography and prostate cancer screening. In South Africa breast cancer is more common in the white population (SA National Cancer Registry) consequently, this particular population may be requesting or receiving better health care screening.

Being male was a negative predictor of glucose screening. This was the only test where males had a lower likelihood of screening; generally, males have been shown to use preventive services less often than females (Robertson, 2008).

Provincial location was a positive predictor for cholesterol testing, Pap smears, mammograms, PSA, and HIV tests. Geographical variation in the use of screening services occurs in many countries and is often due to unequal resource availability and access as well as differing provider organizations, policies, financial arrangements, skills, and capacity (Zapka, 2004; Richardson, 2007; Dailey, 2007; Elit, 2012). Wide variations exist in healthcare utilization and health outcomes across South African provinces (Bradshaw, 2003). This study further confirms that even in this health-insured community with equal payment access for screening services, provincial location is a strong predictor of service utilization.

Owning a hospital plan (core plan) was negatively associated with glucose screening, Pap smears, mammograms, and HIV tests. Low socio-economic status has been implicitly linked to decreased use of preventive health services in many other studies, which can be explained by a combination of factors like low income, lower levels of education, being uninsured, and having limited access to a primary care provider (Holden, 2010). Even in a seemingly homogeneous population (like a health-insured membership such as this), disparities exist in the use of healthcare resources, and these are often related to personal



predictors (Rigal, 2001). The lower socio-economic strata of this population were shown to be at increased risk of not screening in particular for cervical and breast cancer.

Current USPSTF recommendations find no mortality benefit in screening males younger than 75 years; indeed, screening may be associated with harms related to over-evaluation (Chou, 2011). Glucose and cholesterol screening has been shown to have no real benefit when implemented at population level, with benefits yielded when screening is targeted at high risk individuals (USPSTF, 2008; Norris, 2008). Osteoporosis research has shown that no trials to date have directly evaluated effectiveness, harms and intervals in females less than 65 years of age (Nelson, 2010). Although Discovery has adapted some of the USPSTF recommendations to suit their target population, to date they have not undertaken any research to evaluate potential harms that may have occurred as a result of these screening recommendations. Further research is required to fully understand the import of these recommendations.

### 4.3 The Role of Behavioural economics

#### 4.3.1 Prospect Theory

Baseline screening for chronic diseases in this population tended to be higher in the cases compared to the controls in this study population. This may infer that health care professionals perhaps use the patients' presentation at the medical facility as an opportunity to test for a battery of other tests. But the testing behaviour is not sustained over time.

Individuals diagnosed with a chronic disease significantly decreased their screening rate over time for most screening tests. This finding is inline with prospect theory and behaviour in the context of risk. According to prospect theory, people are much more sensitive to losses than gains and tend to derive utility from gains and losses relative to a certain reference point (Diamond, 2007). In the context of being diagnosed with a chronic



disease, the sense of 'loss of health' should have spurred people on to prevent further losses in health by screening more for preventable diseases. The deviation from health (the reference point) to ill health theoretically would have resulted in decreased screening rates, as future outcomes of screening would have caused further deviation from that reference point of health. Thus as Diamond (2007) predicts, the 'sensitivity' to the initial loss of health prevented further testing which would have perpetuated the 'losses' if further poor health was discovered through screening. The context of a chronic disease diagnosis resulted in screening behaviour according to what Kahneman (2004) described as systematic errors or biases in judgement. People systematically decreased their screening rates over time. Newsom (2011) described how major behaviour change theories do not include explicit predictions about behaviour change in the context of chronic illness; however, the basic tenets of behaviour change theories suggests that the onset of chronic illness should at least motivate lifestyle changes (Newsom, 2011). This pattern of behaviour was not followed. Data from the United States Health and Retirement Study also found very low levels of behaviour change 2-14 years after heart disease, stroke, cancer, diabetes and lung disease diagnoses (Newsom, 2011).

Females diagnosed with a chronic disease, however, increased their screening rate over time for breast cancer. According to Deeks et al. women are more likely to have annual check ups, screening tests and seek health advice (Deeks, 2009). Adherence to cancer screening in women was found to be associated with a fear of cancer, on the one hand, and trust in health care providers, on the other hand, understanding risk and framing routine care as status quo (Ackerson, 2009). Several studies have demonstrated a notable gender difference in health-related decision making, and women are often found to be more cautious in survival-related circumstances and will thus take more risks in order to survive (McDermott, 2008). Women, according to McDermott are also more susceptible than men to the way in which the message is framed (McDermott, 2008). Framing the health message in a loss-framed manner has been shown to have a larger impact on intended behaviour related to preventive health screening when the perceived risk involved is high (Bartels, 2010).

Individuals who have a family member diagnosed with a chronic disease decreased their screening rate over time for most preventable diseases. Dolan (1996) found that current health status does influence valuations; however, people who had been ill in the past or who had family members who were ill did not generally differ from people with no past illness (Dolan, 1996). This, according to Dolan (1996), is due to the fact that, as experience with illness becomes more remote, its effect on health state values decreases. This implies that even when there is a certain risk of developing certain chronic diseases when a family member has the same diagnosis, and even though screening may mitigate that risk, people are still risk seeking by *not* screening when faced with possible losses (i.e. health status).

Females who had a family member diagnosed with a chronic disease screened more for breast cancer over time. Women have a gender advantage in terms of mortality and life expectancy (Wingard, 1984). According to Wingard, these differences can be explained by both biological and social/behavioural factors as women tend to engage less in lifestyle behaviours that are detrimental to health. Women are also traditionally more responsible for family health and more knowledgeable about pathological signs; consequently they have a higher propensity to use health care services than men (Oksuzyan, 2008).

Males who had a family member diagnosed with a chronic disease who were themselves exposed to incentives increased their screening rate for HIV over time. The use of incentives has become an increasingly popular means to entice positive changes in health behaviour (Voigt, 2010). Although incentives show promising results in promoting preventive care activities effectively, they have been shown to work best in highly structured environments when coupled with client reminders, and tend to promote behaviour change only in the short term (Kane, 2012; Stone, 2002; Volpp, 2008; Brouwers, 2011). Very little evidence exists on gender differences in response to incentives, but some studies have shown that men tend to respond better when the incentive is monetary and of greater value (Patrick, 2013; Speckelmeyer, 2009). Why

men in this population diagnosed with a chronic disease increased their screening rates for HIV when exposed to incentives is unclear.

Females who had a family member diagnosed with a chronic disease who were not personally exposed to incentives increased their screening rate for HIV over time. However, females in the Vitality program who had a family member diagnosed with a chronic disease screened more for breast cancer over time. In this instance the role of incentives in this instance, proved to be inconsistent, consistent with previous findings in which incentives are effective and applicable in certain settings, but do not work in others (Stocks, 2012; Kane, 2012).

In general, the screening rate for chronic disease sufferers was higher than non-chronic disease sufferers initially, but the rate of increase of screening was not as high in those with chronic diseases compared to those without. This implies that screening tests may have been used as opportunity tests during the time of chronic disease diagnoses for these patients. Over time, these patients may have then dropped out of the health care system or possibly became too ill to continue their screening tests for other diseases. Health care providers should thus take special precautions not to let chronic disease sufferers fall by the wayside for on-going screening tests.

#### 4.3.2 Framing Health Messages

In this stratified sample of health-insured females equally matched for age, health plan type, wellness plan, and geographical location, uptake for Pap smear screening services was extremely low. This is of particular concern as cervical cancer is the second-most common cancer in South African women, with 1 in 41 at risk of developing the disease in their lifetime (South African Department of Health, undated).

In this health-insured population, the annual use of Pap smear services was previously shown to be 16.7%, while adherence to recommendations over a three-year period for eligible females was around 11.7% (Adonis et al., 2013; Adonis et al., 2014). Research



done in one particular health clinic within the public sector has found that approximately 29% of females without access to health insurance had had a Pap smear in a community in KwaZulu-Natal, South Africa (Moodley, 2009). It is unclear what the national Pap smear screening rate is currently within the public health sector in South Africa.

Conversely owning health insurance tends to increase access to cervical cancer screening services (Dimitrikaki et al., 2009; Garrido-Gumrero et al., 2010); as shown by previous research, reminders and follow-up communication could have a cumulative effect on uptake and follow-up investigations (Weller et al., 2009; Januszek-Michalecka et al., 2013; Dietrich et al., 2007). Over a six-month study period, utilization of Pap smear services, even with access to health care coverage and exposure to health messaging, appeared to remain low within this population. The underlying reasons remain unclear. One possibility that may be of more importance to the outcome may be how the message was *delivered* as opposed to how the message was constructed. Individuals may respond differently to the mode in which a health message is delivered (e.g. visual (imagery), verbal, written) or the method of delivery (e.g. email, postal, campaigns or through health organization/personnel) or even who delivers the message. Some channels of message delivery have been found to be more informative than others, however, tailoring of messages so as to be more targeted, has consistently found to be more effective (Robertson, 2008). Several other factors such as length of message or information regarding the degree of certainty of an outcome may confound the findings. The possibility of the underlying variances in the message condition as well as the individual factors of the females could have resulted in a Type II error and an over-estimation of the lack of significance in the difference in outcomes related to the health messaging.

Although no significant effects were demonstrated between the uptakes of cervical cancer screening in the different health messaging groups, small effects of screening may have population-wide effects. Everett e. al. reports in a systematic review on interventions targeted at women to encourage the uptake of cervical screening, that since the implementation of a cervical cancer screening program in 1998 in the United Kingdom, related mortality has decreased significantly (Everett, et. al., 2011). This suggests that cervical cancer related mortality would be higher where no screening exists.



This research found that written message framing resulted in no significant difference in uptake of cervical cancer screening when emailed to a select population.

With regard to the differently framed messages, no differences were found in the uptake of Pap smears subsequent to being exposed to either a neutral, loss-framed, or gain-framed health message.

These inconsistent findings are not unlike the evidence outlined in previous studies (Gallagher et al., 2011; Akl et al., 2011; O'Keefe et al., 2012). Several researchers have found no significant increase in the promotion of preventive behaviours when exposed to either gain-framed or loss-framed messages except perhaps a small advantage for gain-framed messaging promoting dental hygiene (Latimer et al., 2013). Similar to previous research findings, the effect on outcome for a detection behaviour was no different for loss-framed or gain-framed messages when compared to neutral messages (Rothman and Salovey, 1997; Aldridge, 2006).

In this sample, age did not seem to be a factor in altering the outcome of Pap smears on exposure to different message frames. Several factors have been postulated as playing a role in modulating responses to health messages, including prior attitude, context, and perceived efficacy of the behaviour (Gerend et al., 2007; Hull et al., 2012). Moreover, what has become more evident in recent research is the importance of the underlying individual relevance on the general persuasiveness of the framed message (Latimer et al., 2013; v't Riet et al., 2011; O'Keefe and Nan, 2012). It is believed that the way in which the message is framed should take into consideration an individual's sensitivity to the favourable or unfavourable outcome as additional factors influencing the effect of framed appeals (Latimer et al., 2013). Some of the individual factors shown to have an effect on the persuasiveness of framed messages include: personal situation, attitude, experience with the health problem, knowledge, beliefs, ambivalence, and self-efficacy (Covey, 2014; Aldridge, 2006). The underlying personal relevance is thought to moderate the effect of the framed health messages (O'Keefe and Nan, 2012; Hull, 2012). At this stage it remains unclear why women within this seemingly homogenous population would respond equally to differently framed health messages.

Further research is required to understand the personal factors within this health-insured population that drive health-seeking behaviour.

#### 4.4 Implication of Findings

In this health-insured population, where efforts to promote screening are offered, utilization of screening services remains low with much variation between provinces. Adherence to screening recommendations was below fifty percent of the eligible population, with disproportionate usage associated to plan type, gender, provincial residence, and belonging to an incentivized wellness program. In addition, screening behaviour is negatively influenced when a patient is diagnosed with a chronic disease or when a faced with a possible risk of being diagnosed with a chronic diseases. More specifically, screening behaviour for cervical cancer does not seem to be influenced by the way in which a message is framed, when a health message is emailed to an eligible female.

The differential use of services across provinces still points to inequities that exist, most likely with regard to access of care, given equal payment status in this population. Even in the private sector of South Africa, inequities are still prevalent. This is further evidence that more should be done to promote equal access to care, not only in the public sector but in the private sector too.

Screening guidelines are most likely not well known by both users and providers if fewer than fifty percent of eligible adults are up to date with their respective screening tests. This implies that better dissemination of this information is required to promote the guidelines. Innovative ways to ensure patients and providers are reminded to have their tests done include, for example, having a screening page on the outside of each folder with a checklist of screening tests and dates they are to be administered. This requirement is a simple intervention that could keep track of patients' screening behaviour.

Screening in this population was positively associated with the exposure to incentives. Very strong associations were found with belonging to the incentivized program, Vitality and screening for most tests. This provides encouraging evidence that behaviour economic principles of asymmetric paternalism and "nudging" individuals to participate



in health enhancing behaviour can be implemented successfully. This phenomenon could potentially be further explored especially in the public setting. Small incentives for doing certain tests could be provided to public services users, even something as simple as a 'good citizen' sticker on their folders, for example.

Screening has also been shown to be even more likely to occur in those who are able to afford a more expensive health plan, further perpetuating inequities that may already exist. This evidence confirms existing knowledge that preventive behaviour is positively associated with higher socio-economic status, higher education and better area of residence. Health care providers should be more aware of those who are less likely to screen and be more proactive in offering these members their screening tests.

Those who are diagnosed with a chronic disease are at increased risk of not screening for other diseases in the future. In this instance, prospect theory predicts that people are unlikely to take risks when there is a benefit associated with the outcome, and much more likely to take risks when the outcome is associated with a cost. Given the risky situation of a chronic disease diagnosis, screening rates decrease over time, confirming the hypothesis of prospect theory. By understanding human behaviour as described by behavioural economics, health care providers can become proactive in predicting future screening behaviour and take steps to intervene. Health care providers should be especially vigilant with these patients as they may not be taken into consideration when it comes to prevention for further diseases. Even those at risk of developing diseases given that a family member has been diagnosed with a disease should be offered screening tests on a regular basis.

At this stage it appears that the framing of a message regarding cervical cancer screening, has no effect on whether a female screens or not. Framing theory did not appear to affect the health care decision making of females with regard to Pap smears when the message was emailed to the individual. What may be more important is that 'a message' is communicated, often repeatedly and in different formats. Other health care providers should explore this further in order to evaluate the effect of on-going communication, in this population as well as others in South Africa.



This insight into health screening behaviour could provide other health providers like government organizations with some insight on the importance of protracted efforts to enforce increased screening uptake. More could be done to capitalize on the power of prevention. This may include more stringent policy implementation and regular evaluation of localized screening targets; regular education and communications to both providers and health users; personal reminders and follow ups.

In light of the imminent introduction of the National Health Insurance (NHI) and the Primary Health Care Re-engineering projects, understanding preventative health seeking behaviour is imperative in driving the “prevention is better than cure” agenda. This body of research highlights the facts that this specific population screening rates are low with much variation between provinces and that positive association in screening uptake are demonstrated when individuals are exposed to incentives. Health systems restructuring should include a focus on equity redistribution and possibly developing sustainable “nudge” incentives for enforcing positive health seeking behaviour within the public sector. In addition, strong emphasis on developing population based screening policies and targets should take priority, including on-going research in order to establish the most cost effective, evidence-based recommendations within the current South African population context. Future NHI policies should incorporate basic screening tests like cholesterol, glucose, blood pressure and body mass index, as standardized tests for every adult who visits a health care centre, at least on an annual basis. This may have short-term implications on resource allocation; however, it will provide a platform for creating prevention practices as the norm, and will increase the potential of identifying chronic diseases early.

#### 4.5 Strengths and Limitations

This study is limited by the fact that the study group comprises a very select population and the results may not be directly applicable to the larger South African demographic.

The uptake of services study provides some indication of screening patterns at a national level and the variation that still persists in this privately insured population. The strength of screening rate assessment is that it represents an accurate estimate of screening practices compared to for example survey data estimations or self-reported questionnaires.

Predictors of screening behaviour cannot imply causality, and can only report on strength of associations given that the cross-sectional methodology which cannot evaluate the temporality of the independent variables to the dependent variable.

All inferences on the role of incentives can only be reported as a 'possible' effect; associations of cause and effect cannot be implied as patients voluntarily join the incentivized wellness program.

The evaluation of the effect of prospect theory on screening decision making did not evaluate patient's perceptions of risks, costs, benefits and gains, thus making assumptions on the value of screening based only on the medical view of the utility of screening for diseases.

The framing study was limited by the fact that it sent out bulk messages to a stratified sample of eligible females without further assessing the underlying thoughts, beliefs, self-efficacy, or other personal relevance factors within the sample. Further evaluation of underlying psychological or decision-making processes could have been done in order to explained poor uptake of Pap smears. Only two email messages were sent out to the women. This was due to the limited resources of the study. It was also not ascertained whether recipients actually receives, read and or understood the messaging. In addition it is unclear whether the type of message delivery system or the actual message is responsible for the outcome of poor Pap smear utilization. However, it remains an important evaluation for health communication at the population level, at which no specific underlying personal knowledge about the target population is known. It highlights the fact that effect of message framing may be negligible when communication is intended at the population level.

Over all, screening codes captured does not differentiate between screening for preventive reasons or for diagnostic purposes. Consequently the study is limited in that it may over-estimate screening behaviour in this population.

This thesis study is the first of its kind, providing health care utilization data on a population within South Africa of which very little is known, namely, the privately insured population.

## CHAPTER FIVE

### 5.0 CONCLUSION

This was a first look at national screening practices within a South African population. In this health-insured population, screening varied greatly between provinces for CDL and HIV. Screening in the larger uninsured South African population may be even lower. Differences in screening rates favour the better-resourced provinces. The variations between the provinces need further exploration in order to evaluate the effect of resource allocation, access to care, provider factors and socio-demographic characteristics that may affect screening rates.

In this health-insured population with equal payment access for screening services, significant variations exist in the utilization of preventive screening care based on gender, plan type, exposure to incentives, and provincial location. This confirms that payment for screening services alone does not suffice to promote utilization. Several other underlying socio-demographic and health resource organizational influences, each of which requires further research in this population tend to steer screening behaviour.

Owning a certain health plan (be it expensive plan or cheaper) is a predictor of inequitable healthcare utilization, possibly favouring the white affluent member, while males are at particular risk of not screening for chronic diseases of lifestyle.

In the context of chronic disease diagnoses and future screening behaviour, prospect theory was able to predict behaviour for most screening tests.

Individuals who have a family member diagnosed with a chronic disease are also risk seeking when faced with the possible loss of their own health by not screening for chronic diseases.

Women who screen for breast cancer are the only group in which behaviour in the context of risk according to prospect theory cannot be applied. The role of incentives



was inconsistent with respect to steering screening behaviour for individuals diagnosed with a chronic disease or with a family member who has been diagnosed with a chronic disease.

Health care providers should remain vigilant towards chronic disease sufferers so that they do not become neglected and consequently refrain from continuing their screening tests for other chronic diseases and cancers.

