Economic considerations of Complementary and Alternative Medicine (CAM) use in Australia

Thesis submitted for the degree of Doctor of Philosophy

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Abstract

The term '*Complementary and Alternative Medicine*' (CAM) is used to describe "a broad set of health care practices that are not part of the dominant health care system". Much of the CAM literature to date has been published in clinical, public health or psychology journals, owing to the multidisciplinary nature of various aspects of use. However, given high levels of expenditure and prevalence of use in many countries, including Australia, there is now a small but expanding health economics literature. This thesis contains seven self-contained chapters which have all been published or submitted to peer-reviewed journals and which contribute significantly to this area. The overarching objective of this thesis is to better understand the policy implications of CAM use in Australia from a health economics perspective.

This thesis also forms the health economics component of a large, interdisciplinary, National Health and Medical Research Council (NHMRC) funded project titled '**C**omplementary and **A**lternative **M**edicine, **E**conomics, **L**ifestyle and **O**ther **T**herapeutic approaches for chronic conditions' (CAMelot). The project focuses on the strong link between CAM use and chronic illness, especially two of the most prevalent and resource consuming chronic conditions in Australia - type 2 diabetes and cardiovascular disease.

One of the important contributions of this thesis is to characterise the use of CAM in the general population and compare and contrast this to the sub-group of people living with chronic illness. Throughout the chapters, differences emerged between different types of CAM use, for example, different explanatory factors were associated with CAM practitioner use compared with product use. Chronic illnesses, particularly mental health conditions, are found to be predictive of both CAM practitioner and product use. In contrast, healthy behaviours such as being a healthy weight, exercising and not smoking were more likely to be associated with CAM users compared with non-users, perhaps suggesting two different 'types' of CAM user – a more healthy, motivated CAM user and one who is likely to have one or more chronic illnesses.

In terms of the consequences of CAM use by people with chronic illness, a consistent negative correlation was found between CAM use and QoL. It is plausible that this association may work in either direction. Low QoL may be seen as a driver of CAM use, perhaps suggesting that CAM is utilised to mitigate against side effects of conventional treatment or as a 'last resort'. Alternatively, inappropriate or ineffective CAM use may lead to a decrease in QoL. If the latter is

true, it supports the notion of additional consumer support by way of regulation or the provision of (trustworthy) information upon which to base an informed decision.

The final two chapters of the thesis explore the potential effect of proposed changes to the labelling of CMs in Australia. Chapter Six uses new generation eye-tracking to better understand how consumers process information during in a complex decision-making environment. In particular we find evidence of decision rules, or simplifying heuristics which may be used as a coping mechanism and have implications for the design of preferences studies in healthcare more generally. In Chapter Seven, results of a discrete choice experiment are presented which suggest that additional labelling has the potential to change consumer behaviour and therefore may be a useful policy intervention. In particular, positively worded statement regarding the regulation status of products are preferred to negatively worded ones and the addition of a traffic-light system to summarise evidence of effectiveness, side-effects and interactions was generally utility enhancing for consumers.

Overall, this thesis contributes significantly in an under researched area, given such high prevalence and expenditure, presenting novel and exciting research, in an area which offers many opportunities for future health economics insights. Future research may include an expansion of health technology assessment of individual CAM modalities and treatments; the likely effect of public subsidy of selected CAM modalities on the use of existing subsidised conventional services; and consumer preferences for CAM therapies for different health complaints.

General Declaration

Monash University

Declaration for thesis based or partially based on conjointly published or unpublished work

General Declaration

In accordance with Monash University Doctorate Regulation 17.2 Doctor of Philosophy and Research Master's regulations the following declarations are made:

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes four original papers published in peer reviewed journals and three unpublished publications. The core theme of the thesis is economic considerations of complementary and alternative medicine (CAM) use. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the candidate, working within the Centre for Health Economics under the supervision of A/Prof Duncan Mortimer.

The inclusion of co-authors reflects the fact that the work came from active collaboration between researchers and acknowledges input into team-based research.

In the case of Chapters One to Seven my contribution to the work involved the following:

Thesis chapter	Publication title	Publication status*	Nature and extent of candidate's contribution
One	Are the economics of complementary and alternative medicine different to conventional medicine?	Published	80% - refer to specific declaration Chapter One
Two	Policy implications of complementary and alternative medicine (CAM) use in Australia: Data from the National Health Survey	Published	80% - refer to specific declaration Chapter Two
Three	Primary care and complementary medicine use by those with mental health conditions: an opportunity for engagement?	Submitted	70% - refer to specific declaration Chapter Three
Four	Costs and drivers of complementary and alternative medicine (CAM) use in people with Type 2 diabetes or cardiovascular disease	Published	70% - refer to specific declaration Chapter Four

Five	Effects of Complementary and Alternative Medicine (CAM) use on Quality of Life in people with type 2 diabetes and/or cardiovascular disease	Published	70% - refer to specific declaration Chapter Five
Six	Can we make your decision easier? Investigating the use of evidence labelling on complementary medicines using discrete choice analysis and eye-tracking technology	Submitted	70% - refer to specific declaration Chapter Six
Seven	The effect of traffic lights and regulatory statements on the choice between complementary and conventional medicines: Results from a discrete choice experiment	Submitted	70% - refer to specific declaration Chapter Seven

I have renumbered sections of submitted or published papers in order to generate a consistent presentation within the thesis.

Signed: 

Date: 22/01/2014

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Much of the data used in this thesis was collected as part of the CAMelot project and I would like thank all the participants who gave their time and shared their experience in answering the surveys. Thanks also to the technical team at the Australian Bureau of Statistics who assisted in gaining special access to the data laboratory for the analysis in Chapter Three.

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To my friends who have been so forgiving of my preoccupation, I want to say 'I'm back'. I hope you remember me.

Most of all, to my boys. To my partner, Harald Hofmann, it has been an amazing journey – even more so because we got to walk the road together. I honestly can't imagine having done it without you, but I know it would have been a whole lot less fun. To my little man, Lukie, your arrival towards the end of this thesis gave me the best reason to finish as quickly as possible.

Post script – to Emma – you won't be forgotten.

Abbreviations & Glossary

AQoL-4D - Assessment of Quality of Life – 4 dimension

BMI – body mass index

CAM – Complementary and Alternative Medicine

CAMelot - **C**omplementary and **A**lternative **M**edicine, **E**conomics, **L**ifestyle and **O**ther **T**herapeutic approaches for chronic conditions

CIDI - Composite International Diagnostics Interview

CM – complementary medicines

CVD – cardiovascular disease

DCE – discrete choice experiment

fixation – the pause of the eye movement on a specific area of the visual field

gaze plot - a screen shot showing all the fixations a person made on a specific image or webpage

GP – general practitioner

IV – instrumental variable

K10- Kessler Psychological Distress Scale (10 point)

ME – marginal effect

MVP – multivariate probit

NDSS – National Diabetes Services Scheme

NHMRC – National Health and Medical Research Council

NHPA – National Health Priority Area

NHS – National Health Survey (of Australia)

PHI – private health insurance

PHIAC - Private Health Insurance Administration Council

QALY – quality adjusted life-year

QoL – quality of life

RUT – random utility theory

saccade - the rapid movements between fixations

SAH – self-assessed health

T2DM – type 2 diabetes mellitus

WHO – World Health Organization

Introduction

i. Background and motivation

The term '*Complementary and Alternative Medicine*' (CAM) is used to describe "a broad set of health care practices that are not part of the dominant health care system, or part of a particular countries' own tradition" (World Health Organization 2002)[1]. Estimates of the prevalence of use of CAM vary from country to country reflecting both different uptake rates as well as differences in the definitions used. For example, recent estimates suggest that 40% of people in the United States (US) have used a CAM product or practitioner in the previous 12 months (Barnes, Bloom et al. 2008); 26% of people in England (Hunt, Coelho et al. 2010) and 65% of South Koreans (Ock, Choi et al. 2009). Corresponding estimates in Australia are also large, ranging from 52-69% of the general population, with 44% of people reporting a visit to a CAM practitioner in the previous 12 months (MacLennan, Wilson et al. 1996, MacLennan, Wilson et al. 2002, MacLennan, Myers et al. 2006, Xue, Zhang et al. 2007). For all countries, lifetime estimates of use (incidence of use) tend to be much higher than recent use (for example, within the previous 12 months).

CAM is also 'big business'. The World Health Organization (WHO) estimates that global spending on complementary or traditional medicines was in excess of US$83 billion in 2008 and growing exponentially (World Health Organization 2011). In Australia, out of pocket expenditure on CAM (complementary medicines and practitioners) is estimated to be AUD$4.13 billion per year (in 2005 dollars)(Xue, Zhang et al. 2007). In the United States (US) the most recent estimate is US$34.4 billion nationally on all CAM modalities (2007 dollars)(Nahin, Barnes et al. 2009) and in England expenditure on six of the most established CAM therapies has been estimated at over £450 million (1998 British Pounds)(Thomas, Nicholl et al. 2001). Vitamin and

[1] The WHO uses the definition '*traditional medicine*' (TM) to encompass medicine (from plants, animals, or minerals) and non-medicine therapies (such as massage, acupuncture and spiritual practices) which are not part of allopathic or Western medicine (World Health Organization, 2002). This may include systems such as Chinese medicine, Indian Ayurvese, Arabic Unani medicine or indigenous medicine /practices from many countries. The distinction is then made between how this is viewed by the relevant national health system – if it is outside the dominant system, then it may be termed 'complementary or alternative' – otherwise it may be part of 'usual care'. This means that there is no agreement on what constitutes TM or CAM, contributing to differences in prevalence and/or cost estimates. The term 'conventional medicine' is used throughout this thesis to describe the dominant health care system, often referred to as 'Western Medicine' or 'allopathic medicine'.

food supplement companies in Australia and elsewhere are reporting increased profits and advertising budgets (Rourke 2013), arguably moving away from the ideological roots of 'the healing powers of nature' (Baer 2006) towards a business model which has similarities with that of pharmaceutical companies.

Much of the CAM literature to date has been published in clinical, public health or psychology journals, owing to the multidisciplinary nature of various aspects of use. However, given these levels of expenditure and high prevalence of use, there is now a small but expanding health economics literature focused on CAM, which is a motivating factor for the focus of this thesis.

In terms of the main drivers of CAM use, studies have shown a strong association between the existence of chronic illness and higher use (Astin 1998, Eisenberg, Davis et al. 1998, Saydah and Eberhardt 2006, Hunt, Coelho et al. 2010, Metcalfe, Williams et al. 2010). Particular chronic conditions also appear to make CAM use more likely, including arthritis (Kaboli, Doebbeling et al. 2001, Quandt, Chen et al. 2005), mental health conditions (Alderman and Kiepfer 2003, Grzywacz, Suerken et al. 2006, Sevilla-Dedieu, Kovess-Masfety et al. 2010, Crabb and Hunsley 2011), cancer (Ernst and Cassileth 1998, Adams, Sibbritt et al. 2005, Verhoef, Balneaves et al. 2005), cardiovascular disease (Bell, Suerken et al. 2006, Yeh, Davis et al. 2006), diabetes (Arcury, Quandt et al. 2003, Bell, Suerken et al. 2005, Arcury, Bell et al. 2006, Bell, Suerken et al. 2006, Garrow and Egede 2006) and being HIV positive (Littlewood and Vanable 2008, Peltzer, Preez et al. 2008, Liu, Yang et al. 2009). It is also well documented that socio-demographic factors such as age (Grzywacz, Lang et al. 2005, Grzywacz, Quandt et al. 2008, Bishop and Lewith 2010), gender (Astin 1998, Eisenberg, Davis et al. 1998, Bishop and Lewith 2010), cultural background (Arcury, Suerken et al. 2005, Keith, Kronenfeld et al. 2005), and private health insurance status (Paramore 1997, Xue, Zhang et al. 2007, Barnes, Bloom et al. 2008) impact on CAM use, however, these factors do not fully explain the reasons for use.

Questions then arise about why CAM is utilised to such a degree. The literature investigating motivations for CAM use indicates a variety of factors are likely to be important. Some research suggests that CAM use is motivated out of a preventative paradigm; to promote 'general health and wellbeing' (Furnham and Bhagrath 1993, Vincent and Furnham 1996, Esmail 2007). Others have found that CAM use may substitute for conventional care, where the latter is poorly accessible due to cost or other access issues (Pagan and Pauly 2005, Avogo, Frimpong et al. 2008). The Anderson socio-behavioural model (Andersen and Newman 1973, Andersen 1995) has been used to as a framework for explaining why people may use CAM (Kelner and Wellman

1997). Belief systems, including a belief in more 'natural' therapies (Lewith and Chan 2002, MacLennan, Wilson et al. 2002, O'Callaghan and Jordan 2003) or in 'holistic' care appear to be important (Furnham and Forey 1994, Astin 1998, Bishop, Yardley et al. 2007), as may an individual's 'world view' (Furnham and Beard 1995). Other individual characteristics such as personality (Owens, Taylor et al. 1999, Sirois and Gick 2002, Honda and Jacobson 2005), the level of 'health literacy' (Nutbeam 2008) or 'cognitive processing ability' (Capon and Davis 1984) may also be important. When making CAM purchase decisions, a vast and often conflicting array of information may be available, the navigation of which may also involve differences in risk preferences (Sturm 2000, Furnham and Lovett 2001), as well as the understanding and rating of scientific sources of evidence by either weighing the costs and benefits of all available alternatives, or by using heuristics (Hibbard and Peters 2003).