When framing health care messages differential framing of Pap smear health information messages had no effect on Pap smear uptake over a six-month period. No further effect was found on the different age groups for Pap smear screening rate. Two email messages may not have been adequate to have the desired effect on this population. Latimer has found that multiple exposures with several different media tend to have a more favourable outcome (Latimer et al., 2012). Hull, however, demonstrated that *a message* is better than *no message* at all (Hull, 2012). In a large Cochrane study evaluating 38 trials, Everett found that invitation letters may be the best method for encouraging cervical cancer screening and very little evidence exists to support educational interventions (Everett et al., 2011). This study found no evidence for the benefits of framing, but perhaps with a longer study period and repeated communications, greater effects may have become noticeable. There is, however, still a gap in knowing how to customize messages to help optimize their desired effect at the population level. Perhaps future population-based health communication research should be developed to incorporate the specific research design, research setting, and nature of the dependent variables—attitude, beliefs, intentions, and behaviours—as moderating factors (Meyers, 2010). Future research should also concentrate on evaluating not only the number of messages required, but also the modes of delivery of messages on preventive health care utilization. This emphasizes the importance of the role of context and the particular individuals targeted, on developing successful health detection messages.

Screening in this health-insured population was low, with several associated predictors to being up to date with screening recommendations. Behavioural economic principles have been shown to play a significant role in predicting certain behaviours, but have not

proven significant with others. Being aware of these strengths and limitations could greatly enhance our understanding of screening behaviour, enabling us to be that much more capable of developing well-targeted and efficient screening services.

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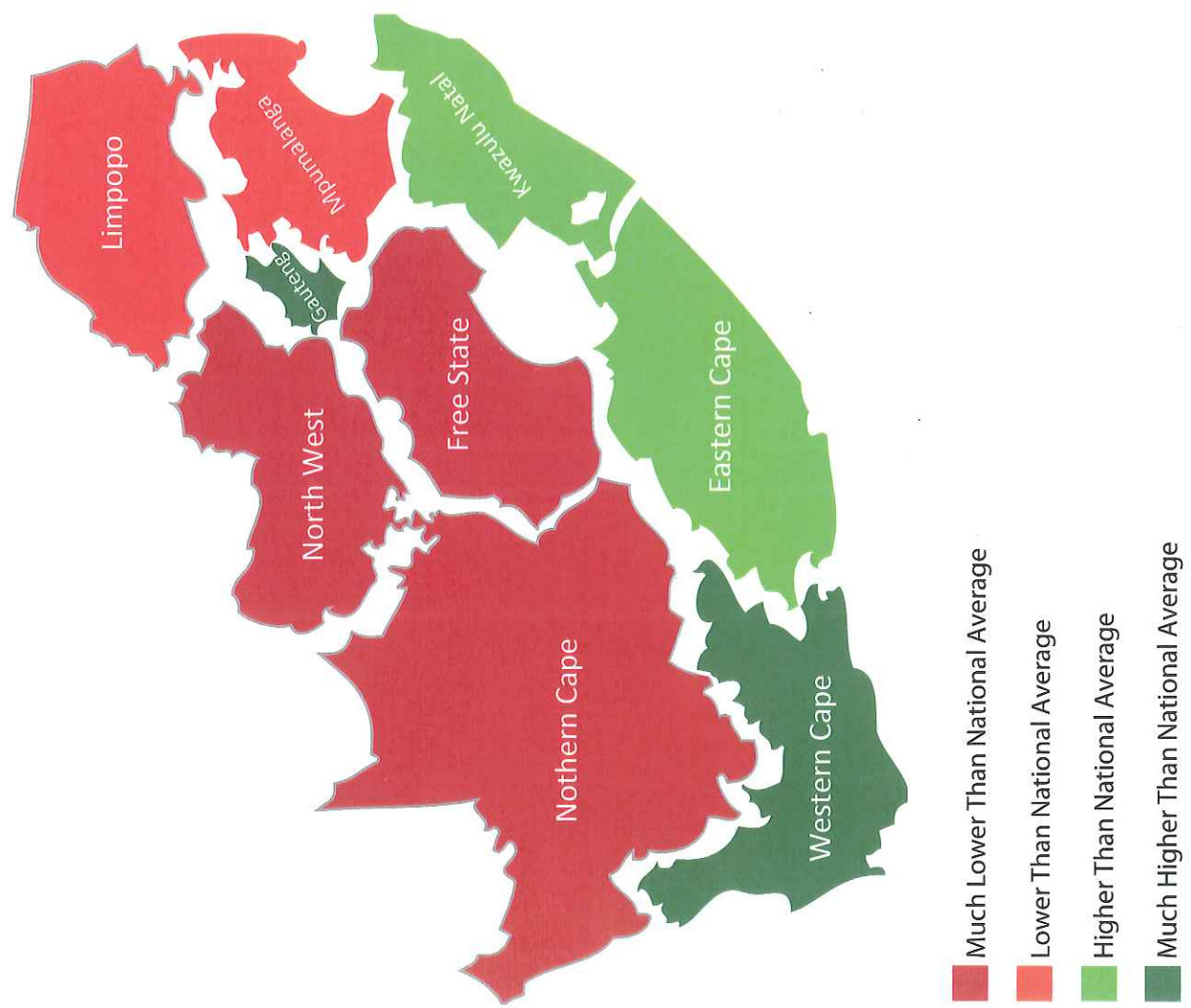
## Appendix I

Non-communicable diseases in screening decision making after a diagnosis

|                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------|
| I10 - Essential (primary) hypertension                                                                                  |
| E785 - Hyperlipidaemia, unspecified                                                                                     |
| J459 - Asthma, unspecified                                                                                              |
| E119 - Non-insulin-dependent diabetes mellitus without complications                                                    |
| E039 - Hypothyroidism, unspecified                                                                                      |
| I259 - Chronic ischaemic heart disease, unspecified                                                                     |
| E109 - Insulin-dependent diabetes mellitus without complications                                                        |
| G409 - Epilepsy, unspecified                                                                                            |
| I499 - Cardiac arrhythmia, unspecified                                                                                  |
| I500 - Congestive heart failure                                                                                         |
| F319 - Bipolar affective disorder, unspecified                                                                          |
| H409 - Glaucoma, unspecified                                                                                            |
| M0699 - Rheumatoid arthritis, unspecified, site unspecified                                                             |
| J449 - Chronic obstructive pulmonary disease, unspecified                                                               |
| I48 - Atrial fibrillation and flutter                                                                                   |
| I209 - Angina pectoris, unspecified                                                                                     |
| I429 - Cardiomyopathy, unspecified                                                                                      |
| G20 - Parkinson's disease                                                                                               |
| N189 - Chronic renal failure, unspecified                                                                               |
| K510 - Ulcerative (chronic) enterocolitis                                                                               |
| G402 - Localization-related (focal)(partial) symptomatic epilepsy and epileptic syndromes with complex partial seizures |
| F209 - Schizophrenia, unspecified                                                                                       |
| K509 - Crohn's disease, unspecified                                                                                     |
| M329 - Systemic Lupus Erythematosus, unspecified                                                                        |
| G35 - Multiple sclerosis                                                                                                |
| I472 - Ventricular tachycardia                                                                                          |
| J439 - Emphysema, unspecified                                                                                           |
| E271 - Primary adrenocortical insufficiency                                                                             |
| J47 - Bronchiectasis                                                                                                    |
| N039 - Chronic nephritic syndrome, unspecified                                                                          |
| E232 - Diabetes insipidus                                                                                               |
| D66 - Hereditary factor VIII deficiency                                                                                 |
| N049 - Nephrotic syndrome, unspecified                                                                                  |
| F208 - Other schizophrenia                                                                                              |
| E780 - Pure hypercholesterolaemia                                                                                       |
| I151 - Hypertension secondary to other renal disorders                                                                  |

Appendix II

# Cholesterol Screening Rate



| Province         | Screening Rate | Confidence Interval |
|------------------|----------------|---------------------|
| Northern Cape    | 13.4           | 13.1-13.8           |
| Free State       | 17.1           | 16.8-17.5           |
| North West       | 17.9           | 17.6-18.3           |
| Mpumalanga       | 18.6           | 18.2-19.0           |
| Limpopo          | 19.7           | 19.3-20.1           |
| Eastern Cape     | 21.9           | 21.5-22.4           |
| Kwazulu Natal    | 23.2           | 22.7-23.6           |
| Western Cape     | 25.5           | 25.0-25.9           |
| Gauteng          | 27.5           | 27.1-27.9           |
| National Average | 20.5           | 20.1-20.9           |

Figure 2 Cholesterol Screening Rate



# Glucose Screening Rate

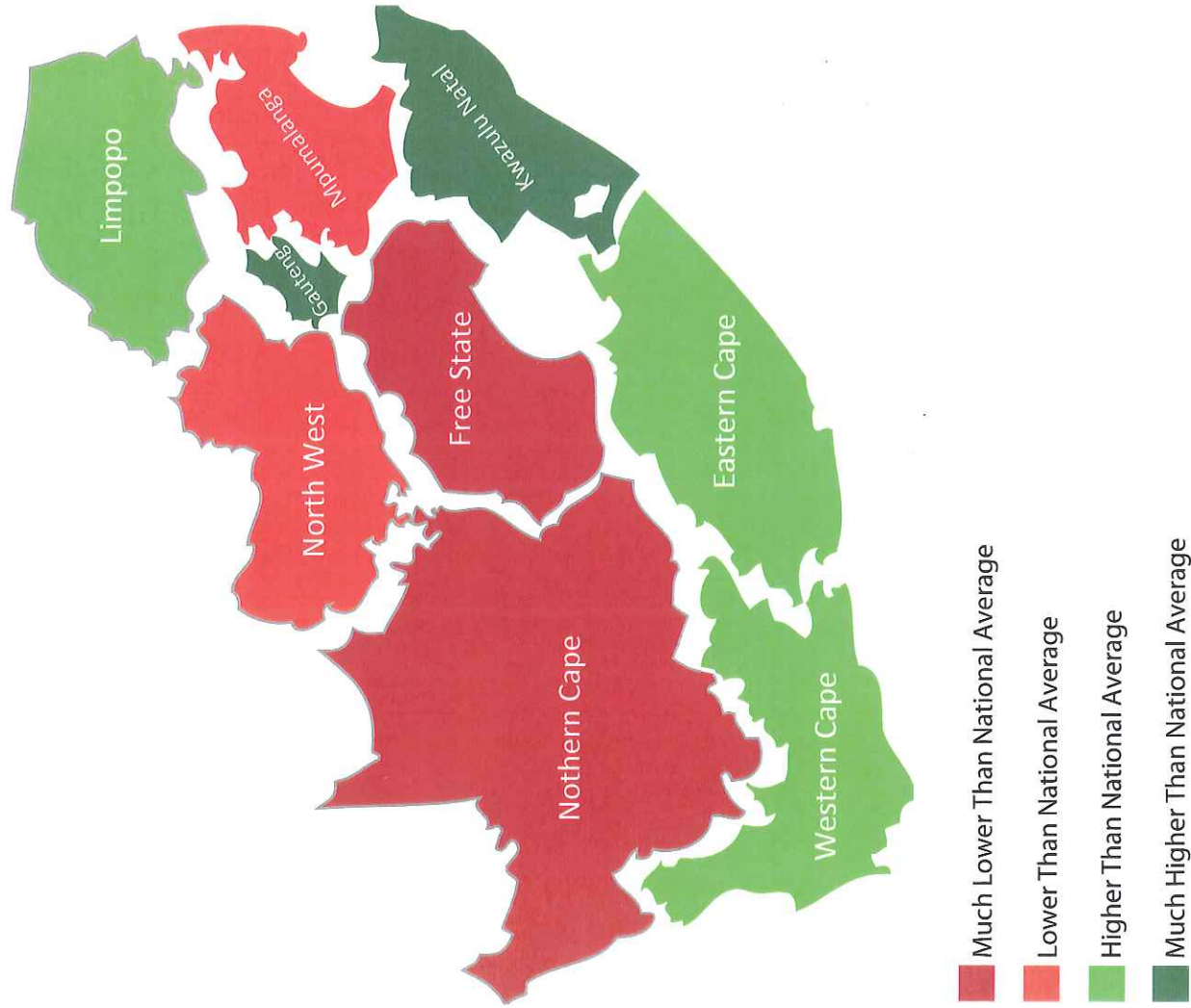


Figure 3 Glucose Screening Rate

# HIV Screening Rate

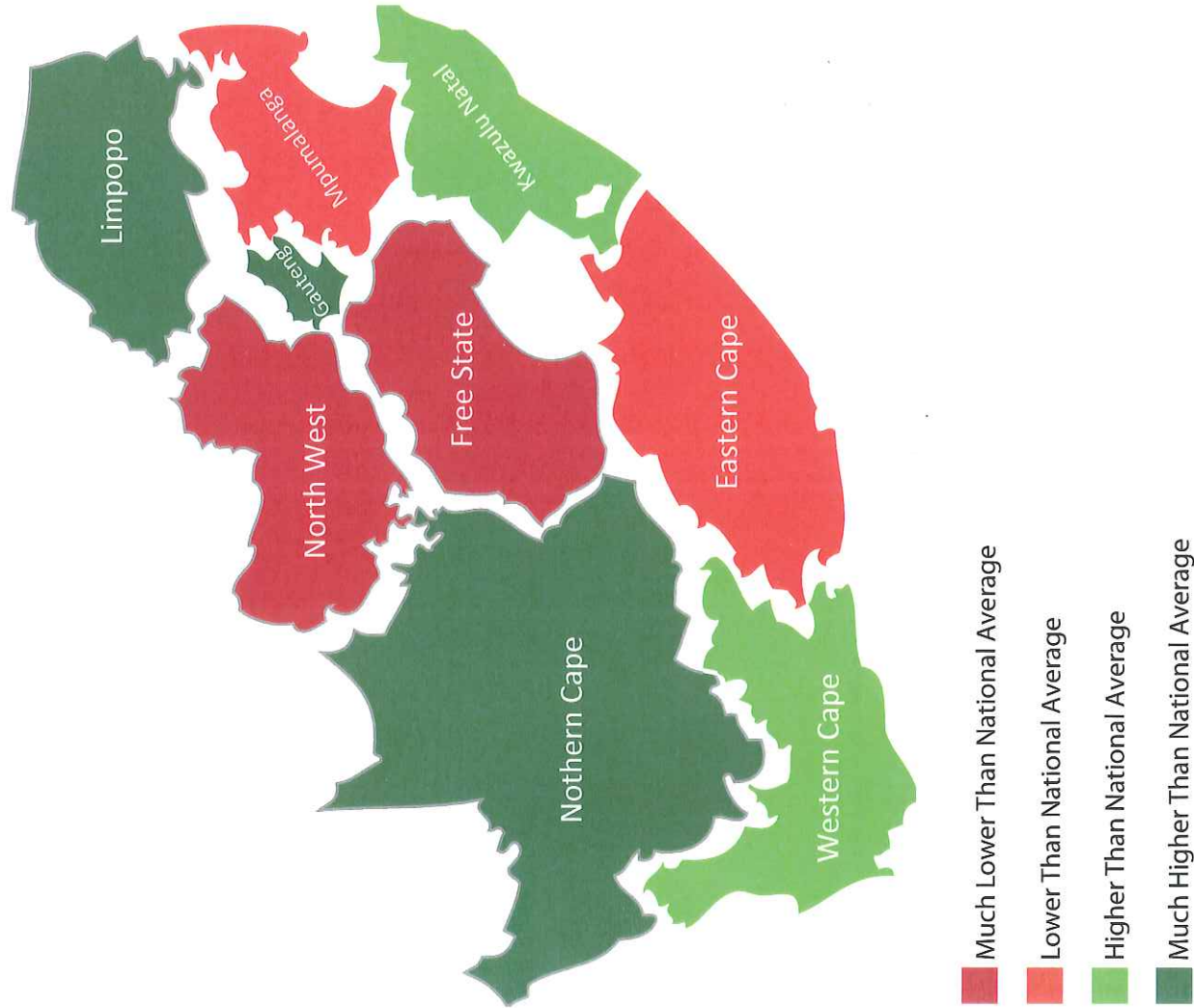
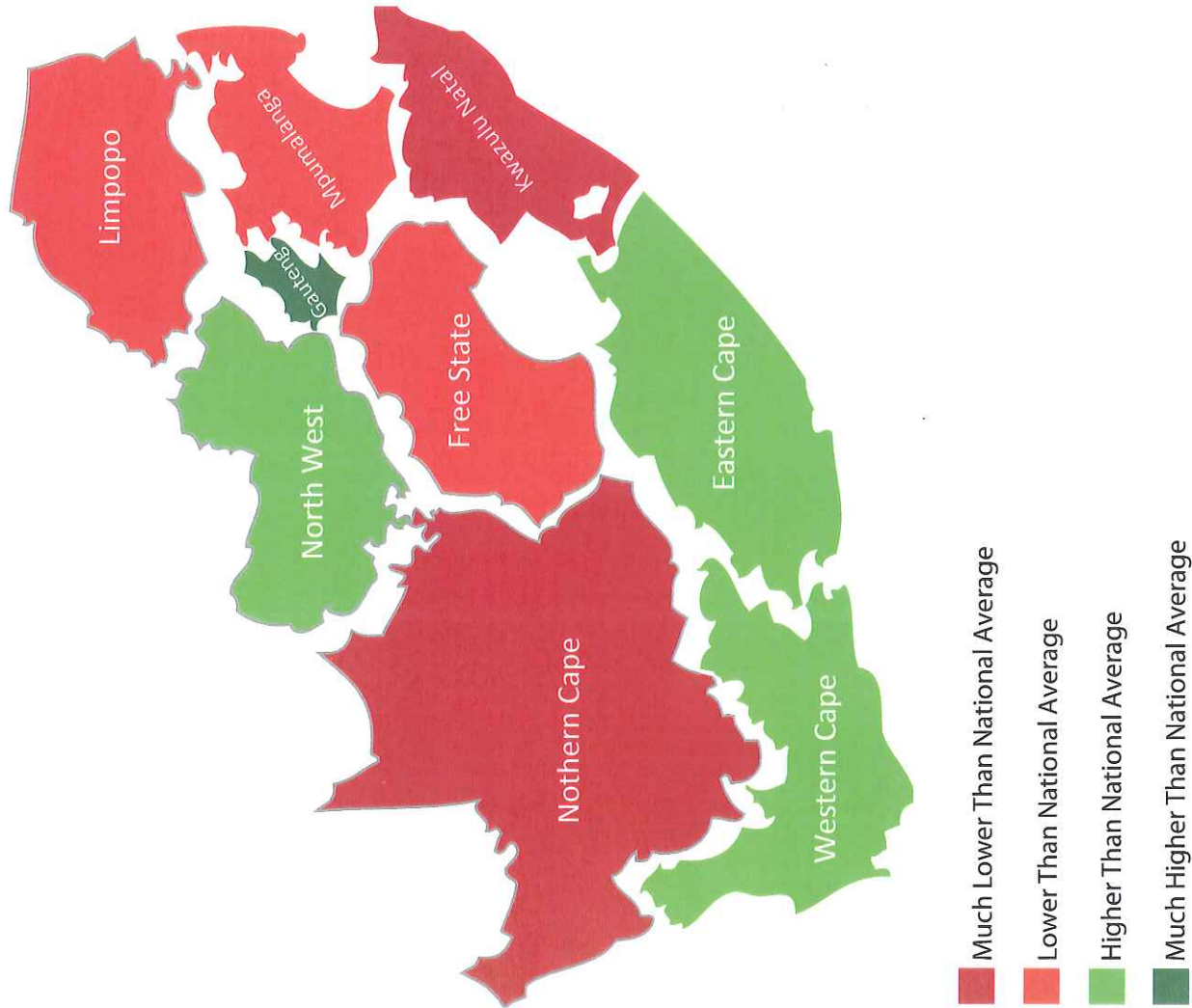


Figure 4 HIV Screening Rate

| Province                | Screening Rate | Confidence Interval |
|-------------------------|----------------|---------------------|
| Free State              | 5.3            | 5.1-5.5             |
| North West              | 6.0            | 5.7-6.2             |
| Eastern Cape            | 7.3            | 7.1-7.6             |
| Mpumalanga              | 7.6            | 6.4-7.0             |
| Western Cape            | 9.9            | 9.6-10.2            |
| Kwazulu Natal           | 10.3           | 10.0-10.6           |
| Limpopo                 | 11.0           | 10.7-11.3           |
| Nothern Cape            | 11.0           | 10.8-11.2           |
| Gauteng                 | 12.8           | 12.5-13.1           |
| <b>National Average</b> | <b>8.9</b>     | <b>8.7-9.2</b>      |

# Prostate Cancer Screening Rate



| Province         | Screening Rate | Confidence Interval |
|------------------|----------------|---------------------|
| Nothern Cape     | 25.6           | 25.1-26.0           |
| Kwazulu Natal    | 27.2           | 26.7-27.6           |
| Limpopo          | 29.4           | 29.0-29.9           |
| Free State       | 32.4           | 31.9-32.9           |
| Mpumalanga       | 32.6           | 32.2-33.1           |
| Eastern Cape     | 33.8           | 33.3-34.8           |
| Western Cape     | 33.8           | 33.3-34.3           |
| North West       | 34.9           | 34.4-35.4           |
| Gauteng          | 37.7           | 37.2-38.1           |
| National Average | 31.9           | 31.5-32.4           |

Figure 5 Prostate Cancer Screening Rate



# Cervical Cancer Screening Rate (Pap smears)

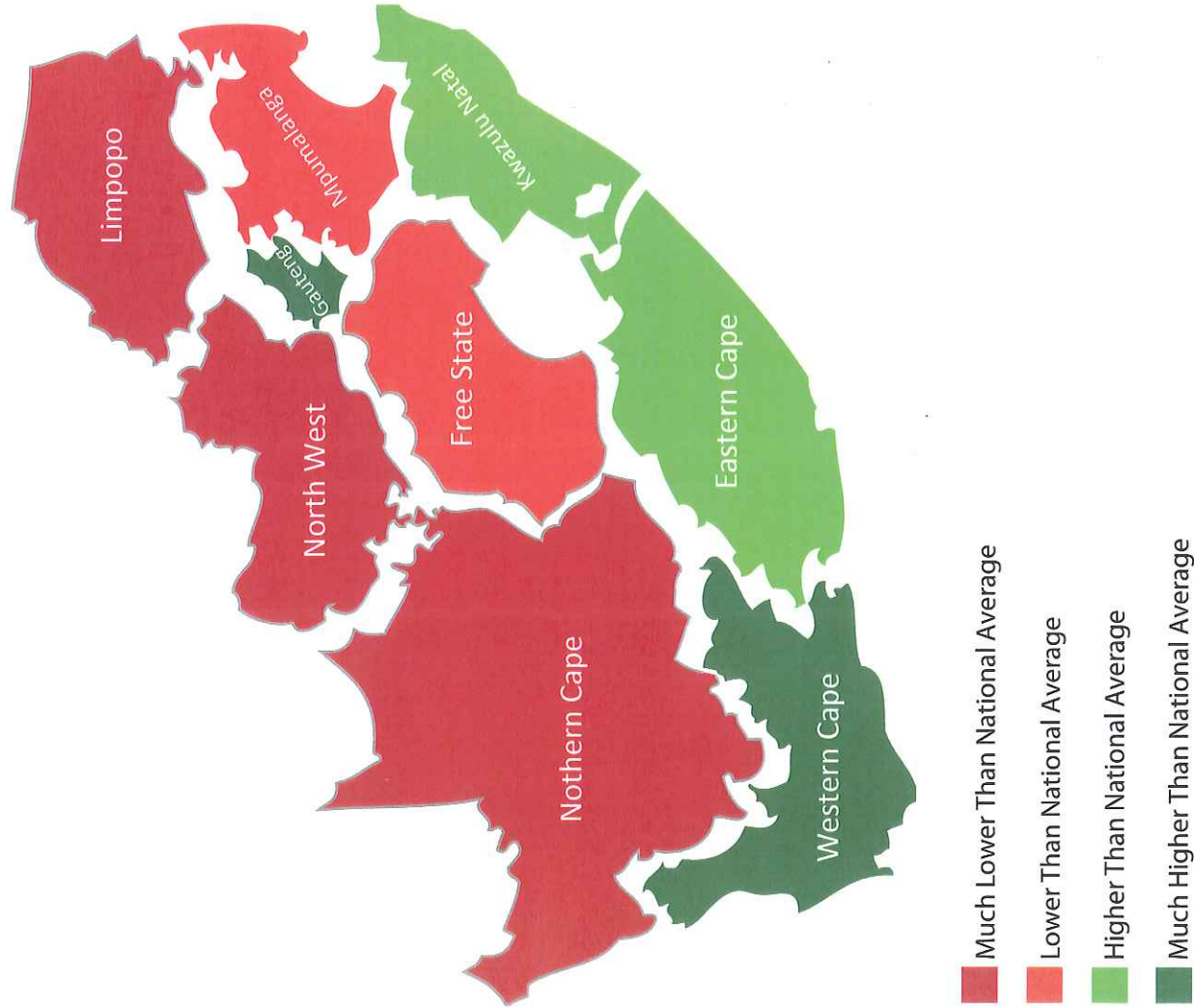


Figure 6 Cervical Cancer Screening Rate



# Breast Cancer Screening Rate (Mammography)

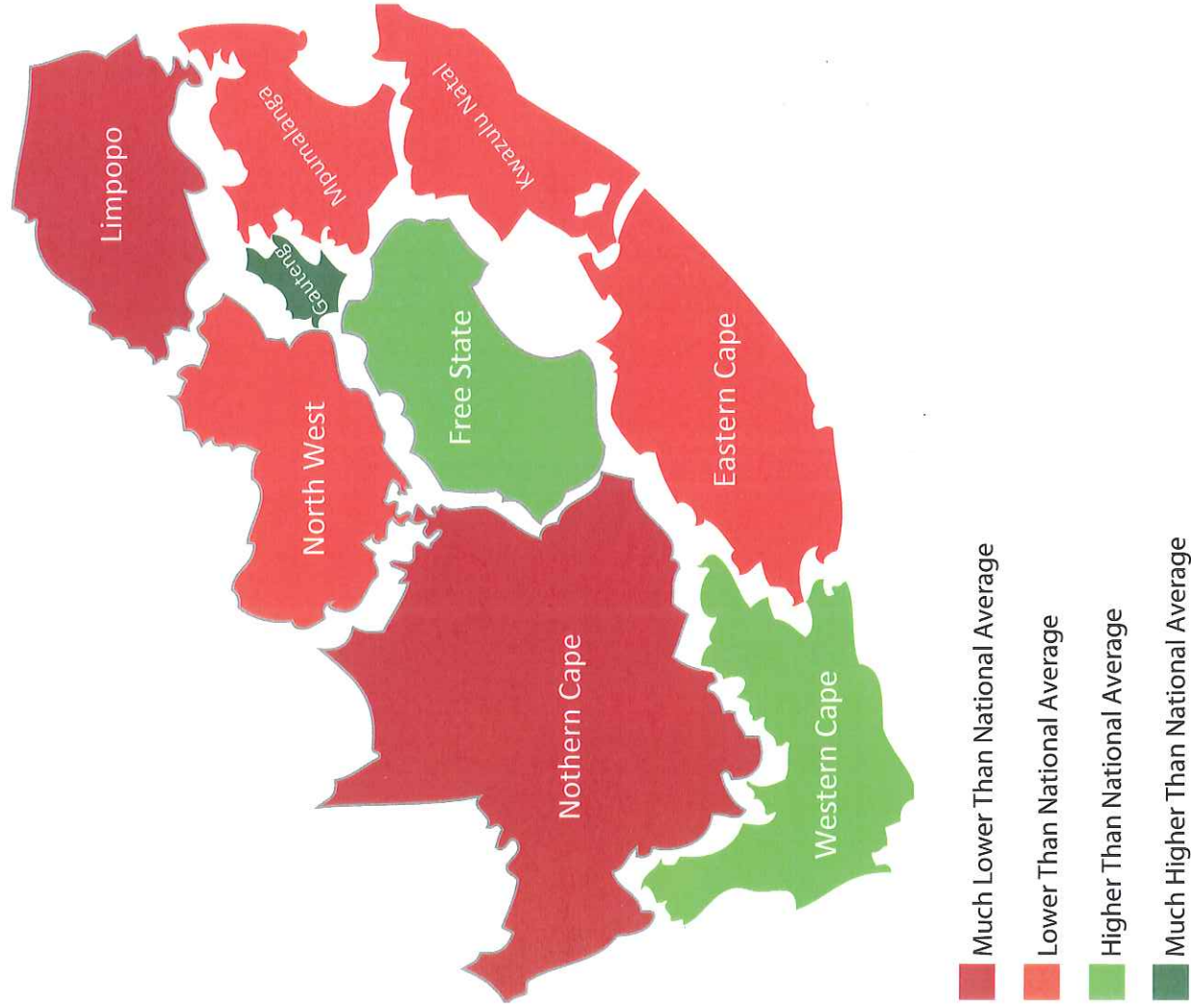
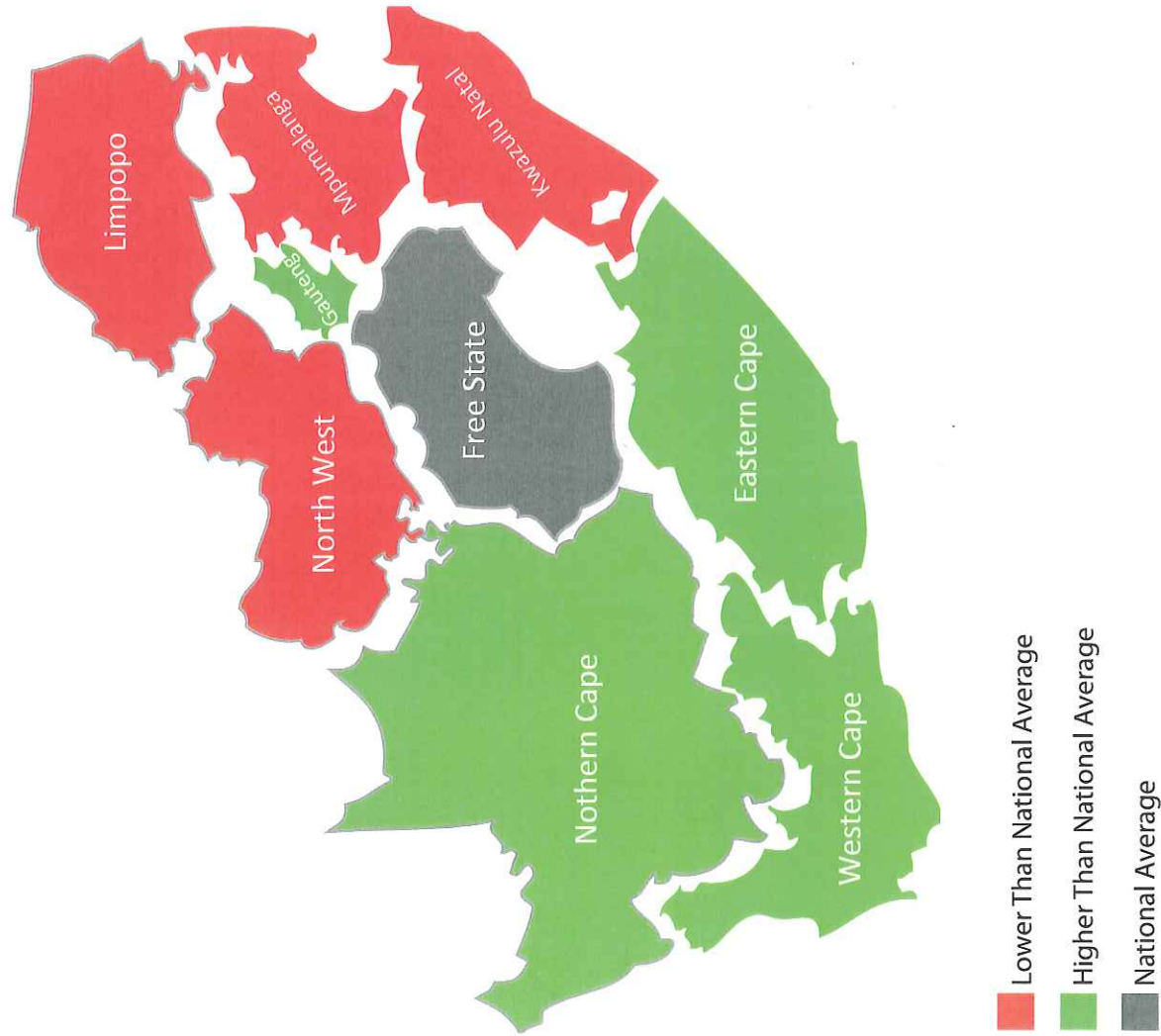


Figure 7 Breast Cancer Screening Rate

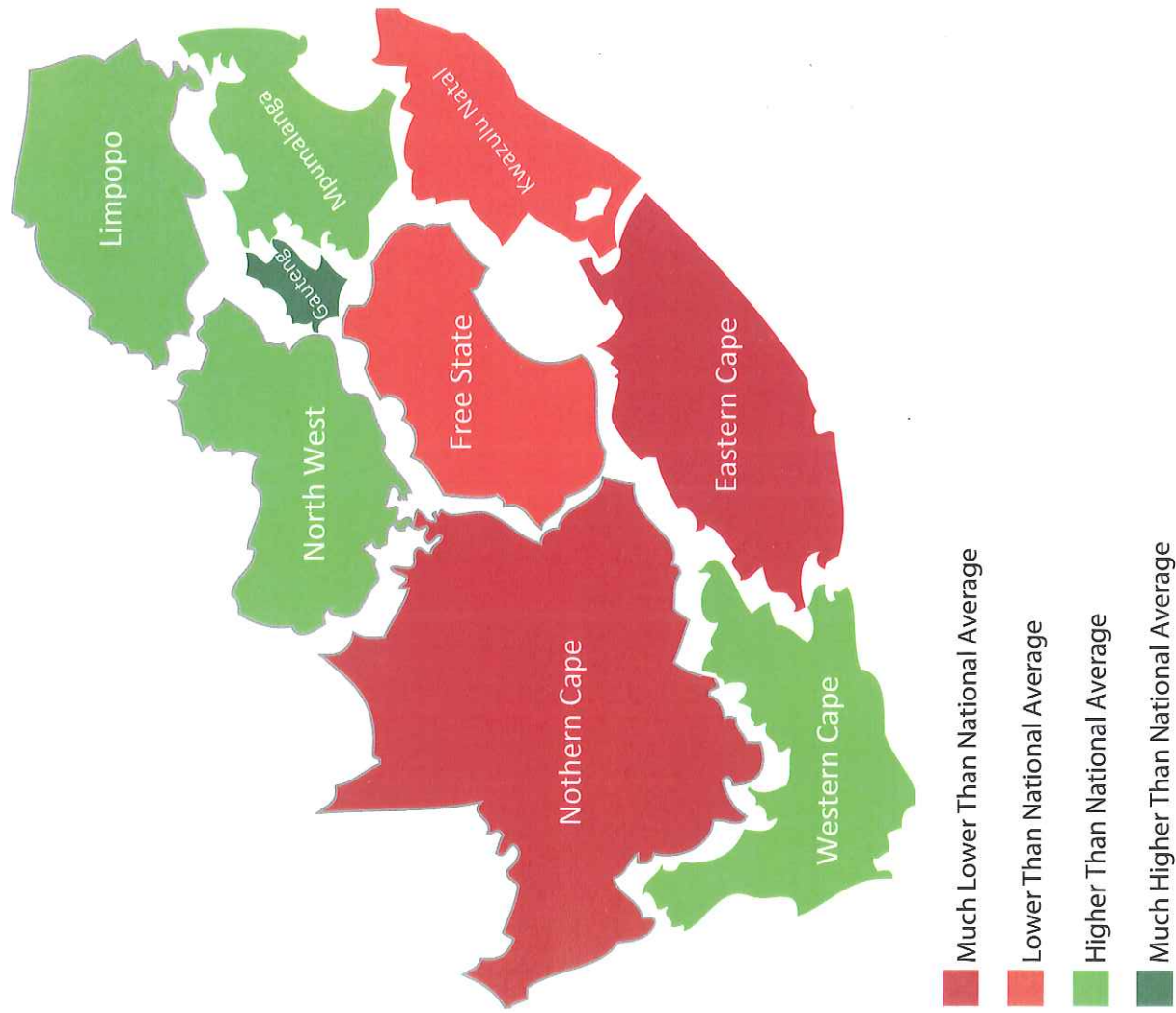
# Colorectal Cancer Screening Rate



| Province                | Screening Rate | Confidence Interval |
|-------------------------|----------------|---------------------|
| Limpopo                 | 0.2            | 0.0-0.7             |
| Kwazulu Natal           | 0.3            | 0.0-0.8             |
| Mpumalanga              | 0.3            | 0.0-0.9             |
| North West              | 0.3            | 0.0-0.8             |
| Free State              | 0.4            | 0.0-1.1             |
| Nothern Cape            | 0.5            | 0.0-1.1             |
| Gauteng                 | 0.6            | 0.0-1.4             |
| Eastern Cape            | 0.7            | 0.0-1.5             |
| Western Cape            | 0.7            | 0.0-0.5             |
| <b>National Average</b> | <b>0.4</b>     | <b>0.0-1.1</b>      |

Figure 8 Colorectal Cancer Screening Rate

# Osteoporosis Screening Rate (Bone Density Scans)



| Province                | Screening Rate | Confidence Interval |
|-------------------------|----------------|---------------------|
| Nothern Cape            | 2.2            | 2.0-2.1             |
| Eastern Cape            | 3.7            | 3.5-3.9             |
| Free State              | 4.9            | 4.7-5.1             |
| Kwazulu Natal           | 4.9            | 4.7-5.1             |
| North West              | 5.3            | 5.1-5.6             |
| Western Cape            | 5.4            | 5.2-5.6             |
| Limpopo                 | 6.0            | 0.2-12.0            |
| Mpumalanga              | 6.5            | 6.3-6.8             |
| Gauteng                 | 8.2            | 7.7-8.2             |
| <b>National Average</b> | <b>5.2</b>     | <b>4.4-6.1</b>      |

Figure 9 Osteoporosis Screening Rate





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## Provincial screening rates for chronic diseases of lifestyle, cancers and HIV in a health-insured population

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### Abstract

**Background**—Screening for asymptomatic diseases can reduce the burden of morbidity and mortality in all population groups. There is widespread geographical variation in the quality of care. Few data are available on national screening rates in South Africa and how these vary across the provinces.

**Objective**—To examine screening rates for chronic diseases of lifestyle (CDL), HIV and cancer in a privately insured population for a single insurer across all nine provinces in South Africa, and to determine whether or not there are any differences between the provinces.

**Method**—Screening rates were calculated as the proportion of eligible members who had received screening tests during 2011 in each province. Mean screening rates were compared between Gauteng and the other eight provinces.

**Results**—Nationwide screening rates were 20.5% for CDL, 8.2% for HIV and 31.9% for cancer. Despite similar insurance coverage, screening rates ranged from 0.3% to 0.95% lower in other provinces compared with Gauteng. Of all the provinces, Gauteng had the highest annual screening rates for CDL, breast cancer, prostate cancer and HIV ( $p < 0.001$ ), while the Western Cape had the highest rate for cervical cancer ( $p < 0.001$ ).