The popularity of CAM can also be seen to present both opportunities and challenges for health policy makers. On one hand, CAM is obviously viewed by many as a legitimate option in their suite of health care choices (Astin 1998). Certain CAM interventions have been shown to be cost-effective compared with conventional medicine interventions and therefore worthy of consideration for public subsidy (White and Ernst 2000, Coon and Ernst 2005, Canter, Coon et al. 2006, Solomon, Ford et al. 2011). On the other hand, there are ongoing potential safety concerns over CAM use (Bensoussan, Myers et al. 2000, Ernst 2001). Whilst in the main CAM use appears to be relatively safe compared with conventional medicine (Ashcroft and Po 1999, House of Lords 2000), some believe that CAM use poses a potential threat to public health (Ernst 2001, White and Ernst 2002, Pittler, Schmidt et al. 2005) and is therefore currently "under-regulated" (Avorn 2000, Briggs 2008, Bollen and Whicker 2009, Harvey 2009, Hunt and Ernst 2010, Smith 2012). Even if increased regulation is the chosen path, some countries are struggling to find the right balance between access and protecting public safety (Ramsay 2010). Harm may be caused as the direct result of using a product or practitioner (Ernst 2001), or as a result of foregoing a proven conventional medicine intervention, such as vaccination (Ernst 1997). There is also the potential for "economic harm"; that is, the opportunity cost to a consumer of purchasing an ineffective or inappropriate good or service (Wardle 2008, Bollen and Whicker 2009).

Amid a growing interest in the intersection between CAM and conventional care, there is evidence to suggest that CAM is more commonly used as a complement to conventional medical care rather than a complete substitute (Paramore 1997, Eisenberg, Davis et al. 1998, Druss and Rosenheck 1999, Connor 2004). However, some groups may view CAM practitioners as their

preferential form of care, for example, Chinese Medicine Practitioners (Bensoussan and Myers 1996) or Naturopaths (Grace, Vemulpad et al. 2006), or as a substitute for particular health issues (Xu and Farrell 2007). Also, there may be an increased likelihood for certain individuals to be more frequent users of both CAM and conventional medicine (Druss and Rosenheck 1999). Given the current emphasis of health policy makers to promote a preventive paradigm in an attempt to control the current chronic disease epidemic, the emphasis of some CAM practitioners, such as naturopaths, to promote consumer education, responsibility and preventive health practices may suit the political ideology of some governments (Baer 2006).

'Chronic-disease self-management' has become a popular description for a range of behavioural interventions designed to promote healthy living as a strategy to decrease the burden of chronic illness (Lorig and Holman 2003). With the underlying principle of the individual taking control of factors relating to their health, CAM use has been described as a type of self-management practice (Arcury, Bell et al. 2006). Indeed, as the majority of CAM products and practitioner services are self-selected by consumers without need for referral from other health practitioners, this description seems very reasonable. From a health economics perspective, the self-selection of CAM in this context is interesting and complex. CAM differs from conventional medicine in a number of important ways including the level of education and training of practitioners; the level of regulation governing the delivery by practitioners; and the extent of self-selection by consumers. Deciding the extent to which CAM is regulated, providing a balance between consumer empowerment and consumer protection, is difficult and perhaps the area of greatest concern for health policy-makers. Health policy makers require information on consumer preferences, relative health outcomes and relative costs of different regulation options to make evidence-based decisions. The lack of such policy-relevant evidence in the CAM literature provides a key motivation for this thesis.

ii. Objectives and scope of the thesis

This thesis forms the health economics component of a large, interdisciplinary, National Health and Medical Research Council (NHMRC) funded project (Number 491171) titled '**C**omplementary and **A**lternative **M**edicine, **E**conomics, **L**ifestyle and **O**ther **T**herapeutic approaches for chronic conditions' (CAMelot), which focuses on CAM use in Australia. The overall project focuses on the strong link between CAM use and chronic illness, particularly two of the most prevalent and resource consuming chronic conditions in Australia, type 2 diabetes

and cardiovascular disease. Type 2 diabetes and cardiovascular disease were chosen as together, they form a significant burden of disease in the Australian community and are responsible for a large proportion of annual government health expenditure (Australian Institute of Health and Welfare 2011). Also, the modification of certain lifestyle factors such as smoking, overweight and obesity, healthy eating and exercise are all important components of the treatment and prevention of complications of these conditions. The self-management of these factors is encouraged by health practitioners and supported by government policy (National Health Priority Action Council (NHPAC) 2006). As CAM may be viewed by consumers as a type of health self-management, the focus on chronic illness and type 2 diabetes and cardiovascular disease adds to the significance of this research. Whilst the main focus of the thesis remains on these two conditions, other chronic illnesses are still of interest. In Chapter Three the focus turns to mental health conditions and CAM use. Mental health conditions are a common co-morbidity alongside chronic illnesses such as diabetes (Petrak and Herpertz 2009) and may impact on psychosocial as well as medical outcomes.

The implications of this focus on T2DM and CVD are discussed further in Chapters 4, 5 and 7 and in my concluding comments.

iii. Research Questions

The overarching objective of this thesis is to better understand the policy implications of the high prevalence and expenditure on CAM in Australia from a health-economics perspective.

Chapter topics were identified for their policy-relevance and their potential contribution to a sparse evidence-base. In the first instance, economic issues relevant to CAM use were reviewed as a way of identifying knowledge gaps – this forms the basis of Chapter One. There is comparatively little empirical research undertaken on CAM use from a health economics perspective and the potential dissemination of published research of this nature may be of interest and use to a variety of disciplines, as well as those concerned with service delivery and policy. For this reason, underlying health economics principles are discussed in Chapter One from the perspective of the non-health economist. Non-health economists may assume that economic evaluation forms the main type of analysis in the discipline. Certainly, the economic evaluation of CAM modalities is a rich field of research and one important research path. However, some progress is already being made in this area (Coon and Ernst 2005, Doran, Chang

et al. 2010). Instead, the research focus here is broader, concentrating on issues such as utilisation patterns and consumer behaviour, as well as health outcomes. While an empirical economic perspective is adopted, the knowledge produced should be of use across a range of disciplines, as well of potential practical use to those involved in making real decisions concerning resource allocation and service delivery.

In Chapter One, a comparison is made between research into CAM and conventional medicine and a discussion follows as to whether the same set of research tools can be reasonably applied to both modalities. Whilst other contributors to the literature have argued that some research questions are more particular to CAM and therefore should not be analysed using the same research methods as for conventional medicine (Cassidy 1995, Nahin and Straus 2001, Hulme and Long 2005), little evidence is found to support this view with the conclusion that economic analysis of conventional medicine and CAM do not differ so much in core methodological approaches, but rather in the magnitude, and consequent measurement of, treatment effects.

Given the lack of previous work in the area, there are relatively few descriptive analyses of consumer preferences for CAM within the general population in Australia. For this reason, the focus of Chapter Two is to provide an overview of the main drivers of CAM use in Australia and relate these to policy considerations from a health economics point of view. Using the latest available nationally representative data from the National Health Survey (2007/08) and a richer set of covariates in regression analysis, this chapter extends what is previously known about CAM use in the general population in Australia (MacLennan, Wilson et al. 1996, MacLennan, Wilson et al. 2002, MacLennan, Myers et al. 2006, Xue, Zhang et al. 2007). It also introduces a framework for thinking about how and to what extent CAM might be regulated or financed by the government. The results from this analysis are also used to identify further key hypotheses, including that which motivates Chapter Three.