**Conclusion**—There is much variation in preventive care utilisation across the provinces within this health-insured population. Provinces with more abundant healthcare resources have higher screening rates. Further research is required to understand the reasons for the variation, given equal payment access.

Geographical variations in healthcare utilisation can perpetuate health disparities.<sup>[1]</sup> Use of preventive services is particularly likely to be low when access to health services is a barrier.<sup>[2–5]</sup> In addition, there is a strong association between a population's residential location or region and use of preventive screening services.<sup>[6–8]</sup> As a result, there are wide variations in healthcare utilisation and health outcomes across the provinces of South Africa (SA).<sup>[9]</sup> Gauteng and the Western Cape are economically more prosperous and urbanised, are better resourced, and have superior health and development indicators compared with poorer provinces such as Limpopo and the Northern Cape.<sup>[10]</sup> Access to medical insurance



is positively associated with the use of preventive care services.<sup>[11,12]</sup> Approximately 14% of SA's population currently has access to medical insurance.<sup>[13]</sup> Little is known about provincial disparities in healthcare utilisation in the privately insured sector, or what factors drive these disparities.

Discovery Health, the largest medical aid in SA, with an approximately 40% market share, offers a fully paid screening programme for its members. This study aimed to investigate the variation in use of preventive screening services of the Discovery Health membership across the nine provinces of SA. Given that all members have equal access to preventive services, other factors may be at play if disparities do exist. Understanding the provincial disparities may steer more targeted messaging or further research into defining reasons, such as health and human resources availability and capacity, for varying preventive care use.

## Materials and methods

### Setting

The study population consisted of all members of Discovery Health medical aid as at the end of 2011. The Discovery Health screening programme offers a paid screening benefit to its members for mammograms, Pap smears, HIV tests, glaucoma screening, prostate-specific antigen (PSA) for prostate cancer screening, random glucose and cholesterol tests, 'flu vaccines and pneumococcal vaccines, irrespective of the type of medical plan members belong to. Other preventive screening tests are not fully paid for and have some form of co-payments; these include colorectal cancer and osteoporosis screening. The Human Research Ethics Committee of the University of the Witwatersrand granted ethical clearance for the study (certificate No. M120854).

### Methods

Eligibility criteria for the tests evaluated were adapted from the US Preventive Services Task Force Recommendations and are outlined in Table 1. Some preventive tests have clear recommendations for screening frequency, while others do not. For this study, screening for a disease was characterised as having had at least one of the screening tests outlined in Table 1 for the calendar year of 2011 (annual average). It is therefore not an evaluation of whether members' screening behaviour adheres to screening recommendations. The study also did not evaluate differences between covered and non-covered tests, but simply the provincial variation in annual screening rates. Each member was assigned to one of the nine provinces according to a valid address in that province for the duration of 2011.

### Statistical analyses

The study was a cross-sectional descriptive analysis of the annual screening rate of all eligible medical aid members in 2011 across all nine provinces. The mean screening rate for each test was compared between provinces using Student's *t*-test for unpaired samples, with Gauteng as the baseline. Variation between provinces was described using ratios of differences. All analyses were conducted using STATA 12.0 (StataCorp, USA).

## Results

Screening rates for a total of 1 889 447 members were evaluated for the year 2011. Descriptive statistics of the study sample by province are reported in Table 2. The provincial screening rates are shown in Table 3.

Gauteng had the highest annual screening rate for cholesterol at 27.5% of eligible insured members, and the Northern Cape the lowest at 13.4%. Gauteng's screening rate for

cholesterol was also significantly higher than those of the other provinces, figures for which were between 0.93 (Western Cape) and 0.49 (Northern Cape) times lower than Gauteng ( $p<0.001$ ). The variations in screening rates are shown in Table 4. The highest annual screening rate for glucose was 29.7% (Mpumalanga), although this was not significantly different from Gauteng's 29.6% ( $p=0.97$ ). The lowest screening rate for glucose was in the Northern Cape (17.5%), with a variation of 0.59 times lower than Gauteng. KwaZulu-Natal had a 0.84 times lower screening for cholesterol than Gauteng.

Prostate cancer screening had the highest uptake of all preventive screening tests. Around 37.7% of males over 50 years old had had a PSA test in Gauteng, versus a low of 25.6% of males in the Northern Cape. Gauteng had the highest screening rate for prostate cancer of all the provinces ( $p<0.001$ ), and screening rates for prostate cancer ranged from 0.90 to 0.68 times lower in other provinces compared with Gauteng.

The Western Cape had the highest cervical cancer screening rate ( $p<0.001$ ), with 23.1% of all eligible females having had a Pap smear versus only 13.1% of females in the Northern Cape. The screening rate for cervical cancer in the Western Cape was 1.03 times higher than that in Gauteng, while the rate was 0.55 times lower in Limpopo than in Gauteng.

The highest screening rate for breast cancer was in Gauteng ( $p<0.001$ ), with 17.0% of eligible females having had a mammogram, while the lowest rate of 9.4% was in the Northern Cape. Rates for mammograms ranged from 0.95 to 0.60 times lower in the other provinces compared with Gauteng.

HIV screening had the largest variation of all the screening tests. Gauteng had the highest rate ( $p<0.001$ ), with 12.8% of members having had the test, and the lowest rate was in the Northern Cape, where only 4.8% of members had been tested in 2011. Northern Cape had a 0.38 times lower screening rate than Gauteng.

Colorectal cancer screening, currently not part of the paid screening benefit, had the lowest rate. The Eastern Cape (0.7%) had the highest rate ( $p<0.001$ ), while the lowest rate (0.2%) was in Limpopo. The Eastern Cape's screening rate was 1.17 times higher than Gauteng's and 3.5 times higher than Limpopo's.

Osteoporosis screening, which is also not part of the paid screening benefit, had the highest rate in Gauteng ( $p<0.001$ ), with 7.9% of members undergoing screening, and the lowest rate in the Northern Cape (2.2%). Rates of screening for osteoporosis were between 0.82 and 0.28 times lower in the other eight provinces than in Gauteng.

Screening rates for all the provinces are presented in Fig. 1, with Gauteng shown in black.

## Discussion

Use of screening services in this SA medical aid population is low and far below international benchmark targets of 93.0% for cervical cancer, 70.5% for colorectal cancer, 81.1% for breast cancer and 82.1% for cholesterol screening.<sup>[14]</sup> Surveys of screening rates in comparable populations showed that 68% of adults in the USA reported having had a cholesterol test in the preceding 5 years, and more than 75% of females aged 40 years and older had had a mammogram in the preceding 2 years;<sup>[15]</sup> in European countries (Germany, the Netherlands, England and Italy), between 61% and 79% of females over 50 years were screened for breast cancer biennially.<sup>[15,16]</sup> Screening rates among medically insured individuals tend to be slightly higher than in the uninsured, with rates of up to 77.6% for mammograms, 91.5% for Pap smears, 85.5% for cholesterol tests and 50.9% for colorectal cancer.<sup>[17]</sup>



There is considerable variation in utilisation of screening services between provinces in the SA insured population. Screening rates for chronic diseases of lifestyle varied from 30% to 50% lower in the Northern Cape and Limpopo compared with Gauteng and the Western Cape. Cancer screening ranged from 45% to 5% lower in some provinces compared with Gauteng. Rates of HIV screening in the Free State, North West and the Northern Cape were less than half that in Gauteng. This is consistent with findings of others that urbanised areas achieved better uptake of screening services.<sup>[18]</sup>

The variation in utilisation of screening services seen in this medically insured population may not be unusual. Even among medical aid members, where the costs of screening tests are paid for, and in settings where screening facilities are easily accessible, researchers have found poor uptake of services.<sup>[19,20]</sup> This confirms the previous conclusion that access alone is not the only driver of healthcare utilisation disparities.<sup>[1]</sup> Access to facilities may be better in the more urbanised provinces and may play a role in the unequal use of preventive services, together with several other individual and provider factors.<sup>[6,21]</sup> Further research is required to fully understand the reasons for inequitable use of preventive services across the nine provinces in this health insured population.

This study is limited by the fact that it focused only on annual uptake of screening services and not on adherence to screening guidelines, disease detection rates or treatment/management outcomes. Further research is necessary to analyse available data over longer time frames in order to establish the proportion of people who have availed themselves of recommended screening, as well as their health outcomes. Another limitation is that inferences in respect of screening rates can be drawn only on other groups within SA with similar health insurance coverage and not on the uninsured population. It is expected that the general uninsured population screening rate would be much lower than those of the health-insured population. Future research agendas should include comprehensive evaluation of all preventive screening services utilisation (CDL, cancers and HIV) in the uninsured population, with a view to establishing eligibility criteria and creating targets for utilisation of services at various national, provincial and district levels and strengthening national databases, given the imminent introduction of National Health Insurance. This study provides some indication of screening patterns at a national level and the variation that persists in this privately insured population. The strength of this study is that it analysed the entire health-insured population's screening activity over a 1-year period at both national and provincial level and therefore accurately represents their annual screening practices compared with survey data estimations.

## Conclusion

This is the first look at national screening practices in a South African population. In this health-insured population, screening varies greatly between provinces for CDL, cancers and HIV. Screening rates in the larger uninsured South African population may be even lower.

We found that the better-resourced provinces had higher screening rates. The variations between the provinces deserve further exploration in order to evaluate the effect of resource allocation, access to care, provider factors and socio-demographic characteristics that may impact on screening rates.

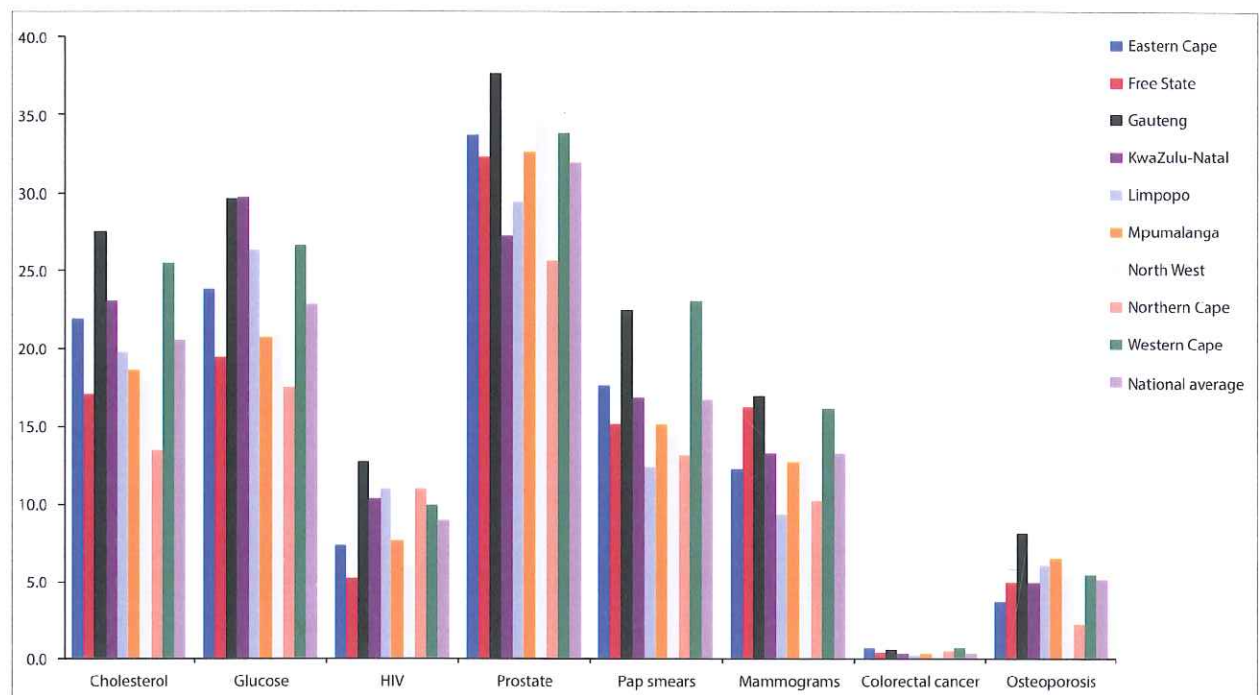
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**Fig. 1.**  
Provincial screening rates, 2011.

Table 1

## Eligibility criteria for screening tests

| Preventive care services    | Eligible population        | Recommendations for how often tests should be performed                                        |
|-----------------------------|----------------------------|------------------------------------------------------------------------------------------------|
| Cholesterol test            | 18 years and older         | Once every 5 years                                                                             |
| Glucose test                | 18 years and older         | No well-established recommendation. Usually once every 5 years                                 |
| Glaucoma screening          | 40 years and older         | No well-established recommendation                                                             |
| HIV                         | 18 years and older         | No well-established recommendation. Usually yearly for persons at risk                         |
| Prostate cancer test        | Male, 50 years and older   | No well-established recommendation                                                             |
| Pap smear                   | Female, 16 years and older | Once every 3 years                                                                             |
| Mammogram                   | Female, 35 years and older | Once every 2 years                                                                             |
| Colorectal cancer screening | 50 years and older         | Colonoscopy: once every 10 years Sigmoidoscopy: once every 5 years Faecal occult blood: yearly |
| Bone density scan           | Female, 50 years and older | No well-established recommendation                                                             |

**Table 2**

Descriptive statistics of the study sample by province

| Province      | Frequency (n) | %     |
|---------------|---------------|-------|
| Eastern Cape  | 98 211        | 5.20  |
| Free State    | 50 415        | 2.76  |
| Gauteng       | 895 202       | 47.38 |
| KwaZulu-Natal | 267 700       | 14.17 |
| Limpopo       | 29 883        | 1.58  |
| Mpumalanga    | 105 662       | 5.59  |
| North West    | 55 787        | 2.95  |
| Northern Cape | 17 889        | 0.95  |
| Western Cape  | 367 186       | 19.43 |
| Non-RSA       | 1 509         | 0.08  |
| Total         | 1 889 447     | 100   |



Table 3

## Provincial screening rates

|                                                         | Cholesterol       | Glucose           | HIV               | Prostate          | Pap smear         | Mammogram         | Colorectal cancer | Osteoporosis     |
|---------------------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|
| National average <sup>*</sup>                           | 20.5              | 23.8              | 8.2               | 31.9              | 16.7              | 13.3              | 0.4               | 5.7              |
| (international targets – where they exist) <sup>†</sup> | (82.1)            |                   |                   |                   | (93.0)            | (81.1)            | (70.5)            |                  |
| Eastern Cape                                            | 21.9              | 23.8              | 7.3               | 33.8              | 17.5              | 12.1              | 0.7 <sup>‡</sup>  | 5.8              |
| Free State                                              | 17.1              | 19.4              | 5.2               | 32.3              | 15.1              | 16.2              | 0.4               | 5.8              |
| Gauteng                                                 | 27.5 <sup>‡</sup> | 29.6              | 12.8 <sup>‡</sup> | 37.7 <sup>‡</sup> | 22.4              | 17.0 <sup>‡</sup> | 0.6               | 7.9 <sup>‡</sup> |
| KwaZulu-Natal                                           | 23.2              | 26.3              | 10.2              | 27.2              | 16.9              | 13.2              | 0.3               | 4.9              |
| Limpopo                                                 | 19.7              | 20.7              | 11.0              | 29.4              | 12.3              | 9.4               | 0.2               | 6.0              |
| Mpumalanga                                              | 18.6              | 29.7 <sup>§</sup> | 6.7               | 32.6              | 15.1              | 12.6              | 0.3               | 6.5              |
| North West                                              | 17.9              | 20.5              | 5.9               | 34.9              | 14.5              | 13.0              | 0.3               | 5.3              |
| Northern Cape                                           | 13.4              | 17.5              | 4.8               | 25.6              | 13.1              | 10.2              | 0.4               | 2.2              |
| Western Cape                                            | 25.5              | 26.6              | 9.9               | 33.8              | 23.1 <sup>‡</sup> | 16.1              | 0.6               | 5.4              |

<sup>\*</sup> Average proportion of eligible Discovery Health Members who utilise the screening service.

<sup>†</sup> Healthy People 2020 Targets (USA).<sup>14</sup>

<sup>‡</sup> Significant difference in screening rate when comparing Gauteng with other provinces/or compared with Gauteng ( $p < 0.001$ ).

<sup>§</sup> No significant difference in screening rate when compared with Gauteng ( $p = 0.97$ ).

Table 4

Variation in screening rates between Gauteng and the other provinces

| Province      | Ratio by which province is lower (higher) than Gauteng |         |      |          |           |           |                   |
|---------------|--------------------------------------------------------|---------|------|----------|-----------|-----------|-------------------|
|               | Cholesterol                                            | Glucose | HIV  | Prostate | Pap smear | Mammogram | Colorectal cancer |
| Eastern Cape  | 0.78                                                   | 0.80    | 0.57 | 0.90     | 0.78      | 0.71      | (1.17)            |
| Free State    | 0.62                                                   | 0.66    | 0.41 | 0.86     | 0.67      | 0.95      | 0.67              |
| KwaZulu-Natal | 0.84                                                   | 0.89    | 0.80 | 0.72     | 0.75      | 0.78      | 0.50              |
| Limpopo       | 0.72                                                   | 0.70    | 0.86 | 0.78     | 0.55      | 0.55      | 0.33              |
| Mpumalanga    | 0.68                                                   | 1.00    | 0.52 | 0.86     | 0.67      | 0.74      | 0.50              |
| North West    | 0.65                                                   | 0.69    | 0.46 | 0.78     | 0.65      | 0.76      | 0.50              |
| Northern Cape | 0.49                                                   | 0.59    | 0.38 | 0.68     | 0.58      | 0.60      | 0.67              |
| Western Cape  | 0.93                                                   | 0.90    | 0.77 | 0.90     | (1.03)    | 0.95      | 1.00              |
|               |                                                        |         |      |          |           |           | 0.73              |
|               |                                                        |         |      |          |           |           | 0.73              |
|               |                                                        |         |      |          |           |           | 0.62              |
|               |                                                        |         |      |          |           |           | 0.76              |
|               |                                                        |         |      |          |           |           | 0.82              |
|               |                                                        |         |      |          |           |           | 0.67              |
|               |                                                        |         |      |          |           |           | 0.28              |
|               |                                                        |         |      |          |           |           | 0.68              |

## ORIGINAL ARTICLE

## Predictors of adherence to screening guidelines for chronic diseases of lifestyle, cancers, and HIV in a health-insured population in South Africa

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**Background:** Adherence to screening guidelines has been widely accepted to reduce morbidity, mortality, and cost outcomes. The aim of this study was to identify predictors of adherence to screening guidelines for chronic diseases of lifestyle (CDL), cancers, and HIV in a health-insured population in South Africa, some of whom voluntarily opt into a wellness program that incentivizes screening.

**Method:** A cross-sectional study for the period 2007–2011 was conducted using a random sample of 170,471 health insurance members from a single insurer. Adherence to screening guidelines was calculated from medical claims data.

**Results:** Adherence to screening guidelines ranged from 1.1% for colorectal cancer to 40.9% for cholesterol screening. Members of the wellness program were up to three times more likely to screen for diseases (odds ratio [OR] = 3.2 for HIV screening, confidence interval [CI] = 2.75–3.73). Plan type (full comprehensive plan) was most strongly associated with cholesterol screening (OR = 3.53, CI = 3.27–3.80), and most negatively associated (hospital-only core plan) with cervical cancer screening (OR = 0.44, CI = 0.28–0.70). Gender was a negative predictor for glucose screening (OR = 0.88, CI = 0.82–0.96). Provincial residence was most strongly associated with cervical cancer screening (OR = 1.89, CI = 0.65–5.54).

**Conclusion:** Adherence to screening recommendations was <50%. Plan type, gender, provincial residence, and belonging to an incentivized wellness program were associated with disproportionate utilization of screening services, even with equal payment access.

**Keywords:** screening; chronic diseases of lifestyle; cancer; HIV; health insurance; incentives

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Significant disparities exist in preventive healthcare utilization (1). Such disparities are evident not only between high and low-income populations but also within seemingly homogenous populations (2–4). It is well accepted that access to health insurance increases the uptake of screening services (5–7); however, even within the insured population with equal access to services, variation in screening rates exists (8, 9). Inequitable use of healthcare perpetuates the burden of severe illness and mortality in people who tend to need healthcare the most (10). The use of preventive health services, like screening for asymptomatic diseases, effectively reduces morbidity and cause-specific mortality (11–13). Several individual-level factors (level of education, income, age, ethnic minority, or occupation) (14–17) as well as environmental

factors (overcrowding, low-income neighborhoods, or lack of a primary care healthcare provider) are negatively associated with the use of screening services (18–20). South Africa is often described as one of the most inequitable countries in the world with marked differences in rates of disease and mortality along racial, gender, provincial, and urban–rural divides as a consequence of its former despotic and poorly functioning government (21–23). Health organizations thus play an important role in improving the overall health status of the population and eliminating health inequality in South Africa.

Discovery Health, the largest health insurance in South Africa with an approximately 40% market share, offers a fully paid screening program for all its members.



Some members opt into an incentivized wellness program called Vitality. The Vitality program offers its members incentives to perform various health-screening tests as well as to participate in other health-enhancing behaviors like gym attendance and purchasing healthy foods at partner stores. Screening tests that are incentivized include those for certain cancers (breast, cervix, and prostate), chronic diseases of lifestyle (glucose, cholesterol, BMI, and blood pressure), and the human immunodeficiency virus (HIV). Members of Vitality pay a fee per month (approximately \$12.33) and receive benefits, like discounts at network stores, for participating in the program. The Discovery Health screening program is a fully paid for service targeting all of its health-insured members, and the incentives are only offered to those members who join the Vitality program. Screening targets and guidelines used are adapted from the United States Preventative Services Task Force (USPSTF) recommendations.

Even after major health sector reform, South Africa has only some formal population-based screening policies (e.g. cervical cancer screening policy) (24), often poorly implemented with suboptimal uptake (25). A few targeted programs however do operate in selected institutions, provinces, via health insurers and through donor-funded projects. No data exists on the uptake of these programs or the inequities that drive preventive screening behavior in South Africa. This paper aims to identify the factors that impact screening for chronic diseases of lifestyle (CDL), cancers, and HIV in a health-insured population with equal payment access, some of whom are exposed to incentives for screening, specific to South Africa. Knowing the disparities pertaining to preventive care utilization would enable further research agendas, relevant and selective messaging to certain

subgroups and could lead to more targeted resource organization and allocation.

### Present investigation

The analysis was a cross-sectional study conducted from 2007 to 2011 based on data collected from Discovery Health member claims using Current Procedural Terminology (CPT) codes. A random 1% sample, not stratified across any variables, consisting of 170,471 members, was generated from the health insurance member database. The study population consisted of all members who were eligible for screening tests (which served as the inclusion criteria), as adapted from the USPSTF recommendations. This is outlined in Table 1. The Vitality program uses these adapted screening recommendations to award points.

### Materials and methods

The dependent variables were adherence to the Discovery screening recommendations. These recommendations were classified as follows: 1) receipt of a cholesterol test in the previous 5 years; 2) receipt of a glucose test in the previous 5 years; 3) receipt of a Pap smear in the previous 3 years; 4) receipt of a mammogram in the previous 2 years; 5) receipt of a colon cancer test (fecal occult blood test, sigmoidoscopy, or colonoscopy) in the previous 5 years; 6) receipt of a prostate specific antigen (PSA) test in the previous year; 7) receipt of a HIV test in the previous year; and 8) receipt of a bone scan in the previous year. The following independent variables were studied: socio-demographic factors, such as age and gender; plan type (comprehensive plan: the best benefit package, with higher premiums; core plan: only in-hospital benefits, with the lowest premiums; saver plan (including priority plan): between

*Table 1.* Current USPSTF recommendations and inclusion criteria

| Tests                       | Frequency and age eligibility                                                                                                                                                                                                                                                                      |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cholesterol                 | Once every 5 years aged 35+, men aged 20–35 should be screened if they are at increased risk for heart disease                                                                                                                                                                                     |
| Glucose                     | Adults once every 5 years; more frequently if BP > 135/80                                                                                                                                                                                                                                          |
| Pap smear                   | Women aged 21–65 every 3 years. For women aged 30–65 years who want to lengthen screening intervals, screening with a combination of cytology, and human papillomavirus testing every 5 years                                                                                                      |
| Mammogram                   | Recommendations for 2002: screening mammography with or without clinical breast examination every 1–2 years for women aged 40 and older                                                                                                                                                            |
| Colorectal cancer screening | For adults 50–75 years: Colonoscopy every 10 years and sigmoidoscopy once every 5 years Fecal occult blood: yearly                                                                                                                                                                                 |
| Prostate specific antigen   | Current evidence is insufficient to assess the balance of benefits and harms of screening in men younger than age 75. Screening may be recommended for older men, those with a family history of prostate cancer and African American men who are at increased risk of death from prostate cancer. |
| HIV                         | Counseling/screening is recommended for all adults. Frequency of tests not established.                                                                                                                                                                                                            |
| Osteoporosis                | Women 65 years and older and in younger women whose fracture risk is equal to or greater than that of a 65-year-old White women who has no additional risk factors. Consideration may be given to women at age 50 years who are post-menopausal and at increased risk.                             |



the comprehensive plan and the core plan in terms of benefits and premiums)<sup>1</sup>; Vitality status (belonging to the wellness program); and province of residence. Current USPSTF recommendations are shown in Table 2. Permission to use the data was provided by the head of research and development at Discovery Vitality and ethical clearance was received from the Witwatersrand Human Research Ethics Committee, certificate number M120854.

### Statistical analysis

A descriptive analysis of all of the study variables was performed. The estimated prevalence for undergoing a screening test during the 2007–2011 study period, with corresponding 95% confidence intervals (CIs) for each screening test, was calculated. An analysis of the association of the study variables with screening adherence was performed using the Chi-squared test statistic and Student's *t*-test, where applicable. Multivariate logistic regression was used to determine which variables were independent predictors of screening for cholesterol, glucose, Pap smears, mammograms, PSA, colorectal cancer, osteoporosis, and HIV. The adjusted odds ratio (OR) and its 95% CI were calculated to measure the strength of the association. A logistic regression multivariate model was built using the forward modeling method. All statistically significant variables (whose bivariate tests were significant) were selected for the multivariate analysis. Calculations were done using the STATA program (Stata Corporation 12.0), and statistical significance was set at  $p < 0.05$  ( $p$ -values are two tailed).

### Results

More than 38% of the insured members were aged 18–35 and 33.3% belonged to 36–50 years of age category; both categories had a 52% female distribution. Over 64% of the Discovery Health membership belonged to the Vitality program. The plan types were divided as follows: 40% of the participants were insured through the comprehensive plan, 42% were insured through the saver plan, and 16% were insured through the core plan. The highest proportion of members resided in the better-resourced provinces, as follows: 43% in Gauteng, 18% in Western Cape, and 13% in KwaZulu-Natal. These results are depicted in Table 1.

In this sample data, 40.9% of eligible adults were up-to-date with their cholesterol tests and only 16.6% had taken a glucose test in the preceding 5 years. The cervical screening rate was 11.7% in the previous 3 years, while the breast cancer screening rate was 7.9% in the previous 2 years. The prostate cancer screening rate was 20.6% in the previous year. Just over 2.2% of eligible females had been screened for osteoporosis in the previous year. Only 1.1% of all members aged 50 years and over had been screened for colorectal cancer in the previous 5 years. The HIV

Table 2. Characteristics of the study sample

| Variables                                              | Percentage (%) |
|--------------------------------------------------------|----------------|
| Age groups (range of years)                            |                |
| 18–35                                                  | 38.5           |
| 36–50                                                  | 33.3           |
| 51–60                                                  | 14.5           |
| > 60                                                   | 13.7           |
| Gender                                                 |                |
| Male                                                   | 48             |
| Female                                                 | 52             |
| Wellness program membership                            |                |
| Vitality members                                       | 64.3           |
| Non-vitality members                                   | 35.7           |
| Plan type                                              |                |
| *Core                                                  | 16.6           |
| **Saver                                                | 42.7           |
| ***Comprehensive                                       | 40.6           |
| Provincial distribution of health insurance membership |                |
| Gauteng                                                | 43.4           |
| Western Cape                                           | 18.6           |
| KwaZulu-Natal                                          | 13.5           |
| Eastern Cape                                           | 12.8           |
| Mpumalanga                                             | 4.4            |
| North West                                             | 2.3            |
| Free State                                             | 2.3            |
| Limpopo                                                | 1.3            |
| Northern Cape                                          | 0.9            |

\*Unlimited private hospital coverage • Essential coverage for chronic medicine • Coverage for medical emergencies when travelling in and outside South Africa. Contributions per month: main member = \$153.41; adult dependent = \$120.68; child = \$61.25.

\*\*Unlimited private hospital coverage • Essential coverage for chronic medicine • A Medical Savings Account • Coverage for medical emergencies when travelling in and outside South Africa. Contributions per month: main member = \$206.14; adult dependent = \$162.27; child = \$82.39.

\*\*\*Unlimited private hospital coverage • A choice of a high or no Medical Savings Account and an unlimited Above Threshold Benefit • Comprehensive coverage for chronic medicine • Coverage for medical emergencies when travelling in and outside South Africa. Contributions per month: main member = \$350.68; adult dependent = \$331.59; child = \$70.

Note: KeyCare plan type was excluded from the analyses as the benefit offering differed too much from the other plan types.

screening rate was 8.7% in the previous year. These data, together with eligibility criteria, are shown in Table 3.

Health insurance members were 67% more likely to have had a cholesterol test in the preceding 5 years if they belonged to Vitality (OR = 1.67), more than 3.5 times more likely if they had a comprehensive plan (OR = 3.53), and 42% more likely if they lived in Gauteng province (Gauteng OR = 1.42). Comprehensive plan type was also

<sup>1</sup>See Table 1 for description of plan characteristics.



a positive predictor for having had a glucose test in the preceding 5 years, with members being almost twice as likely to have undergone that screening (OR = 1.9). The negative predictors of glucose tests were gender (males were 22% less likely to have had a glucose test [OR = 0.88]) and core plan type (core plan members were 22% less likely [OR = 0.78]).

Females who were members of Vitality were 78% more likely to have had a Pap smear compared to non-Vitality members (OR = 1.78); moreover, they were 89% more likely to have had the test if they lived in Northern Cape province (OR = 1.89). Female core plan holders were 56% less likely to be up-to-date with their Pap smear tests (OR = 0.44). Female Vitality members were 89% more likely to be up-to-date with mammography screening (OR = 1.89) and females with a comprehensive plan type were almost three times more likely to be up-to-date with mammography screening (OR = 2.99). Core plan type was a negative predictor of mammography screening; females holding that type of plan were 66% less likely to be up-to-date with mammography screening (OR = 0.44).

Males over 50 years who were members of Vitality were 45% more likely to have had a prostate cancer screening test (OR = 1.45) and were 2.26 times more likely to have had that test if they owned a comprehensive plan (OR = 2.26).

The only positive predictor of colorectal cancer (CRC) screening was province of residence, where members were more than 50% more likely to have had CRC screening if they lived in KwaZulu-Natal (OR = 1.54) with no negative predictors.

Overall, members of Vitality were more than three times more likely to have had a HIV test (OR = 3.2) and

they were 27% less likely to have had a HIV test if they owned a core plan (OR = 0.73).

Osteoporosis screening decreased by 40% for every 10-year increase in age (OR = 0.6).

Table 4 shows all of the predictive variables, their odds ratios, and the corresponding confidence intervals.

## Discussion

Screening rates among this insured population is low. This is not an uncommon finding. Even amongst health insurance members where costs of screening tests are paid for or in settings where screening facilities are easily accessible, researchers have found poor uptake of services (26, 27). Overall, screening rates in this population are far behind comparable international populations. For example, recent 2012 US findings established that 68% of US adults had a cholesterol test in the preceding 5 years (28), and some European countries (Germany, Netherlands, England, and Italy) manage to screen between 61 and 79% of females over 50 years for breast cancer biennially (11).

For this health-insured population, belonging to a wellness program that provides incentives for performing screening tests is a strong predictor of whether a person will undergo cholesterol testing, Pap smears, mammograms, prostate cancer screening, and HIV tests. The use of economic incentives has shown promising results directing patients towards health-enhancing behaviors (29, 30). Positive incentives that reward behavior, rather than negative incentives that are punitive if certain goals are not achieved, tend to achieve greater success (31). Financial incentives can effectively increase the use of

Table 3. Proportion of members up-to-date with preventive screening 2007–2011

| Tests<br>(eligibility criteria for Vitality Screening Program)    | Adapted recommendation as per Discovery<br>Health screening program |                      | Proportion of<br>eligible members<br>who screen (%) | Confidence interval |
|-------------------------------------------------------------------|---------------------------------------------------------------------|----------------------|-----------------------------------------------------|---------------------|
|                                                                   |                                                                     |                      |                                                     |                     |
| Cholesterol (adults $\geq 18$ years, $n = 20\ 859$ )              | Adults once every five years                                        |                      | 40.9                                                | 40.25–41.56         |
| Glucose (adults $\geq 18$ years, $n = 21\ 517$ )                  | Adults once every five years                                        |                      | 16.6                                                | 16.01–17.07         |
| Pap smear (females $\geq 16$ years, $n = 2529$ )                  | Once every three years                                              |                      | 11.7                                                | 10.5–12.9           |
| Mammogram (females $\geq 35$ years, $n = 827$ )                   | Once every two years                                                |                      | 7.9                                                 | 6.1–9.8             |
| Colorectal cancer screening (adults $\geq 50$ years, $n = 4963$ ) | For adults 50 years and older:                                      |                      | 1.1                                                 | 0.8–1.4             |
|                                                                   | Colonoscopy and sigmoidoscopy:<br>once every five years             |                      |                                                     |                     |
|                                                                   | Fecal occult blood: yearly                                          |                      |                                                     |                     |
| Prostate-specific antigen (males $\geq 50$ years, $n = 107$ )     | Yearly                                                              | Mean 2007–2011       | 27.4                                                | 25.6–29.2           |
|                                                                   |                                                                     | In the previous year | 20.6                                                | 12.8–28.3           |
| HIV (adults $\geq 18$ years, $n = 20\ 859$ )                      | Yearly                                                              | Mean 2007–2011       | 5.4                                                 | 5.1–5.7             |
|                                                                   |                                                                     | In the previous year | 8.7                                                 | 8.1–9.3             |
| Osteoporosis (females $\geq 60$ years, $n = 46$ )                 | Yearly                                                              | Mean 2007–2011       | 6.6                                                 | 5.2–7.9             |
|                                                                   |                                                                     | In the previous year | 2.2                                                 | 1.7–2.7             |

Table 4. Factors associated with preventive screening

|                 | Adjusted OR (CI)                                      |                                                      |                                                            |                                                   |                                                      |                                                            |                                                      |                                                  |
|-----------------|-------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------|------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------|--------------------------------------------------|
|                 | Cholesterol                                           | Glucose                                              | Pap smear                                                  | Mammogram                                         | PSA                                                  | CRC                                                        | HIV                                                  | Bone scan                                        |
| Age             | Per 10 year increase: 1 (ref)<br>1.04 (1.03–1.04)     | Per 10 year increase: 1(ref)<br>1.3 (1.29–1.35)      | Not Significant                                            | Per 10 year increase: 1 (ref)<br>1.42 (1.16–1.74) | Per 10 year increase: 1 (ref)<br>1.29 (1.16–1.44)    | Not significant                                            | Per 10 year increase: 1 (ref)<br>0.73 (0.69–0.76)    | Per 10 year increase: 1 (ref)<br>0.6 (0.39–0.92) |
| Gender          | Female: 1 (ref)<br>Male: 1.14<br>(1.08–1.21)          | Female: 1 (ref)<br>Male: 0.88<br>(0.82–0.96)         | –                                                          | –                                                 | –                                                    | Not significant                                            | Not significant                                      | –                                                |
| Vitality member | Non-member: 1 (ref)<br>1.67 (1.57–1.76)               | Non-member: 1 (ref)<br>1.22 (1.13–1.31)              | Non-member: 1 (ref)<br>1.78 (1.4–2.3)                      | Non-member: 1 (ref)<br>1.89 (1.13–3.17)           | Non-member: 1 (ref)<br>1.45 (1.20–1.73)              | Not significant                                            | Non-member: 1 (ref)<br>3.2 (2.75–3.73)               | Not significant                                  |
| Plan Type       | Core<br>1.56 (1.44–1.68)                              | 0.78 (0.69–0.86)                                     | 0.44 (0.28–0.70)                                           | 0.44 (0.17–1.12)                                  | Not Significant                                      | Not Significant                                            | 0.73 (0.63–0.98)                                     | Not significant                                  |
| Saver           | 1 (ref)                                               | 1 (ref)                                              | 1 (ref)                                                    | 1 (ref)                                           | 1 (ref)                                              | 1 (ref)                                                    | 1 (ref)                                              | 1 (ref)                                          |
| Comprehensive   | 3.53 (3.27–3.80)                                      | 1.9 (1.73–2.12)                                      | Not significant                                            | 2.99 (1.72–5.24)                                  | 2.26 (1.6–3.1)                                       | Not Significant                                            | 0.85 (0.73–0.98)                                     | Not significant                                  |
| Province        | Eastern Cape: 1 (ref)<br>Gauteng: 1.42<br>(1.26–1.61) | Eastern Cape 1 (Ref)<br>Gauteng: 0.99<br>(0.82–1.14) | Eastern Cape: 1 (ref)<br>Northern Cape 1.89<br>(0.65–5.54) | Not Significant                                   | Eastern Cape: 1 (ref)<br>Gauteng 1.22<br>(0.83–1.79) | Eastern Cape: 1 (ref)<br>KwaZulu-Natal 1.54<br>(0.49–4.88) | Eastern Cape: 1 (ref)<br>Gauteng 1.32<br>(0.99–1.77) | Not significant                                  |

Adjusted odds ratios using multivariate logistic regression model, adjusted for age, gender, Vitality member, plan type, and Province of residence.  
OR: odds ratio; CI: confidence interval; Comp: comprehensive plan type; Ref: reference value; PSA: prostate-specific antigen; CRC: colorectal cancer.



preventive services, like mammography screening, Pap smears, and colorectal cancer screening (32), although incentives tend to be more effective for simpler behaviors, like influenza vaccinations, than complex behaviors (29, 33). The type of incentive does not seem as important as the nature of the incentive (i.e. how relevant the incentive is to the person) and researchers are still unsure what size of incentive has the best outcome (33). In this study's population, Vitality members receive discounts at stores for goods like electronic equipment, books, airline flights, car rentals, and discounted holidays. Exposure to incentives in this population may further perpetuate the inequitable use of preventive care services.