For Chapter Three, the same dataset was utilised to conduct a more detailed analysis of CAM use from a primary health care perspective for a particular group in the population – those with mental health conditions. Here, the focus is on the substitution or complementarity of use between CAM practitioners and other primary care (conventional) providers by people with mental health conditions. This is a very important topic due to the high prevalence of undiagnosed and untreated mental health conditions in the population. Here, CAM is

hypothesised to offer a potential referral pathway to mainstream care for those who currently may be undiagnosed or undertreated.

From a technical perspective, the relationship found between chronic health issues and service utilisation (here, CAM use), is known to be potentially problematic as issues of endogeneity (simultaneity and reverse causality) can bias estimates. This is taken into consideration in the econometric analysis. The focus of this chapter is health as a predictor of CAM use. Later, in Chapter Five, the focus switches to CAM use as a predictor of health status.

Chapters Four and Five then focus on another important group living with chronic conditions – those with type 2 diabetes (T2DM) and / or cardiovascular disease (CVD). CAM use by people with chronic illness arguably offers both the greatest potential gains and greatest challenges for health policy makers. If CAM is found to be suitably efficacious and safe, it may offer alternative or additional treatment benefits for people with chronic illness, which may prove cost-effective compared with conventional options. As governments around the world struggle with the increasing burden of treating chronic illnesses such as T2DM and CVD, such information would be of great interest. However, if CAM is being widely used as a complement to conventional care, this group is perhaps the most likely to be at risk of drug-drug or treatment-drug interactions.

As mentioned earlier, CAM use may be driven by a variety of different paradigms including treatment beliefs, risk preferences and self-efficacy, as well as more pragmatic concerns of price and availability. Here the challenge is to better understand the relative contributions of each of these potential drivers, as well as to assess the possible health outcomes of CAM use.

Chapter Four describes CAM use by people with type 2 diabetes and/or cardiovascular disease in Australia, with the aim of providing a general description of the costs and drivers of CAM use in this population for the general reader. Purposefully collected primary data are utilised. Multinomial and ordered logit models are used in the main analysis and a number of different dependent variables are used for different categories of CAM use.

Chapter Five then focuses on one of the key findings from the preceding chapter for further analysis – here, the negative relationship found between CAM use and Quality of Life (QoL). As it was hypothesised that CAM use would be positively associated with QoL, this finding was unexpected. As mentioned above, the relationship between health outcomes and CAM use is

problematic as reverse causality may occur here and is difficult to account for. Further, there is an issue of selection whereby unobserved factors may be correlated both with the choice to use CAM and the health outcome of interest (QoL).

Here, two strategies are used to account for this problem. Firstly, using a step-wise ordinary least squares (OLS) regression analysis, the addition of each group of covariates is tested against a set of exogenous variables. Whilst not entirely overcoming the empirical issue, this does allow the opportunity to assess the direction and magnitude of any associations. Subsequently, the treatment effects model (Greene 2003)(pp.787-789) with instrumental variables is used, where selection into CAM use (the treatment) is undertaken in the first stage before allowing the fitted results from this regression to enter the main equation. If the instrumental variables used in the analysis are valid, such a strategy should adequately correct for the selection issue. Additional details of the modelling strategy undertaken are provided in the Appendix to Chapter Five.

Chapters Six and Seven continue to investigate CAM use in the population with type 2 diabetes or cardiovascular disease, but the focus moves towards testing a more specific policy intervention. As mentioned in the Background & Motivation section, most CAM modalities, including complementary medicines (CMs) are available for self-selection by consumers. Although such a strategy is considered to be relatively low-risk (Ashcroft and Po 1999, House of Lords 2000), it is not risk-free (Ernst 2001, Harvey 2008). The difficulty for policy-makers then becomes to find the balance between supporting consumer choice (and self-management principles) and protecting consumer safety. One 'middle-ground' strategy that has been proposed in Australia is to increase the amount of reliable information consumers have at the point of purchase to be able to make better choices. As found in Chapter Five, negative QoL was found to be associated with CAM use in this population and one explanation for this finding may be that consumers are making poor purchasing choices.

Mandatory labelling is one such way of providing additional information. This had led to some debate as to the merits of mandatory labelling as well as the specific suggestions for content (Harvey, Korczak et al. 2008, Harvey, Korczak et al. 2008). One suggestion is that a disclaimer could be added to all CMs, to make it clear to consumers that the product had not been assessed by any regulatory authority for efficacy. The proposed wording of the disclaimer is: "*This medicine has not been evaluated by Australian Health Authorities for efficacy*" (Harvey 2009). The reason being that although CM's are generally subject to far less scrutiny from regulatory agencies, there is

evidence to suggest consumers are unaware of this fact (MacLennan, Myers et al. 2006, Boon and Kachan 2007, Williamson, Tudball et al. 2008). A less wordy version of this statement has also been proposed – simply the word "*Untested*" (Tippet 2011). We were also interested in how a positive endorsement might be perceived: "*This medicine has been evaluated by Australian Health Authorities for efficacy*". 'Traffic light' logos offer another alternative and have been used in food labelling (Sacks, Rayner et al. 2009, Balcombe, Fraser et al. 2010).

The implementation of mandatory labelling has implications for a number of stakeholders including consumers, regulatory authorities and CM manufacturers. Thus, well-targeted research to identify the possible effects of such a strategy would be timely. As revealed preference data cannot be used to address this question, stated preference methods including a discrete choice experiment (DCE) are utilised.

The aim of Chapter Six is to better understand how consumers make decisions with regard to complementary medicine use, and health-care decisions more generally. It has been argued that consumers may employ a passive bounded-rationality strategy, attempting to make optimal decisions in complex situations by considering all options, but are increasingly likely to make mistakes through this process (Depalma, Myers et al. 1994). Alternatively, it is thought that consumers may employ decision simplification rules or heuristics. For example, when faced with complex decisions, many will employ a 'satisficing' (Simon 1990) or 'fast and frugal' (Gigerenzer and Todd 1999) heuristic whereby the mental task of calculating the cost and consequences of all possible options is overwhelming and so employ mental short-cuts to make decisions easier. If this is the case, underlying assumptions of random utility theory, upon which consumer theory and DCE analysis are based, may be violated. To better understand how consumers may react to the implementation of mandatory labelling on CMs, a combination of new generation eye-tracking technology, semi-structured interview and DCE survey design are utilised.

In Chapter Seven, a DCE is used to test the average effect of mandatory labelling in a chronic disease population by asking consumers to choose between the use of a CM, a conventional (pharmaceutical) medicine or doing 'something else' for a number of different minor health complaints. For the DCE, a d-efficient experimental design was generated using Ngene software and a mixed-logit model with error-components was used to model the parameters. The appearance of the traffic light logo and regulatory statements on the CM label are of key interest.

i. Methodology and methods

A variety of methods are utilised in this thesis, depending on the type of question being addressed, as well as the underlying economic theory upon which certain analyses are based. Much of this thesis, particularly Chapters Two, Three, Four, Six and Seven, is concerned with the demand for health and health care. It is important to remember when analysing the determinants of demand, that consumers are not seeking heath care services *per se*, but rather they are looking to improve their health. This important notion was first discussed by Grossman (1972) and it still influences health economics thinking today. This leads the researcher to think about a range of factors that might be relevant when modelling the decision to use health care, including behavioural and lifestyle factors.

Consumer theory from mainstream economics is also relevant here, especially the notion of market failure and why this is so important in relation to health care. In this context, CAM use exhibits many of the factors known to lead to market failure. One of the most important is the idea that consumers have full information upon which to make their choices. Given that the evidence base for complementary medicine lags behind that of conventional medicine (Manheimer and Ezzo 2007), it is unsurprising that consumers are at risk of making poor purchasing decisions. One may argue that this is of even greater concern for CAM compared with conventional medicine given that consumer's usual agent in navigating the health system may be hostile to CAM. This is evident given the high amount of self-selection of both CAM practitioner and product use. While government intervention in the CAM market also occurs, in Australia this is not as extensive as for conventional medicine. This theme is of particular importance in Chapters three, six and seven. The prices for CAM practitioners are also distorted given that the government subsidises private health insurance in Australia (Colombo and Tapay 2003), which in turn covers the use of many CAM treatments through ancillary insurance policies. These factors need to be borne in mind when analysing the demand for CAM.

These theoretical considerations influenced the methods chosen for different chapters. The focus in many Chapters (especially Two, Three, Four and Five) was on describing or estimating the relationship between CAM use and other key variables of interest in populations, taking other known factors into account. Here, econometric techniques (particularly regression techniques) are most appropriate and were extensively utilised in Chapters Two, Three, Four, Five and Seven. Deciding which model was used in any particular instance was a function of the type of data being analysed (categorical, continuous); the assumptions of model; and whether this

type of analysis was supported by underlying economic theory. Data limitations also had to be considered. For example, when analysing the relationship between QoL and CAM use Chapter Five), in the absence of data from a randomised sample, where randomisation is used to account for the selection problem, more sophisticated models (such as the treatment effects model, or propensity matching) are needed to account for this issue.

The underlying theoretical basis for Chapters Six and Seven, whilst still related to the demand for health care and consumer theory, is slightly different. Arising from the disciplines of psychology (Thurstone 1927, Luce 1959) and economics (Hotelling 1929, Lancaster 1966), the underlying principle of DCEs is random utility theory (RUT), developed by McFadden (1973) and later Hanemann (1984). Whilst the assumptions of RUT *per se* are quite flexible, the relationship between the assumptions of consumer theory (whether from the choice-based or preference-based approach) and choice modelling are less well defined (Lancsar and Louviere 2006).

Thus, the use of mixed-methods to explore consumer preferences and behavioural changes to proposed labelling changes for CMs is very appropriate. This allows for the assumptions of RUT and consumer theory to be explored alongside the policy issues. In Chapter Six, qualitative methods, in the form of semi-structured interviews were used alongside eye-tracking technology to better understand the consumer process of decision making in relation to complementary medicines (CMs). Results of this analysis also acted as a pilot study for the larger DCE presented in Chapter Seven. The use of the new generation of eye-tracking technology is still in its infancy and to our knowledge this is the first instance of its use in health economics. We use it here to better understand how consumers process information in relation to the choice of CMs and triangulate the results with both the qualitative and quantitative (DCE) survey results. In particular we are interested in the use of decision rules, or simplifying heuristics which may be used by consumers when faced with risky and complex choices, which may lead to what is known in the DCE literature as "attribute non-attendance". Results of the semi-structured interviews were not included in this thesis however, these data have been analysed and will form the basis of a future publication.

Finally, Chapter Seven utilises some of the more flexible design and modelling techniques which have been developed in recent years in the quickly evolving field of DCEs. D-efficient designs were developed specifically to account for complex questions where increased efficiency (feasible sample sizes) is an important constraint. This complements the use of the mixed-multinomial logit to model the results, where one of the major advantages is that it has far fewer restrictive behavioural assumptions than its parent model, the multi-nominal logit.

ii. Data

Pragmatic considerations also guide the scope of the thesis. As with the analysis of other aspects of health and health care systems, a number of different perspectives and methodologies are available for the analysis of CAM use. As research into the economics of CAM is still in its early stages compared with conventional medicine, one the main constraints is the amount and type of available data. The analysis of existing administrative data on CAM use is an obvious way forward. Thus, in the first instance, sources of available existing administrative data were explored to assess their suitability to meet the research objectives. However, the majority of CAM use in Australia is funded by private expenditure, and as such only limited publically available administrative data exists. The key source of administrative data utilised here is the National Health Survey of Australia (Australian Bureau Statistics 2007), which includes questions on CAM use, other health service use, health risk factors, as well as socioeconomic factors. Ideally it would have been possible to pool data across a number of health surveys allowing for a time-series analysis, however, differences in the way individuals were asked about the health care utilisation patterns across survey meant that this was not possible. The National Health Survey data is used in two papers presented in this thesis.

During my candidature, I also explored the possibility of using private health insurance claims data from the Private Health Insurance Administration Council (PHIAC) as some CAM modalities are subsidised by private health insurers in Australia. Analysis of these data may allow estimation of the effect of changes in the utilisation rates of CAM in relation to the type and amount of subsidy of different CAM therapies. This is currently an area of review by the Australian Government (The Australian Government Department of Health 2013). Access to these data proved difficult and is therefore left as an area of future enquiry.

Existing *detailed* data on CAM use by people living with type 2 diabetes and cardiovascular disease was not identified. The collection of these data set forms a major component of the successful CAMelot NHMRC grant application. In 2010, a large survey was undertaken to collect data on many aspects of CAM use in this sub-population, including questions pertinent to the health economics research objectives of the grant. These questions include information on CAM use (type, frequency & expenditure); relevant socio-demographic information; health status and conventional medicine use, with the aim of better understanding the costs and drivers of CAM use. I was involved in all aspects of the collection and analysis of these data throughout my

candidature, including stakeholder consultation; the design of the survey; the compilation and cleaning of the data; and analysis and presentation of the results. This data set is used in two chapters within this thesis (Chapter Three and Chapter Four). Following on from this more general survey detailing CAM use in people with type 2 diabetes or cardiovascular disease, participants (who provided consent to be contacted again) were invited to participate in a second, more focused survey using a discrete choice experiment (DCE) methodology. The DCE presented in Chapter Seven (and separate pilot study, presented in Chapter Six) are undertaken to better understand proposed regulatory changes to the labelling of complementary medicines.

iii. Outline of the thesis

This thesis comprises of seven related chapters.