The comprehensive plan is one of the most expensive plan types offered by this health insurer, possibly making it affordable for a more affluent part of the membership. This plan type was associated with cholesterol, glucose, Pap smears, mammograms, prostate and cancer. In this population, the finding of a positive association between the comprehensive plan type and some of the screening tests is similar to the findings from other studies that have shown a positive correlation with income level (and level of education), and rates of cervical cancer and prostate cancer screening in particular (34–36). The tests that had the strongest correlations with the comprehensive plan were cholesterol, mammography and prostate cancer screening. In South Africa, breast cancer is more common in the white population (37) and thus this particular population may be requesting/receiving better healthcare screening.

Being male was a negative predictor of glucose screening. This was the only test where males had a lower likelihood of screening whereas in general, males have been shown to use preventive services less often than females (38).

Provincial location was a positive predictor for cholesterol testing, Pap smears, mammograms, PSA, and HIV tests. Geographical variation in the use of screening services occurs in many countries and is often due to unequal resource availability and access as well as differing provider organizations, policies, financial arrangements, skills, and capacity (1, 19, 20, 35). Wide variations exist in healthcare utilization and health outcomes across South African provinces (39). This study further confirms that even in this health-insured community with equal payment access for screening services, provincial location is a strong predictor of service utilization.

Owning a hospital plan (core plan) was negatively associated with glucose screening, Pap smears, mammograms, and HIV tests. Low-socioeconomic status has been implicitly linked to decreased use of preventive health services in many other studies, which can be explained by a combination of factors like low income, lower levels of education, being uninsured, and having limited access to a primary care provider (40). Even in a seemingly homo-

geneous population (like a health-insured membership such as this), disparities exist in the use of healthcare resources and these are often related to personal predictors (3). The lower socioeconomic strata of this population were shown to be at increased risk of not screening, in particular, for cervical and breast cancer.

Current USPSTF recommendations find no mortality benefit in screening males younger than age 75 and indeed screening may be associated with harms related to over-evaluation (41). Glucose and cholesterol screening has been shown to have no real benefit when implemented at population level, with benefits yielded when screening is targeted at high risk individuals (42, 43). Osteoporosis research has shown that no trials to date have directly evaluated effectiveness, harms, and intervals in females younger than age 65 (44). Although Discovery has adapted some of the USPSTF recommendations to suit their target population, they have to date not undertaken any research to evaluate potential harms that may have occurred as a result of these screening recommendations. Further research is required to fully understand the impact of these recommendations.

### Limitations

This study provides no new information about the predictors of preventive screening services utilization, but highlights vulnerable subgroups of the population specific to the South African health-insured market. The study is a cross-sectional study on the associated factors relating to screening tests and thus cannot make inferences about the direction of the cause-and-effect of the factors found to be associated with those screening tests. The random sample included test for both asymptomatic screening as well as for diagnostic purposes as no distinction could be made based on the CPT code. Screening for asymptomatic diseases may thus be inflated. People self-select into the wellness program creating a selection bias; nevertheless, strong associations were identified for many of the screening tests and belonging to the incentivized program. Screening recommendations are not exactly as per USPSTF but an adaptation according to the context of Discovery Health's population and resources. Comparison to other populations' screening rates thus cannot be done specifically for cardiovascular disease screening. Furthermore, the study's participants represent a very select sample of the South African population and inferences about the results cannot be applied to the general population. However, this is the first study of its kind evaluating predictors of screening behavior in a South African population.

### Conclusion

In this health-insured population with equal payment access for screening services, significant variations exist in the utilization of preventive screening care based on



gender, plan type, exposure to incentives, and provincial location. This confirms that payment for screening services alone is not enough to promote utilization. Several other underlying sociodemographic and health resource organizational influences that require further research in this population tend to steer screening behavior.

Owning a certain health plan (either an expensive plan or a cheaper plan) is a predictor of inequitable healthcare utilization, possibly favoring the white affluent member, while males are at particular risk of not screening for chronic diseases of lifestyle.

### Author contributions

LA contributed to the concept, design, and data analysis of the paper. DB and JL both made significant contributions to the interpretation of the results and structure of the research paper. All authors approved the final version for publication.

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The authors declare that they have no competing interests.

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# Appendix V

## **The role of prospect theory in screening behavior decision-making in a health-insured population of South Africa**

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## **Abstract**

**Background:** Prospect theory suggests that people avoid risks when faced with the benefits of a decision but take risks when faced with the costs of a decision.

**Purpose:** To assess whether prospect theory can predict screening behavior in the context of a chronic disease diagnosis as well as the exposure to incentives to screen.

**Methods:** A retrospective longitudinal cohort study for the period 2008-2011 was conducted using a random 1% sample of 170,471 health-insured members, assessing screening for cancers, chronic diseases of lifestyle and HIV, some of whom voluntarily join an incentivized wellness program.

**Results:** Individuals diagnosed with a chronic disease screened up to 9.0% less for some diseases over time. Mammogram screening however increased ( $p < 0.001$ ).

Where a family member was diagnosed with a chronic disease, individual screening decreased up to 8.6%. Similarly females in families where a member was diagnosed with a chronic disease screened more for breast cancer ( $p < 0.001$ ). Males were more sensitive to incentives only for HIV screening ( $p < 0.001$ ), while the female responses to incentives were inconsistent.

**Conclusion:** A chronic disease diagnosis or the risk of developing a chronic disease resulted in reduced future screening behavior for most diseases. The role of incentives was inconsistent. Prospect theory adequately predicts screening behavior when diagnosed or faced with a possible chronic disease diagnosis for most screening tests except for females screening for breast cancer.

**Keywords:** behavior economics, prospect theory, behavioral decision making, screening, chronic diseases, cancers, HIV, incentives

## **Introduction**

Screening behavior decision-making is often poorly understood (Ackerson K, Preston SD, 2009). It is widely accepted that screening for preventable diseases decreases morbidity and mortality, especially for breast, cervical, and colorectal cancers (Chu et al., 2009; Cutler, 2009; Sabatino et al., 2009, Weller et al., 2009). However, screening below recommended targets remain widespread (Biesheuvel et al., 2011; Smith et al., 2010). Preventive screening behavior in the context of any other chronic disease diagnosis or when a family member has been diagnosed with a chronic disease has never been described. Prospect theory, however, has been used to describe decision-making in the context of risk (Tversky & Kahneman, 1992; Levy, 1992; Barberis 2013; Mullainathan, 2013). According to Kahneman and Tversky, the first to describe prospect theory, the experimental evidence for prospect theory confirms the manner in which individuals make decisions in risky situations (Edwards, 1996; Wilkinson, 2008). The theory postulates that people are risk averse in choices involving certain gains, but risk seeking in choices involving certain losses. Choices are made based on values placed on the gain or loss relative to a reference point and decision weighing of the outcomes. The aim of this paper is to evaluate whether prospect theory could predict screening behavior in those who have already been diagnosed with a chronic disease or in those who have a family member diagnosed with a chronic disease. Are people risk seeking (not screening for preventive diseases) when faced with the risky situation of already being diagnosed with a chronic disease when the outcome has a certain cost associated with it (the possibility of being diagnosed with another disease), or are they risk averse? Similarly, do people take the risk of not screening for a preventable disease when a family member has a chronic disease diagnosis, or do they avoid screening?

## Methods

The study design was a longitudinal case-control consisting of a random 1% sample (170,471 individuals) of medically insured individuals belonging to Discovery Health (the largest medical insurer in South Africa), tracked over time between 2008-2011. Discovery Health offers a fully paid-for screening benefit for all its members, regardless of plan type, which includes cholesterol, glucose, and Human Immunodeficiency Virus (HIV) tests, mammograms, Pap smears, and screening for prostate-specific antigen (PSA) and glaucoma. Members of the health insurance can voluntarily opt into joining an incentivized wellness program linked to the health insurance company called Vitality at the cost of around \$20 per month. Individuals diagnosed with a chronic disease are encouraged to join the Chronic Illness Benefit, where conditions and medications are managed in accordance with managed care principles. To assess individual-level decision making on screening for tests covered in the screening benefit, eligibility criteria included all individuals over 18 years of age diagnosed with any chronic disease in 2008, captured on the Chronic Illness Benefit as per ICD10 classifications. Chronic diseases included in the analyses are outlined in Appendix 1. Controls included all individuals over 18 years not diagnosed with any chronic disease in 2008. Furthermore, for household-level decision making, eligibility criteria for cases included any family member within a household where a family member has been diagnosed with a chronic disease in 2008, compared to controls where no family member was diagnosed with a chronic disease in 2008. The outcome variable assessed was screening rate (for glucose, cholesterol, HIV, mammography, Pap smears, PSA, colorectal cancer and osteoporosis screening) for all cases and controls at two separate points in time (2008 and 2011) which was extracted from claims data captured using Current Procedural Terminology (CPT)



codes. Eligibility criteria for the different screening tests were as follows: all adults aged 18 and older for cholesterol, glucose, and HIV screening; males 50 years and older for prostate cancer screening (PSA); females 16 years and older for Pap smears; females 35 years and older for mammograms; adults 50 years and older for colorectal cancer screening and females 65 years and older for osteoporosis screening (bone scans). The eligibility criteria are an adaptation of the United States Preventative Task Force guidelines and chosen by the medical insurance to encourage more people to screen. Given the size of the insured population, prevalence of disease and cost of curative care, the insurer deems these criteria to be a cost effective screening strategy. The insurer to date has demonstrated no adverse effects of these screening guidelines.

The rationale for assessing screening behavior when diagnosed with any chronic disease (or when a family member is diagnosed with a chronic disease) is based on the theoretical framework of prospect theory, which suggests that when people are faced with new information (in this case a chronic disease diagnosis), they tend to take the risk of not screening for further/any other chronic diseases. The rationale is that the potential cost of finding/identifying further diseases is high, thus avoiding further screening and taking greater risks. Comparing the screening rates for those with a chronic disease (or when a family member has a chronic disease) to those without a chronic disease could provide an indication of screening choices (and risk taking) based on or related to a diagnosis of any other pre-existing disease. Ethical clearance for the study was provided by the Human Research Ethics Committee (certificate number M120854).

### *Statistical analysis*

A descriptive analysis was performed to identify the demographic characteristics of the sample as well as the proportion of individuals and household members diagnosed with a chronic disease during the study period. The screening rate was calculated as the number of screening tests per eligible population in 2008 and again in 2011. The difference in screening rate over time was compared between cases and controls using the difference-in-difference methodology. This method attempts to take into consideration pre-existing differences between cases and controls that may exist during a general time trend. It assumes that whatever happened to the control group over time is what would have happened to the cases group in the absence of treatment (i.e. chronic disease diagnosis). Further stratification of the sample by gender and wellness membership was conducted to identify possible confounders. The statistical difference in mean screening rate over time between cases and controls was calculated using Student's t-tests for matched pairs with a significance level set at  $p < 0.5$  (two-tailed). All data were calculated using the STATA program (Stata Corporation 12.0).

### **Results**

Participants consisted of a random sample of 174,471 individuals. Approximately 38% of the sample was aged 18-35 years, 33.3% were 36-50 years, 14.5% were 51-60 years, and 13.7% were over 60 years. Forty eight percent were male and 52% female. Just over 64% of the sample was members of Vitality. Chronic disease prevalence in the sample was 6% in 2008 and 6.3% in 2011. Approximately 13.7% of individuals were part of a household where at least one family member was diagnosed with a chronic disease in 2008, compared to 16.3% in 2011. Uptake of screening services of

the entire population (n = 1 889 447) ranged from only 0.4% for colorectal cancer to 31.9% for prostate cancer in 2011. This data is shown in Table 1.

#### *Individual screening behavior*

Baseline screening rates tended to be higher for most screening tests in individuals who were diagnosed with a chronic disease compared to those without a chronic disease. HIV testing was the only test where baseline-testing results were not higher in the chronic diseases patients compared to the non-chronic disease patients.

Individuals who had been diagnosed with a chronic disease increased their screening for cholesterol by only 0.3%, whereas those without a chronic disease screened 6.2% more between 2008 and 2011. The net difference-in-difference screening rate for cholesterol is thus 5.9% lower in 2011 for cholesterol compared to 2008.

Glucose screening similarly decreased over time, as those with a chronic disease only increased their screening rate by 1.6% compared to a 7.6% increase in those without a chronic disease. The net screening rate was thus 6.0% lower over time.

HIV screening decreased overall by 1.4% between those who have a chronic disease diagnosis and those who do not. Chronic disease sufferers increased their HIV screening rate by 3.5%, but because non-chronic disease sufferers increased their screening rate by 4.9%, the net screening rate overall decreased.

Colorectal cancer screening decreased over time for both those who have a chronic disease diagnosis and those who do not. Chronic disease sufferers screened 4.5% less over time for colorectal cancer compared those without a chronic disease, who screened 0.3% less. The overall screening rate was 4.2% lower between 2008 and 2011.



Those with a chronic disease diagnosis screened 1.1% less over time for prostate cancer compared to those without a chronic disease, who screened 7.9% more. The net screening rate resulted in a 9.0% decrease in screening for prostate cancer. Cervical cancer screening increased by 1.0% for those with a chronic disease compared to a 1.5% increase for those without a chronic disease. This resulted in a net decrease in Pap smears by 0.5%.

Screening for breast cancer was the only screening test that resulted in a net increase of 0.27% over time when compared to the screening rate for those who have a chronic disease diagnosis and those who do not. Those with a chronic disease screened 0.07% more compared to those without a chronic disease, who screened 0.2% less.

Osteoporosis screening decreased over time by 2.1% between 2008 and 2011 when comparing those suffering from a chronic disease and those who do not. These results are depicted in Table 2.

#### *Family member screening behavior*

Screening rates in 2008 tended to be higher for most screening tests in individuals who had a family member diagnosed with a chronic disease compared to those without a family member diagnosed with a chronic disease. HIV and Pap smear testing were the only tests where baseline-testing results were not higher in the individuals with a family member diagnosed with a chronic disease compared to those without a family member diagnosed with a chronic disease.

Individuals with a family member who has been diagnosed with a chronic disease increased their screening for cholesterol by 0.6% whereas those without a family member with a chronic disease screened 6.6% more between 2008 and 2011. The net

difference-in-difference screening rate for cholesterol is thus 6.0% lower for cholesterol screening.

Glucose screening similarly decreased over time, as those who have a family member diagnosed with a chronic disease only increased their screening rate by 3.2% compared to a 8.1% increase in those who have no family members with a chronic disease. The net screening rate was thus 4.9% lower over time.

HIV screening decreased overall by 1.4% between those who have a family member with a chronic disease diagnosis and those who do not. Family members who have a chronic disease sufferer in the household increased their HIV screening by 3.5%, but family members with no chronic disease sufferers in the household increased their screening rate by 4.8%, thereby decreasing the net screening rate overall.

Colorectal cancer screening decreased over time for both those who have a chronic disease sufferer on their membership or in their household as well as those who do not. Family members of chronic disease sufferers screened 0.6% less overtime for colorectal cancer whereas those without a chronic disease sufferer screened 0.3% less. The overall screening rate was thus 0.3% lower between 2008 and 2011.

Those family members with another member diagnosed with a chronic disease screened 0.9% more over time for prostate cancer compared to those without a family member with a chronic disease who screened 9.5% more. The net screening rate resulted in a 8.6% decrease in screening for prostate cancer when comparing those with a family member with a chronic disease compared to those without a family member diagnosed with a chronic disease.

Pap smears increased by 0.2% for those with a family member with a chronic disease compared to a 2.6% increase for those without a family member diagnosed with a chronic disease. This resulted in a net decrease of 2.4% in cervical cancer screening.

Screening for breast cancer, once again, was the only screening test that resulted in a net increase of 0.7% over time when comparing the screening rate for those who have a family member diagnosed with a chronic disease and those who do not. Family members with a chronic disease increased their screening rate for breast cancer by 1.8% whereas those without a family member diagnosed with a chronic disease only increased their screening rate by 1.1% over time.

Osteoporosis screening decreased over time by 3.4% between 2008 and 2011 when comparing those who suffer from a chronic disease and those who do not. These results are outlined in Table 3.

#### *Stratification by gender and wellness membership*

When stratified for other possible variables (gender and Vitality status), significant increases in screening behavior were seen only for HIV and breast cancer screening in individuals whose family members had been diagnosed with a chronic disease.

For HIV screening - males on the Vitality program who had a family member diagnosed with a chronic disease screened 7.1% more in 2011 compared to 2008.

Males on Vitality without a family member diagnosed with a chronic disease only increased their HIV screening by 6% between 2008 and 2011, resulting in a difference-in-difference screening rate of 1.1% more. Males not on the Vitality program did not yield the same results and decreased their overall screening rate by 1.0% over time.

Females, however, showed greater increases in screening behavior among those **not** belonging to the Vitality program who had a family member diagnosed with a chronic disease compared to those who did not have a family member diagnosed with a chronic disease. These females screened 0.3% more for HIV over time.



Females on the Vitality program who had a family member diagnosed with a chronic disease, however, screened 0.4% more for breast cancer and 0.6% more for osteoporosis compared to females not on the Vitality program who did not have family members diagnosed with a chronic disease. This data is shown in Table 4.

## Discussion

Baseline screening for chronic diseases tended to be higher in the 'cases' compared to the 'controls' in this study population. This may infer that health care professionals perhaps use the patients' presentation at the medical facility as an opportunity to test for a battery of other tests. But the testing behavior is not sustained over time.

Individuals diagnosed with a chronic disease significantly decreased their screening rate over time for most screening tests. This finding is inline with prospect theory and behavior in the context of risk. According to prospect theory, people are much more sensitive to losses and tend to derive utility from gains and losses relative to a certain reference point (Diamond & Vartiainen, 2008). In the context of being diagnosed with a chronic disease, the sense of 'loss of health' spurred people on to prevent further losses in health by not screening more for preventable diseases. The deviation from health (the reference point) to ill health theoretically have resulted in decreased screening rates, as future outcomes of screening would have caused further deviation from that reference point of health. Newsom et al. described how major behavior change theories do not include explicit predictions about behavior change in the context of chronic illness, however the basic tenets of behavior change theories suggests that the onset of chronic illness should at least motivate lifestyle changes (Newsom et al., 2011). Data from the United States Health and Retirement Study also found very low levels of behavior change 2-14 years after heart disease, stroke, cancer, diabetes and lung disease diagnoses (Newsom et al., 2011).

Females diagnosed with a chronic disease, however, increased their screening rate over time for breast cancer. According to Deeks et al. women are more likely to have annual check ups, screening tests and seek health advice (Deeks et al., 2009).

Adherence to cancer screening in women were found to be associated with a fear of cancer but trust in health care providers; understanding risk and framing routine care as status quo (Ackerson, 2009). Several studies have demonstrated a notable sex difference in health-related decision making, and women are often found to be more cautious in survival-related circumstances and will thus take more risks in order to survive.<sup>17</sup> Women, according to McDermott are also more susceptible than men to the way in which the message is framed (McDermott et al., 2008). Framing the health message in a loss-framed manner has been shown to have a larger impact on intended behavior related to preventive health screening when the perceived risk involved is high (Bartels et al., 2010).

Individuals who have a family member diagnosed with a chronic disease decreased their screening rate over time for most preventable diseases. Dolan et al found that current health status does influence valuations, however people who had been ill in the past or who had family members who were ill did not generally differ from people with no past illness (Dolan, 1996). This, according to Dolan is due to the fact that, as experience with illness becomes more remote, its effect on health state values becomes less. This implies that even when there is a certain risk of developing certain chronic diseases when a family member has the same diagnosis, and screening may mitigate that risk, people are risk seeking by not screening when faced with possible losses.