Chapter One – Are the economics of complementary and alternative medicine different to conventional medicine?

This chapter details the Framework for the economic analysis of CAM utilised in this thesis. It considers the similarities and differences of mainstream health economic methodologies and their suitability for analysing questions relating to CAM use.

Citation: **Spinks J,** Hollingsworth B (2009). *Are the economics of complementary and alternative medicine different to conventional medicine?* Expert Review Pharmacoeconomics & Outcomes Research, 9(1): 1-4.

Chapter Two – Policy implications of complementary and alternative medicine (CAM) use in Australia: Data from the National Health Survey

This chapter describes CAM use in the general population in Australia, broken down by product and practitioner use. The discussion details potential government options for intervention in relation to current CAM use.

Citation: **Spinks J**, Hollingsworth B (2011). *Policy implications of complementary and alternative medicine (CAM) use in Australia: data from the National Health Survey*. J Alterative and Complementary Medicine, 18(4): 371-378.

Chapter Three – Primary care and complementary medicine use by those with mental health conditions: an opportunity for engagement?

This chapter focuses on one of the findings of the previous chapter – a strong association between CAM use and mental health conditions – to explore the role of CAM in relation to other type of primary health care, as an opportunity to engage people with undiagnosed and untreated mental health conditions.

Citation: **Spinks J**, Srivastava P (2014). *Primary care and complementary medicine use by those with mental health conditions: an opportunity for engagement?* Social Science and Medicine, under review.

Chapter Four – Costs and drivers of complementary and alternative medicine (CAM) use in people with Type 2 diabetes or cardiovascular disease

This chapter uses purposefully collected primary data to describe the costs and drivers of CAM use by people with type 2 diabetes and / or cardiovascular disease in Australia.

Citation: **Spinks J**, Hollingsworth B, Manderson L, Lin V, Canaway R (2012). *Costs and drivers of complementary and alternative medicines (CAM) use in people with type 2 diabetes or cardiovascular disease.* European J Integrative Medicine, 5(1):44-53.

Chapter Five – Effects of Complementary and Alternative Medicine (CAM) use on Quality of Life in people with type 2 diabetes and/or cardiovascular disease

This chapter analyses the relationship between CAM use and quality of life across different dimensions of quality of life; different CAM modalities; and the intensity of CAM use.

Citation: **Spinks J**, Johnston D, Hollingsworth B (2014). *Effects of Complementary and Alternative Medicine (CAM) use on Quality of Life in people with type 2 diabetes and/or cardiovascular disease*, Complementary Therapies in Medicine, 22,107-115.

Chapter Six – Can we make your decision easier? Using eye-tracking to investigate the effect of complexity on attribute non-attendance in discrete choice experiments

This chapter uses eye-tracking data to explore the effect of providing additional information to consumers within an already complex decision-making environment. Here, the focus is on the relationship between complexity and 'attribute non-attendance' or the 'non-processing' of information which is simulated within a discrete choice experiment.

Citation: **Spinks J**, Mortimer D (2014). *Can we make your decision easier? Using eye-tracking to investigate the effect of complexity on attribute non-attendance in discrete choice experiments,* European Journal of Health Economics, under review.

Chapter Seven – The effect of traffic lights and regulatory statements on the choice between complementary and conventional medicines: Results from a discrete choice experiment

This chapter estimates the impact of the introduction of traffic light and/or regulatory statements on complementary medicine labels using a discrete choice experiment (DCE).

Citation: **Spinks J**, Mortimer D (2014). *The effect of traffic lights and regulatory statements on the choice between complementary and conventional medicines: Results from a discrete choice experiment,* Social Science and Medicine, under review.

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Specific Declaration Chapter One

Declaration by candidate

In the case of Chapter Four, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
• Contributed to the original concept for the paper • Wrote the first draft and coordinated all suggested changes • Submitted the paper (corresponding author)	80

The following co-authors contributed to the work. Co-authors who are students at Monash University must also indicate the extent of their contribution in percentage terms:

Name	Nature of contribution
Bruce Hollingsworth	Contributed to the original concept for the paper; Edited and reviewed the manuscript

Candidate's Signature		**Date** 17/03/2013

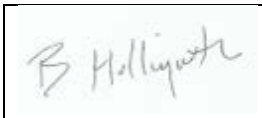
Declaration by co-authors

The undersigned hereby certify that:

(1) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(4) there are no other authors of the publication according to these criteria;
(5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s)	**Not applicable**

[Please note that the location(s) must be institutional in nature, and should be indicated here as a department, centre or institute, with specific campus identification where relevant.]

Signature 1	 Bruce Hollingsworth	**Date** 27/03/2013

Chapter One: Are the economics of Complementary and Alternative Medicine (CAM) different to conventional medicine?

This editorial puts forward the main areas of focus for current economic research into Complementary and Alternative Medicine (CAM) use. It identifies the broad categories of the types of analyses being undertaken, as well as some current knowledge gaps and opportunities for future research. A comparison is made between current research themes in economic research for both conventional medicine and CAM. It is concluded that although pharmacoeconomic research and the economics of CAM are at different stages of development, the two subject areas share many of the same issues in terms of the way forward.

Complementary and Alternative Medicine (CAM) is valued by consumers. In Australia, "out of pocket expenditure" is estimated as being as high as AUD$4.13 billion (US$3.12 billion) per year [1]. In the USA estimates have ranged between US$27.0 billion and US$34.4 billion for out of pocket expenditure [2], and in England, out of pocket expenditure on six of the most established CAM therapies has been estimated at over £450 million [3]. Given the levels of expenditure, and consequent outcome and policy implications, there is now a growing health economics literature in this area.

As with the analysis of other aspects of the health care system, a number of different perspectives and methodologies are available for health economic analysis of CAM use. As research into the economics of CAM is still in its early stages compared with conventional medicine, the analysis is currently limited by the amount and type of available data. However, as social, clinical and economic research into CAM use continues to expand [4], so too do the opportunities for larger scale data collection and analysis.

The analysis of available administrative data on CAM is an obvious place to start. The majority of CAM use in most countries is funded by private expenditure, and so limited administrative data exists for estimates of total expenditure on CAM by the community. CAM use may also be subsidised by private health insurers, whose claims data are of potential use in estimating the effect of changes in the utilisation rates of CAM in relation to the type and amount of subsidy of different CAM therapies. Some literature already exists using these data [5-7]. One of the most interesting aspects of using claims data is that they provide some evidence on the utilisation patterns of certain CAM therapies for Governments who are interested in including CAM on national health subsidy schemes [8]. Certain types of administrative data may also be used to calculate price elasticities of demand for different CAM therapies, as compared with conventional health services [9]. This is of interest to both private and public health insurers, as

well as CAM practitioners, as analysis of this nature shows how price differentials and changes between products can affect relative rates of utilisation.