Females who had a family member diagnosed with a chronic disease screened more for breast cancer over time. Women have a gender advantage in terms of mortality and life expectancy (Wingard, 1984). According to Wingard, these differences can be explained by both biological and social/behavioral factors as women tend to engage less in lifestyle behaviors that are detrimental to health. Women are also traditionally



more responsible for family health and are more knowledgeable about pathological signs and thus have a higher propensity to use health care services than men (Oksuzyan et al., 2008).

Males who had a family member diagnosed with a chronic disease who were themselves exposed to incentives increased their screening rate for HIV over time. This sub-group of the population was thus more risk averse. The use of incentives has become an increasingly popular means to entice positive changes in health behavior (Voigt, 2010). Although incentives show promising results in their efficacy in promoting preventive care activities, they have been shown to work best in highly structured environments when coupled with client reminders, and tends to promote behavior change only in the short term (Kane et al., 2004; Stone et al., 2002; Volpp et al., 2006; Browers et al., 2011). Very little evidence exists on the gender differences in response to incentives, but some studies have shown that men tend to respond better when the incentive is monetary and of greater value (Patrick et al., 2013; Speckelmeyer et al., 2009). Why men in this population diagnosed with a chronic disease increased their screening rates for HIV when exposed to incentives is unclear. Females who had a family member diagnosed with a chronic disease who were not personally exposed to incentives increased their screening rate for HIV over time. However, females in the Vitality program who had a family member diagnosed with a chronic disease screened more for breast cancer over time. The role of incentives in this instance, proved to be inconsistent, consistent with previous findings in which incentives are effective and applicable in certain settings, but do not work in others (Voigt, 2010; Stocks et al., 2012).

In general, the screening rate for chronic disease sufferers was higher than non-chronic disease sufferers initially, but the rate of increase of screening was not as high in those with chronic diseases compared to those without. This implies that screening tests may have been used as opportunity tests during the time of chronic disease diagnoses for these patients. Over time, these patients may have then dropped out of the health care system or possibly too ill to continue their screening tests for other diseases. Health care providers should thus take special precautions not to let chronic disease sufferers fall by the wayside for ongoing screening tests.

#### Limitations

The study did not evaluate the impact of health message framing on the outcome of screening, a significant area of prospect theory. It also did not evaluate patient's perceptions of risks, costs, benefits and gains, thus making assumptions on the value of screening based only on the medical view of the utility of screening for diseases. Inferences on the role of incentives can only be reported as a 'possible' impact and associations of cause and effect cannot be implied as patients voluntarily join the incentivized wellness program.

## **Conclusion**

In the context of chronic disease diagnoses and future screening behavior, prospect theory is able to predict behavior for most screening tests.

Individuals who have a family member diagnosed with a chronic disease are risk seeking by not screening themselves when faced with the possible loss of their own health.

Women who screen for breast cancer are the only group in which behavior in the context of risk according to prospect theory cannot be applied. The role of incentives was inconsistent with respect to steering screening behavior for individuals diagnosed with a chronic disease or with a family member who has been diagnosed with a chronic disease.

Health care providers should remain vigilant towards chronic disease sufferers so that they do not become neglected from continuing their screening tests for other chronic diseases, HIV and cancers.

## **Conflicts of Interest**

The authors declare that they have no competing interest.



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Table 1. Demographic Characteristics of Study Sample

| Variables                                                   |                      | Percentage (%) |                |
|-------------------------------------------------------------|----------------------|----------------|----------------|
| Age groups (range of years)                                 | 18-35                | 38.5           |                |
|                                                             | 36-50                | 33.3           |                |
|                                                             | 51-60                | 14.5           |                |
|                                                             | >60                  | 13.7           |                |
| Gender                                                      | Male                 | 48             |                |
|                                                             | Female               | 52             |                |
| Wellness program membership                                 | Vitality members     | 64.3           |                |
|                                                             | Non-Vitality members | 35.7           |                |
| Chronic Disease Prevalence                                  | Individual           | 6.0<br>(2008)  | 6.3<br>(2011)  |
|                                                             | Family Member        | 13.7<br>(2008) | 16.3<br>(2011) |
| Screening Uptake of Eligible Members for 2011 (n=1 889 447) | Cholesterol          | 20.5           |                |
|                                                             | Glucose              | 23.8           |                |
|                                                             | HIV                  | 8.2            |                |
|                                                             | Colorectal Cancer    | 0.4            |                |
|                                                             | Prostate Cancer      | 31.9           |                |
|                                                             | Cervical Cancer      | 16.7           |                |
|                                                             | Breast Cancer        | 13.3           |                |
|                                                             | Osteoporosis         | 5.7            |                |

Table 2. Screening rates of individuals diagnosed with a chronic disease

|                             | Individuals        | Screening Rate 2008 (N) | Screening Rate 2011 | Difference | Difference-in-Difference | p-value |
|-----------------------------|--------------------|-------------------------|---------------------|------------|--------------------------|---------|
| Cholesterol Screening       | Chronic Disease    | 29.1% (N=6483)          | 29.4% (N=6176)      | 0.3        | -5.9                     | <0.001  |
|                             | No Chronic Disease | 17.1% (N=6613)          | 23.3% (N=6765)      | 6.2        |                          |         |
| Glucose Screening           | Chronic Disease    | 28.1% (N=6483)          | 30.5% (N=6176)      | 1.6        | -6.0                     | <0.001  |
|                             | No Chronic Disease | 17.3% (N=6613)          | 24.9% (N=6765)      | 7.6        |                          |         |
| HIV Screening               | Chronic Disease    | 4.4% (N=6483)           | 7.9% (N=6176)       | 3.5        | -1.4                     | <0.001  |
|                             | No Chronic Disease | 6.9% (N=6613)           | 11.8% (N=6765)      | 4.9        |                          |         |
| Colorectal Cancer Screening | Chronic Disease    | 1.3% (N=2863)           | 0.6% (N=3027)       | -4.5       | -4.2                     | <0.001  |
|                             | No Chronic Disease | 0.5% (N=6613)           | 0.2% (N=6765)       | -0.3       |                          |         |
| Prostate Cancer Screening   | Chronic Disease    | 37.5% (N=1324)          | 36.4% (N=1411)      | -1.1       | -9.0                     | <0.001  |
|                             | No Chronic Disease | 21.9% (N=473)           | 29.8% (N=600)       | 7.9        |                          |         |
| Pap Smears                  | Chronic Disease    | 17.5% (N=3455)          | 18.5% (N=3278)      | 1.0        | -0.5                     | <0.001  |
|                             | No Chronic Disease | 22.2% (N=3673)          | 23.7% (N=3700)      | 1.5        |                          |         |
| Mammograms                  | Chronic Disease    | 18.57% (N=2546)         | 18.64% (N=1411)     | 0.07       | 0.27                     | <0.001  |
|                             | No Chronic Disease | 15.6% (N=1732)          | 15.4% (N=1984)      | -0.2       |                          |         |
| Bone Scans                  | Chronic Disease    | 8.7% (N=840)            | 8.2% (N=977)        | -0.5       | -2.1                     | <0.001  |
|                             | No Chronic Disease | 6.3% (N=174)            | 7.9% (N=240)        | 1.6        |                          |         |



Table 3. Screening rate for individuals who have a family member diagnosed with a chronic disease

|                             | Family Members     | Screening Rate 2008 (N) | Screening Rate 2011 (N) | Difference | Difference-in-Difference | p-value |
|-----------------------------|--------------------|-------------------------|-------------------------|------------|--------------------------|---------|
| Cholesterol Screening       | Chronic Disease    | 30.2% (N=5211)          | 30.8% (N=5173)          | 0.6        | -6.0                     | <0.001  |
|                             | No Chronic Disease | 18.0% (N=5053)          | 24.6% (N=6765)          | 6.6        |                          |         |
| Glucose Screening           | Chronic Disease    | 28.3% (N=5211)          | 31.5% (N=5173)          | 3.2        | -4.9                     | <0.001  |
|                             | No Chronic Disease | 17.8% (N=5053)          | 25.9% (N=4976)          | 8.1        |                          |         |
| HIV Screening               | Chronic Disease    | 4.2% (N=5211)           | 7.6% (N=5173)           | 3.5        | -1.4                     | <0.001  |
|                             | No Chronic Disease | 6.6% (N=5053)           | 11.4% (N=4976)          | 4.8        |                          |         |
| Colorectal Cancer Screening | Chronic Disease    | 1.3% (N=2464)           | 0.7% (N=2448)           | -0.6       | -0.3                     | <0.001  |
|                             | No Chronic Disease | 0.5% (N=852)            | 0.2% (N=843)            | -0.3       |                          |         |
| Prostate Cancer Screening   | Chronic Disease    | 36.5% (N=1142)          | 37.4% (N=1139)          | 0.9        | -8.6                     | <0.001  |
|                             | No Chronic Disease | 23.6% (N=402)           | 33.1% (N=398)           | 9.5        |                          |         |
| Pap Smears                  | Chronic Disease    | 18.1% (N=2760)          | 18.3% (N=2741)          | 0.2        | -2.4                     | <0.001  |
|                             | No Chronic Disease | 22.7% (N=2815)          | 25.3% (N=2763)          | 2.6        |                          |         |
| Mammograms                  | Chronic Disease    | 18.5% (N=2125)          | 20.3% (N=2106)          | 1.8        | 0.7                      | <0.001  |
|                             | No Chronic Disease | 15.6% (N=1432)          | 16.7% (N=1510)          | 1.1        |                          |         |
| Bone Scans                  | Chronic Disease    | 9.3% (N=742)            | 7.8% (N=734)            | -1.5       | -3.4                     | <0.001  |
|                             | No Chronic Disease | 7.0% (N=157)            | 8.9% (N=156)            | 1.9        |                          |         |

Table 4. Stratification associated with increased screening uptake

| Family Members | Gender and Vitality Status | Chronic Disease Status  | Screening Rate 2008 (N) | Screening Rate 2011 (N) | Difference | Difference-in-Difference | p-value |
|----------------|----------------------------|-------------------------|-------------------------|-------------------------|------------|--------------------------|---------|
| HIV Screening  | Males on Vitality          | With Chronic Disease    | 6.3% (N=1513)           | 13.3% (N=1528)          | 7.1        | 1.1                      | <0.001  |
|                |                            | Without Chronic Disease | 8.1% (N=1641)           | 14.1% (N=1689)          | 6          |                          |         |
|                | Males not on Vitality      | With Chronic Disease    | 2.0% (N=986)            | 2.1% (N=952)            | 0.1        | -1.0                     | <0.001  |
|                |                            | Without Chronic Disease | 2.4% (N=736)            | 3.5% (N=661)            | 1.1        |                          |         |
|                | Females on Vitality        | With Chronic Disease    | 5.9% (N=1505)           | 9.9% (N=1511)           | 4.0        | -2.6                     | <0.001  |
|                |                            | Without Chronic Disease | 8.1% (N=1836)           | 14.7% (N=1846)          | 6.6        |                          |         |
|                | Females not on Vitality    | With Chronic Disease    | 1.2% (N=1207)           | 1.9% (N=1182)           | 0.7        | 0.3                      | <0.001  |
|                |                            | Without Chronic Disease | 4.2% (N=840)            | 4.6% (N=780)            | 0.4        |                          |         |
| Mammograms     | Females on Vitality        | With Chronic Disease    | 23.3% (N=1083)          | 23.4% (N=1078)          | 0.1        | 0.4                      | <0.001  |
|                |                            | Without Chronic Disease | 19.3% (N=928)           | 19.0% (N=925)           | -0.3       |                          |         |
|                | Females not on Vitality    | With Chronic Disease    | 13.6% (N=1042)          | 17.1% (N=1028)          | 3.5        | -2.6                     | <0.001  |
|                |                            | Without Chronic Disease | 8.9% (N=504)            | 15.0% (N=479)           | 6.1        |                          |         |

Appendix 1  
List of Chronic Diseases included in the analyses

|                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------|
| I10 - Essential (primary) hypertension                                                                                  |
| E785 - Hyperlipidaemia, unspecified                                                                                     |
| J459 - Asthma, unspecified                                                                                              |
| E119 - Non-insulin-dependent diabetes mellitus without complications                                                    |
| E039 - Hypothyroidism, unspecified                                                                                      |
| I259 - Chronic ischaemic heart disease, unspecified                                                                     |
| E109 - Insulin-dependent diabetes mellitus without complications                                                        |
| G409 - Epilepsy, unspecified                                                                                            |
| I499 - Cardiac arrhythmia, unspecified                                                                                  |
| I500 - Congestive heart failure                                                                                         |
| F319 - Bipolar affective disorder, unspecified                                                                          |
| H409 - Glaucoma, unspecified                                                                                            |
| M0699 - Rheumatoid arthritis, unspecified, site unspecified                                                             |
| J449 - Chronic obstructive pulmonary disease, unspecified                                                               |
| I48 - Atrial fibrillation and flutter                                                                                   |
| I209 - Angina pectoris, unspecified                                                                                     |
| I429 - Cardiomyopathy, unspecified                                                                                      |
| G20 - Parkinson's disease                                                                                               |
| N189 - Chronic renal failure, unspecified                                                                               |
| K510 - Ulcerative (chronic) enterocolitis                                                                               |
| G402 - Localization-related (focal)(partial) symptomatic epilepsy and epileptic syndromes with complex partial seizures |
| F209 - Schizophrenia, unspecified                                                                                       |
| K509 - Crohn's disease, unspecified                                                                                     |
| M329 - Systemic Lupus Erythematosus, unspecified                                                                        |
| G35 - Multiple sclerosis                                                                                                |
| I472 - Ventricular tachycardia                                                                                          |
| J439 - Emphysema, unspecified                                                                                           |
| E271 - Primary adrenocortical insufficiency                                                                             |
| J47 - Bronchiectasis                                                                                                    |
| N039 - Chronic nephritic syndrome, unspecified                                                                          |
| E232 - Diabetes insipidus                                                                                               |
| D66 - Hereditary factor VIII deficiency                                                                                 |
| N049 - Nephrotic syndrome, unspecified                                                                                  |
| F208 - Other schizophrenia                                                                                              |
| E780 - Pure hypercholesterolaemia                                                                                       |
| I151 - Hypertension secondary to other renal disorders                                                                  |



## Appendix VI

Framing Preventive Care Messaging and Cervical Cancer Screening in a Health-insured Population in South Africa – Implications for Population-based Communication?

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## Abstract

**Objective:** To determine the impact of health message framing on cervical cancer screening uptake in a health-insured population.

**Methods:** A prospective randomized control study, consisting of 561 females, was conducted August 2013–February 2014. Females aged 21–65 who had not had a Pap smear in the previous three years were randomly selected to receive either a loss-framed, gain-framed, or neutral health message (control) regarding cervical cancer screening. Pap smear uptake was determined from medical claims data.

**Results:** Median age was 42.8 years (IQR: 26.8–58.8). The overall Pap smear screening rate was 7.9% (CI: 7.63–8.17). Screening rate in the control group was 9.56% (CI: 9.27–9.85), 5.71% (CI: 5.48–6 .98) in the gain-framed group, and 8.53% (CI: 8.24–8.81) in the loss-framed group. Statistically there was no difference between the screening rates of the groups ( $p = 0.8$ ). Females had 43% less odds ( $OR = 0.57$ ) to have a Pap smear if exposed to a gain-framed message, compared to a neutral message, although this finding was non-significant ( $p = 0.1$ ). When receiving a loss-framed message, females were only 22% ( $OR = 0.88$ ) less likely to have a Pap smear compared to a neutral-framed message, also not significant ( $p = 0.7$ ). In addition, further age stratification revealed no differences in Pap smear uptake between different age groups.

**Conclusion:** Pap smear uptake in this health-insured population is low, with no difference in exposure to differently framed health messages. Framing of health messages may not be a significant consideration when constructing population-based communication.

Word count: 247

*Keywords:* framing health messages, cervical cancer, screening



## Introduction

Globally, cervical cancer is the second-most common cancer among women (Everett et al., 2011). According to estimates there are approximately 530,000 new cases and 275,000 global deaths annually (Pimenta et al., 2013; Parkin & Bray, 2011). Some 83% of the cases occur in developing countries, where cervical cancer accounts for 15% of female cancers, with a risk before age 65 of 1.5%, while in developed countries it accounts for 3.6% of new cancers, with a cumulative risk (ages 0–64) of 0.8% (Parkin & Bray, 2011). Cervical cancer incidence and mortality has been reduced substantially in countries that have well-developed cervical screening programs (Pimenta et al., 2013). Recently, the United States consensus guidelines and guidelines from the Canadian Task Force on Preventive Health Care were updated, recommending that cytology exams be repeated every three years starting at age 21 or 25 respectively and should end at age 65 years (Tota et al., 2014; Vesco et al., 2011). Even with several advances in the structuring and delivery of cervical cancer screening programs, not every eligible female is screened according to recommendation (DuBard et al., 2008; Hughes et al., 2008; Screening and Immunization team, 2013; Centers for Diseases Control Use of Pap smears, 2013).

As a mechanism to increase participation in screening programs, sending screening invitations, reminders, and various forms of communication to eligible females has been shown to be effective (Eaker et al., 2004; Camilloni et al., 2013; Byrnes et al., 2007; Zapka & Lemon, 2004)

However, it is unclear what sort of messaging would have the greatest impact on cervical cancer screening uptake.

As far as responding to messages is concerned, people are thought to respond to health messaging differently depending on how the message is framed. This is

known as the framing effect—when two logically equivalent (but not transparently equivalent) statements of a problem lead decision makers to choose different options (Rothman et al., 1997; Druckman, 2001). The framed message focuses on a subset of considerations that in turn get the person receiving the message to focus specifically on these (and subsequently act upon it) (Druckman, 2001).

Messages can either be constructed as gain-framed, focusing on the benefits of engaging in the behavior or loss-framed, which emphasizes the costs or consequences of not engaging in the behavior (Gallagher et al., 2011). One particular theory that has been used to explain the framing effect is called Prospect Theory (Rothman et al., 1997). This theory states that people tend to avoid risks when faced with the potential benefits of a decision but are willing to take risks when faced with the potential costs of a decision. Based on this, researchers have surmised (and tested) that gain-framed messaging is more persuasive when advocating prevention behavior (like sunscreen or condom use) that is risk averse, while loss-framed messaging is more effective for detection behavior (like screening for diseases) that is thought to be higher risk due to the probability of detecting disease (Rivers et al., 2005; Bartels et al., 2010; Gallagher et al., 2011). Evidence for the framing effect on health consumer behavior is inconsistent at best (Akl et al., 2011). Overall, the evidence suggests that, when risk is low (either in preventive or detection behavior), people respond more favorably to gain-framed messages and when risk is high (preventive or detection), people respond better to loss-framed messages (Latimer et al., 2007; v't Riet et al., 2011). According to v't Riet, loss-framed messages may be more persuasive to those who don't need much persuasion—a "preaching to the choir" effect. Most studies, however, have focused on intention to partake in a behavior, attitude to a behavior, and self-reported behavior (Rivers et al., 2005; Akl et al., 2011; Gainsforth et al., 2011). Few studies

have assessed actual behavior change as a measure of persuasiveness. It is well known that there is often a disconnect between people's attitude, intentions, and their actual behavior. There is thus an important gap in the health message framing literature to evaluate the actual behavior change as a response to gain-framed and loss-framed messages. This study aims to evaluate what type of framed messaging has the best impact on Pap smear uptake (a detection behavior) when emailed to a stratified sample of health-insured females in South Africa, who have not had a Pap smear in the previous three years.