One question that the analysis of administrative data may be able to illuminate is whether CAM use is more often used as a *substitute* for conventional medicine or a *complement* [10]. This has important ramifications for the economic evaluation of CAM using cost-effectiveness analyses or similar techniques, as it is important to identify if the costs associated with CAM should be treated as an addition to conventional medicine, or as a cost offset (substitute) [11]. Of particular interest is high prevalence chronic conditions, such as diabetes or cardiovascular disease, for which some evidence already exists that CAM is being used as a complement to conventional medicine, rather than a substitute by people with these conditions [12, 13].

The relative lack of administrative CAM data may be contrasted with the availability of data on pharmaceutical usage in the community. Large panels of data now exist from a number of sources including national pharmaceutical subsidy schemes, private health insurers and summaries of the number of units of product sold through wholesalers and manufacturers [14]. Corresponding socioeconomic data are often available for these panels, making it possible to analyse the relationship of these socioeconomic factors with regard to the use of pharmaceuticals [15, 16]. Such an analysis has important consequences for identifying pockets of inequity of access to essential medicines in the community, and therefore providing potential opportunities to address any inequity and improve the health outcomes of the community as a whole.

More work is required before CAM is likely to be comprehensively included in public health subsidy schemes, and for equivalent administrative data to be available through this mechanism. However, it is feasible that these data may become available for analysis through other mechanisms, such as routine data collection by professional bodies as they become more established. One important thing to note from an economic perspective is that the methodologies used in the analysis of administrative data would appear to be comparable for both pharmaceutical and CAM use, even though the questions may differ.

Other sources of administrative data already exist for CAM in a similar form to those for conventional medicine. A good example is the national health surveys of a number of countries [17-19] which have already included questions on CAM use, pharmaceutical use and other health service use, as well as socioeconomic factors. Such surveys are often undertaken regularly, using consistent methodologies, so that cross-sectional results may be compared over time. An interesting question yet to be answered comprehensively is whether there is some type of

relationship between the use of CAM and conventional medicine for the individuals surveyed. If such a relationship is found to exist, national level conventional medicine service utilisation records may be able to be used to predict the CAM use across populations, controlling for socioeconomic factors.

The economic evaluation of conventional medicine is well established [20]. The economic evaluation of pharmaceuticals, in particular, is heavily reliant on clinical evidence in the form of randomised controlled trials. Some concerns have been raised as to whether the current use of randomised trials to establish the safety, efficacy, and subsequent cost-effectiveness of CAM treatments is appropriate [21-23]. Others have a more clear position - in the UK, the Inquiry into Complementary and Alternative Medicine by a Parliamentary Select Committee provides such an example: "In our opinion any therapy that makes specific claims for being able to treat specific conditions should have evidence of being able to do this above and beyond the placebo effect" [24].

The relevance of much of this debate is highly dependent on the perspective being taken. From the point of view of the consumer, most CAM therapy is currently purchased privately as an out of pocket expense. There is evidence that this expenditure continues to grow [25] despite the lack of rigorously conducted randomised trials providing evidence of safety and efficacy upon which consumers can make an informed choice. Some may argue (leaving aside obvious ethical concerns of information imbalance) that if consumers continue to pay for their own choices, whether those choices are well informed or not, it is of little consequence to others. However, if you take a public health perspective, the lack of safety data may impact on the community in the form of increased harms [26], which are subsequently treated and paid for under subsidised health insurance schemes (either publically or privately). The arguments for not conducting economic evaluations based on sound outcomes evidence is even less convincing from the perspective of a third party insurer interested in subsidising CAM therapy, such as a government or private health insurer. Third parties are required to make decisions on how to spend resources and choose between competing ranges of alternatives, so evidence of comparative effectiveness is a vital part of accountability of decision making. It may be argued that the importance of perspective is very similar to that with regard to evaluation of conventional medicine therapies.

When it comes to the practicalities of undertaking economic analyses of CAM therapies, a number of arguments can be found in the literature as to why the evaluation of this modality may differ to that of conventional medicine [11, 21, 27]. One such argument is that CAM offers

something that cannot be detected by existing health outcomes measurement, such as the experience of holistic practitioner care by the patient [21, 28]. Others claim that it is not feasible to conduct randomised trials for therapies that are not well defined [29]. For example, how is a "course of massage therapy" defined? Such arguments are valid to the extent that they identify challenges to be overcome. However, these arguments do not fully acknowledge that the economic evaluation of pharmaceuticals, despite its general acceptance, is still faced with many of the same challenges [30].

Some governmental agencies, such as the National Institute for Clinical Excellence (NICE) in the United Kingdom, recommend the use of quality of life instruments (in particular the EQ-5D), rather than condition specific measures in economic evaluations, so as to compare "like with like". Quality of life outcome measures are designed to capture the net benefits to patients of a given treatment, both positive and negative, including the recognised "intervention effect". The intervention effect occurs where an overall improvement in quality of life occurs not just as a direct result of the treatment being trialled, but also of any additional care that the participant may have received as a result of being part of a trial that they would not have received otherwise. In the same way, quality of life measures should be able to measure not just a particular CAM intervention effect, but the overall effect of holistic treatment.

Other problems encountered in the economic evaluation of pharmaceuticals include the standardisation of therapy, so that the definition of a "standard course" of a particular therapy is broadly accepted, and can be generalised [31]. To a certain extent this has been overcome by the implementation of standard treatment guidelines in conventional medicine, which have evolved as a result of the evidence provided by randomised trials. While the concept of the standardisation of CAM therapies for the purpose of economic evaluation poses some interesting new challenges, it is difficult to identify compelling reasons as to how these challenges are sufficiently different from those faced by conventional medicine interventions to warrant their exclusion from this type of analysis.

Examples of another area of economic evaluation, cost-benefit analysis, incorporating the inclusion of patients' preferences, have also begun to appear in the CAM literature [31, 32]. Cost benefit analysis differs from cost-effectiveness (or cost-utility analysis) in that the outcome differences between comparators are measured in monetary terms. The potential advantage of using a cost-benefit approach in the evaluation of CAM compared with cost-effectiveness or cost-utility is that the scope for analysis is broader. Monetary values can be assigned to health outcomes by consumers using three general approaches: (i) a human capital approach; (ii)

revealed preferences; or (iii) stated preference of willingness to pay [20]. Such evaluations may provide supplementary evidence for decision makers and funders of CAM therapies.

It may that the economic analysis of conventional medicine and CAM do not differ so much in core methodological approaches, but rather in the magnitude, and consequent measurement of, treatment effects. Take for example the treatment of a person with diabetes. Unless their blood glucose levels are controlled within a normal range, it is likely that the person will suffer morbidity and possibility mortality as a result of that condition. In this case, conventional medical treatment, including the use of glucose modifying agents, is likely to have a significant positive impact on that person's quality of life. However, either the condition or the conventional medical treatment may have other unwanted effects that decrease the person's quality of life. Such unwanted effects may be treated with CAM therapies. CAM therapies may also be used to assist with weight loss or lifestyle modifications that can alter the underlying pathophysiology of the disease. In this case, the CAM therapy may still show a positive incremental cost per quality adjusted life-year (QALY), which is simply smaller than that for the conventional medicine[2].