## Methods

Study type was a prospective longitudinal randomized control study. The setting was a health insurance organization in South Africa called Discovery Health. The company currently has an approximately 40% market share in a health economy where roughly 15% of the total South African population is covered by health insurance. Discovery Health owns a subsidiary wellness organization called Discovery Vitality that encourages members to join for a monthly fee of \$20. Through the wellness organization, members receive incentives for participating in various health-enhancing and promoting activities, including screening, attending gym and fitness activities or purchasing healthy foods. Screening activities are paid for through the health care fund for all members regardless of belonging to the wellness organization or plan type.

The sample was stratified by province to only include Gauteng Province (where the largest proportion of health-insured members reside), age (females 21–65 years), plan type (Comprehensive plan type only) and Wellness plan status (belonging to Vitality). A structured email was sent to eligible females in August 2013 and then again three months later in November 2013. Females randomly received a loss, gain,



or neutral-framed email. This stratification is based on earlier work by the authors that showed marked variation between use of services across provinces and predictors of screening associated with provincial location, plan type, and wellness plan membership (Adonis et al., 2013; Adonis et al., 2014). Sample stratification is illustrated in Figure 1.

All eligible females had to have had no Pap smear in the preceding three years (i.e., 2012, 2011, and 2010). The neutral framed message served as the control group, consisting of 187 females, with the intervention groups of gain- and loss-framed messages consisting each of 187 females, constituting a total sample size of 561. The sample size was calculated according to a Pap smear screening prevalence of 17% amongst the unexposed (Adonis et al., 2013) and an expected uptake of 25% amongst the exposed. Sample size was calculated using Open Epi Version 2 (Open Epi Results from OpenEpi, Version 2, open source calculator—SSCohort). Examples of the framed messages, loss, gain, and neutral, are shown in Table 1.

#### Measurement and Analyses

Pap smear uptake in each message-framing category was calculated as the proportion of eligible females receiving the message that had a Pap smear in the six-month study period with corresponding 95% confidence intervals (CIs). Data were collected from the health insurance database using Current Procedural Terminology (CPT) codes. Description of age was done using median and interquartile ranges (IQR) for non-normally distributed data. Analysis of differences for Pap smear uptake between message categories was done using the Kruskal Wallis test for skewed categorical variables. Further stratifications by age categories were done to determine if any differences between Pap smear uptake might occur for the different framed

messages at different age categories, namely 21–30 years, 31–40 years, and 41–65 years. Logistic regression was performed to determine if any differences in Pap smear uptake occurred for gain-framed or loss-framed messages when compared to neutral messages.

Calculations were done using the STATA program (Stata Corporation 12.0), and statistical significance was set at  $p < 0.5$  ( $p$  values are two-tailed).

Ethical clearance was received from the Witwatersrand Human Ethics Committee, certificate number M120854.

## Results

From the initial sample of 561 females aged 21–65 years a total of 32 were lost to follow-up (5.7%). This resulted in a final total of 529 females included in the analysis. Of the initial 187 females in the control group, 4.8% ( $N = 9$ ) were lost to follow-up resulting in a final total of 178. In the gain-framed sample, 8.33% ( $N = 12$ ) were lost to follow-up resulting in a final total of 175. The loss-framed sample had a 9.10% ( $N = 11$ ) loss to follow-up resulting in the final total of 176. The losses to follow-up figures were as a result of members defaulting on their medical insurance. These figures are shown in the sample flow diagram in Figure 1. The median age for the study sample of 529 females was 42.8 years (IQR: 26.8–58.8). The Pap smear screening rate for the total sample was 7.9% (CI: 7.63–8.17). The median age of the females in the control, gain-framed, and loss-framed samples were 42.9 (IQR: 25.9–59.9), 43.3 (IQR 28.3–58.3), and 42.3 (25.3–59.3) respectively. The screening rate in the control group was 9.56% (CI: 9.27–9.85), 5.71% (CI: 5.48–6.98) in the gain-framed group and 8.53% (CI: 8.24–8.81) in the loss-framed group. Screening rates for each group are depicted in Figure 2. Statistically there was no difference between the screening rates of the groups ( $p = 0.81$ ) with Ranksum values of 47928.50 in the

control group, 45345.50 in the gain-framed group, and 46911.50 in the loss-framed group.

When the sample was further stratified by age to evaluate whether there were any differences in screening rates across the different age groups, no significant differences were found for age groups 21 to 30 ( $p = 0.4$ ), age groups 30 to 40 ( $p = 0.6$ ) and aged 40 to 65 ( $p = 0.9$ ). These data are outlined in Table 2.

According to the logistic regression analyses, females were about 43% ( $OR = 0.57$ ) less likely to have a Pap smear if exposed to a gain-framed message, compared to a neutral message, although this finding was non-significant ( $p = 0.2$ ). When receiving a loss-framed message, females were only 22% ( $OR = 0.88$ ) less likely to have a Pap smear compared to a neutral-framed message. This finding was also not significant ( $p = 0.7$ ). These findings are depicted in Table 3.

## Discussion

In this stratified sample of health-insured females equally matched for age, health plan type, wellness plan, and geographical location, uptake for Pap smear screening services was extremely low. This is of particular concern as cervical cancer is the second-most common cancer in South African women, with 1 in 41 at risk of developing the disease in their lifetime (South African Department of Health, National Guidelines for Cervical Cancer Screening).

In this health-insured population, the annual use of Pap smear services was previously shown to be 16.7%, while the adherence to recommendations over a three-year period for eligible females was around 11.7% (Adonis et al., 2013; Adonis et al., 2014). Research done in one particular health clinic within the public sector has found that approximately 29% of females without access to health insurance had had a Pap smear in a community in KwaZulu Natal, South Africa (Moodley, 2009). It is unclear



what the national Pap smear screening rate is currently within the public health sector in South Africa.

Conversely owning health insurance tends to increase access to cervical cancer screening services (Dimitrikaki et al., 2009; Garrido-Gumrero et al., 2010) and as shown by previous research, reminders and follow-up communication could have a cumulative impact on uptake and follow-up investigations (Weller et al., 2009; Januszek-Michalecka et al., 2013; Dietrich et al., 2007). Over a six-month study period, utilization of Pap smear services, even with access to health care coverage and exposure to health messaging, appeared to remain low within this population. The underlying reasons remain unclear.

With regards to the differently framed messages, no differences were found in the uptake of Pap smears subsequent to being exposed to either a neutral, loss-framed, or gain-framed health message.

These inconsistent findings are not unlike the evidence outlined in previous studies (Gallagher et al., 2011; Akl et al., 2011; O'Keefe et al., 2012). Several researchers have found no significant increase in the promotion of preventive behaviors when exposed to either gain-framed or loss-framed messages except perhaps a small advantage for gain-framed messaging promoting dental hygiene (Latimer et al., 2013). Similar to previous research, the impact on outcome for a detection behavior was no different for loss-framed or gain-framed messages when compared to neutral messages (Rothman & Salovey, 1997; Aldridge, 2006).

In this sample, age did not seem to play any factor in altering the outcome of Pap smears on exposure to different message frames. Several factors have been postulated as playing a role in modulating responses to health messages, including prior attitude, context, and perceived efficacy of the behavior (Gerend et al., 2007;

Hull et al., 2012). In addition, what has however, become more evident in recent research is the importance of the underlying individual relevance on the general persuasiveness of the framed message (Latimer et al., 2013; v't Riet et al., 2011; O'Keefe & Nan, 2012). It is believed that the way in which the message is framed should take into consideration an individual's sensitivity to the favorable or unfavorable outcome as additional factors influencing the impact of framed appeals (Latimer et al., 2013). Some of the individual factors shown to have an impact on the persuasiveness of framed messages includes: personal situation, attitude, experience with the health problem, knowledge, beliefs, ambivalence, and self-efficacy (Covey, 2014; Aldridge, 2006). The underlying personal relevance is thought to act as a moderator to the impact of the framed health messages (O'Keefe & Nan, 2012; Hull, 2012). At this stage it remains unclear why women within this seemingly homogenous population would respond equally to differently framed health messages.

Further research is required to understand the personal factors within this health-insured population that drive health-seeking behavior.

#### Limitations

This study is limited by the fact that it sent out bulk messages to a stratified sample of eligible females without further assessing the underlying thoughts, beliefs, self-efficacy, or other personal relevance factors within the sample. Further evaluation of underlying psychological or decision-making processes could have been done in order to explained poor uptake of Pap smears. Only two email messages were sent out to the women. This was due to the limited resources of the study. It was also not ascertained whether recipients actually receives, read and or understood the messaging. In addition it is unclear whether the type of message delivery system or the actual message is responsible for the outcome of poor Pap smear utilization.

However, the study remains an important evaluation for health communication at the population level, where no specific underlying personal knowledge about the target population is known. It highlights the fact that message framing may not be that important when communication is intended at the population level.

## Conclusion

In this stratified health-insured sample of female, differential framing of Pap smear health information messages had no impact on Pap smear uptake over a six-month period. No further impact was found on the different age groups for Pap smear screening rate. Two email messages may not have been adequate to have the desired impact on this population. Latimer has found that multiple exposures with several different media tend to have a more favorable outcome (Latimer et al., 2012). Hull, however, demonstrated that *a message* is better than *no message* at all (Hull, 2012). In a large Cochrane study evaluating 38 trials, Everett found that invitation letters may be the best method for encouraging cervical cancer screening and very little evidence exists to support educational interventions (Everett et al., 2011). This study found no evidence for the benefits of framing, but perhaps with a longer study period and repeated communications, greater impacts may have become noticeable. There is, however, still a gap in knowing how to customize messages to help optimize their desired effect at the population level. Perhaps future population-based health communication research should evolve to incorporate the specific research design, research setting, and nature of the dependent variables—attitude, beliefs, intentions, and behaviors—as moderating factors (Meyers, 2010). Future research should also concentrate on evaluating not only the number of messages required, but also the modes of delivery of messages on preventive health care utilization. This emphasizes



the importance of the role of context and the particular individuals targeted on developing successful health detection messages.

#### Declaration of Conflicting Interests

The authors declare that there is no conflict of interest.

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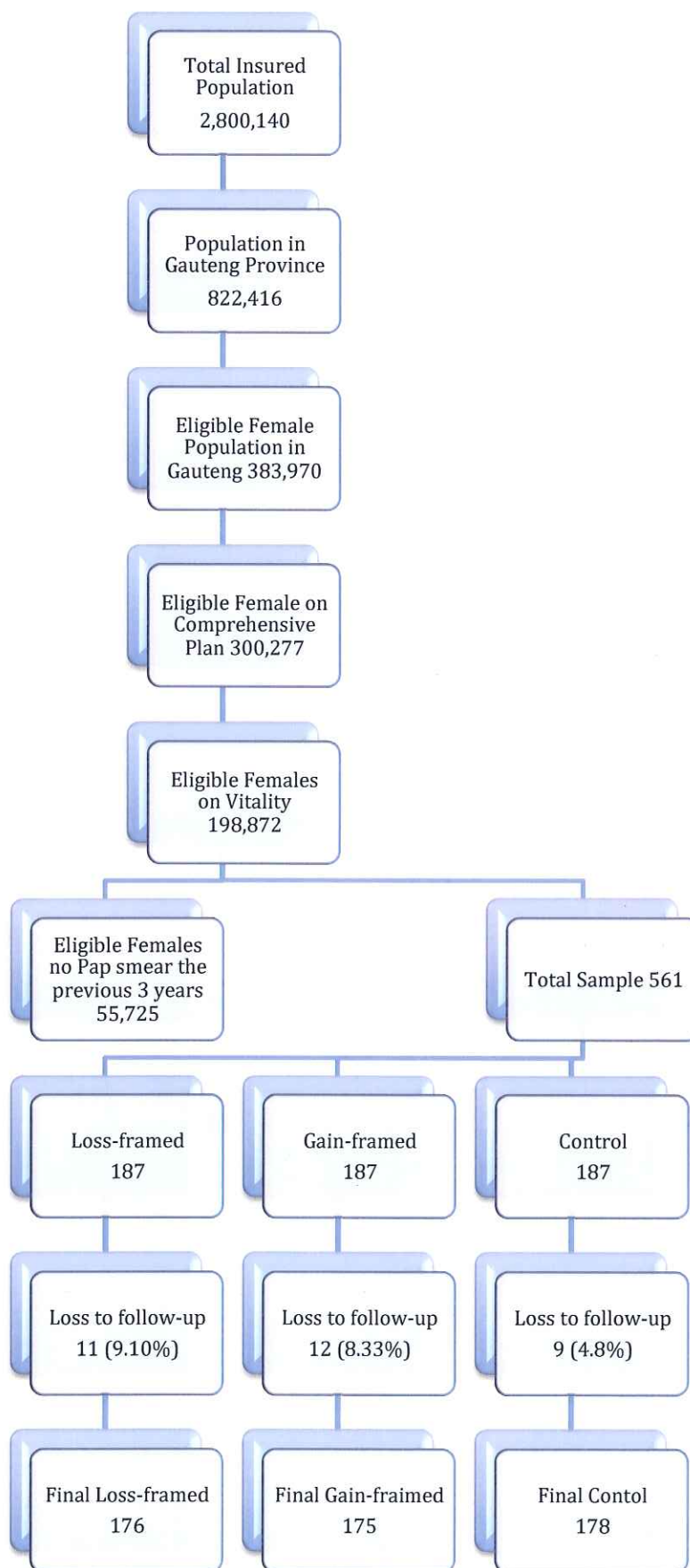


Figure 1: Sample flow diagram

Table 1: Health information messages

| Loss-framed                                                                                                                                                                                                                                                                                                                                      | Gain-framed                                                                                                                                                                                                                                                                                                                                                     | Neutral-framed                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dear <member name>                                                                                                                                                                                                                                                                                                                               | Dear <member name>                                                                                                                                                                                                                                                                                                                                              | Dear <member name>                                                                                                                                            |
| One in 35 women in South Africa has a risk of getting cervical cancer.                                                                                                                                                                                                                                                                           | Regular Pap smears are essential to your health and wellbeing.                                                                                                                                                                                                                                                                                                  | It is currently recommended that women have a Pap smear at least once every three years.                                                                      |
| It is currently recommended that women have a Pap smear at least once every three years. If you don't have regular Pap smears, you won't be able to detect early cervical cancer or changes in cervical cells that can lead to cancer. This means that you may only detect the cancer when it is too late. This can lead to bad health outcomes. | It is currently recommended that women have a Pap smear at least once every three years.<br><br>A Pap smear is the best way to detect cervical cancer or changes in cervical cells that can lead to cancer. Early detection of abnormal cells and early intervention can lead to better health outcomes and increases your chances of a better quality of life. | Schedule a Pap smear with your general practitioner or gynecologist now. The procedure only takes a few minutes and you will have your results in a few days. |
| Speak to your general practitioner or gynecologist about the benefits and risks of a Pap smear. The procedure only takes a few minutes and you will have your results in a few days.                                                                                                                                                             | Speak to your general practitioner or gynecologist about the benefits and risks of a Pap smear. The procedure only takes a few minutes and you will have the results in a few days.                                                                                                                                                                             |                                                                                                                                                               |



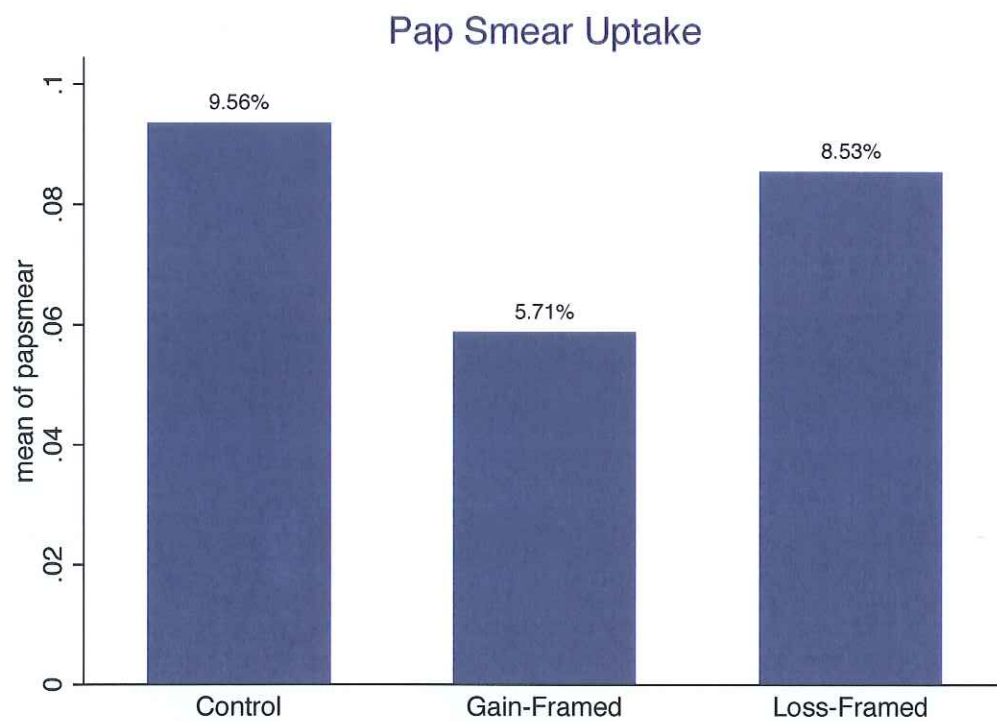


Figure 2: Proportion of Pap smear uptake for different message groups

Table 2: Descriptive and statistical association of sample and health message

|                                                              | Control<br>(Neutral)            | Gain-framed                    | Loss-frames                     |
|--------------------------------------------------------------|---------------------------------|--------------------------------|---------------------------------|
| <b>Sample Size<br/>(Number)</b>                              | 178                             | 175                            | 176                             |
| <b>Age, Median<br/>(IQR)</b>                                 | 42.9 (25.9-<br>59.9)            | 43.3 (28.3-<br>58.3)           | 42.3 (25.3-59.3)                |
| <b>Screening Rate<br/>(CI)</b>                               | 9.56% (9.27–<br>9.85)<br>N = 16 | 5.71% (5.48–<br>6.98)<br>N = 9 | 8.53% (8.24–<br>8.81)<br>N = 15 |
|                                                              | Ranksum (P-value = 0.8123)      |                                |                                 |
| <b>Difference in<br/>Screening Rate<br/>(Kruskal-Wallis)</b> | 47928.50                        | 45345.50                       | 46911.50                        |
| <b>Age Group<br/>21–30 years</b>                             | N = 21                          | N = 18                         | N = 28                          |
| <b>Chi-squared (P-<br/>value)</b>                            | 1.645 (p=0.4)                   |                                |                                 |
| <b>Age Group<br/>31–40 years</b>                             | N = 60                          | N = 59                         | N = 53                          |
| <b>Chi-squared (P-<br/>value)</b>                            | 0.978 (p=0.6)                   |                                |                                 |
| <b>Age Group<br/>41–65 years</b>                             | N = 105                         | N = 107                        | N = 105                         |
| <b>Chi-squared (P-<br/>value)</b>                            | 0.12 (p=0.9)                    |                                |                                 |

Table 3: Logistic regression of Pap smears for different health messages compared to neutral message

| Pap smear<br>Comparator:<br>Neutral message | Odds Ratio | 95% Confidence<br>Interval | P-value | Probability<br>> Chi2 |
|---------------------------------------------|------------|----------------------------|---------|-----------------------|
| <b>Gain-framed<br/>message</b>              | 0.57       | 0.26–1.29                  | 0.18    | 0.37                  |
| <b>Loss-framed<br/>message</b>              | 0.88       | 0.43–1.82                  | 0.74    |                       |