However, the cost-effectiveness of conventional medicine, and likely CAM, forms a spectrum. It may be true in a differing scenario that CAM can be shown to have a greater positive effect on quality of life outcomes as compared with conventional medicine. Another potentially interesting question that then arises is whether the method for identifying an acceptable cost effectiveness ratio threshold would differ between conventional medicine and CAM, or when they are analysed together. This is another possible area for future research.

Finally, it is important that all economic research should be conducted with an awareness of the theoretical underpinnings of the philosophy and beliefs of CAM practice, and how these differ from conventional medicine. This is important as some of current failures of conventional medicine, including the encouragement of healthy behaviours, the holistic treatment of users and equity and access issues surrounding conventional health services are all reasons given for accessing CAM services [33]. Given the cost, outcome, and policy implications of CAM use,

[2] A systematic review by Canter et al [34] of the cost-effectiveness of CAM therapies in the UK found that for five of the six studies included in the review, treatment effects favoured CAM over conventional treatment, but that these effect sizes were small or uncertain. Thus, whilst for four of the studies, the incremental cost per quality adjusted life year (QALY) was less than £10,000 which is comparable to cost-effective benchmarks for conventional treatments, the clinical trials from which the data is drawn do not have adequate blinding, leaving the significance of these small clinical treatment effects in some doubt. The authors of the review identify this as a major weakness of all studies identified and as such questions the validity of the cost-effectiveness results presented.

and its relationship to conventional therapies, its assessment in economic terms is a rich area for future research.

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Specific Declaration Chapter Two

Declaration by candidate

In the case of Chapter Four, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
• Contributed to the original concept for the paper • Wrote the first draft and coordinated all suggested changes • Analysed the data • Submitted the paper (corresponding author)	80

The following co-authors contributed to the work. Co-authors who are students at Monash University must also indicate the extent of their contribution in percentage terms:

Name	Nature of contribution
Bruce Hollingsworth	Contributed to the original concept for the paper; Edited and reviewed the manuscript; Analysed the data

Candidate's Signature		**Date** 17/03/2013

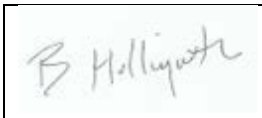
Declaration by co-authors

The undersigned hereby certify that:

(7) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(8) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(9) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(10) there are no other authors of the publication according to these criteria;
(11) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(12) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s)	**Centre for Health Economics, Monash University, Clayton Campus**

[Please note that the location(s) must be institutional in nature, and should be indicated here as a department, centre or institute, with specific campus identification where relevant.]

Signature 1	 Bruce Hollingsworth	**Date** 27/03/2013

Chapter Two: Policy Implications of complementary and alternative medicine (CAM) use in Australia: Data from the National Health Survey

Abstract

Objective: To investigate the drivers of complementary and alternative medicine (CAM) use in the general population in Australia and to identify key policy implications.

Data and Methods: The National Health Survey (NHS) 2007/8, a representative survey of the Australian population, provides information on CAM use (practitioners and products) in the last 12 months. All adult respondents (N=15,779) aged 18 years or older are included in this study. Logistic regression is employed to determine the effect of socio-economic, condition-specific, health behaviour variables, and private health insurance status on CAM use.

Results: In addition to socio-economic variables known to affect CAM use, individuals who have a chronic condition, particularly a mental health condition, are more likely to use CAM. There does not appear to be a correlation between CAM use and more frequent GP use, however ancillary private health insurance is correlated with a greater likelihood of CAM use as expected.

Conclusion: The Australian government does not currently intervene in the CAM market in a systematic way. CAM is clearly considered to be a legitimate and important component of health care for many Australians, despite the limited availability of clinical evidence for its efficacy and safety. Policy interventions may include the regulation of CAM products, practitioners, and information as well as providing subsidies for cost-effective modalities.

Introduction

It is estimated that complementary and alternative medicine (CAM) is used by 52-69% of the Australian population, with 44% reporting a visit to a CAM practitioner in the previous 12 months [1-4]. Out of pocket expenditure on CAM is estimated at over AU$4 billion per year, higher than the amount Australians spend on out of pocket payments on pharmaceuticals [1].

However, despite the size of the CAM "market" and the high estimates of prevalence of use, there has been little research undertaken from a policy viewpoint, especially considering the role of government. The Australian government does not currently intervene in the CAM market in the systematic way it does with conventional medicine, despite the perception by many that CAM is a legitimate and important part of primary care.

In economic terms, health 'markets' do not operate competitively, generally providing a clear rationale for government intervention [5]. This is because consumers do not have sufficient information upon which to make optimal decisions and there is a high level of risk and uncertainty in determining the future demand for healthcare. When considering the CAM market, it is obvious that these key assumptions also do not hold. Whilst work is ongoing, there is still a perceived lack of clinical evidence upon which to make treatment decisions for CAM [6], and negative effects from CAM can exist [7, 8]. CAM also suffers from the problem of information asymmetry, where consumers are not able to make well informed decisions on their own [9]. Further, it is well accepted that all individuals face uncertainty with regard to health status and therefore their need for healthcare, including CAM. The institutional response to uncertainty, in this instance, traditionally includes the consideration of insurance and subsidy schemes to protect the population from catastrophic or unexpected expenditures.

This is similar to the conventional medicine market. It therefore appears justified that consideration of government intervention in the CAM market is warranted. Accepting this logic, policy interventions such as regulation and subsidy might be discussed. However, we still know little about patterns of CAM use at a population level, especially in relation to conventional medicine use.

Many different factors influence the use of CAM products and practitioners. Being female and middle-aged has been positively associated with CAM use [4, 10-14] and has been studied specifically in Australia [15-17]. CAM use has been shown to vary across cultural-groups [18-20].

Particular chronic conditions have also been positively associated with its use: diabetes [21-23], mental health conditions [24, 25], cancer [26-28], arthritis [29], back pain [30] and hypertension [31].

CAM use is seen by many as an important and legitimate component of health-care and self-management of chronic disease [21, 32]. There is some evidence to suggest that CAM is more commonly used as a complement to conventional medical care rather than a complete substitute [11-13, 33]. However, some groups may view CAM practitioners as their preferential form of care, for example, Chinese Medicine Practitioners [34] or Naturopaths [35], or as a substitute for particular health issues [36]. Also, there may be an increased likelihood for certain individuals to be more frequent users of both CAM and conventional medicine [12].

Co-users of CAM and conventional medicine may not always report their CAM use to their General Practitioners (GPs), and conversely they may not provide full details of conventional medicine use to CAM practitioners [11, 37]. Such behaviour is not without risk; there are known interactions between some CAM therapies and conventional medicines, for example, St John's wort (*Hypericum perforatum*) is known to potentially alter the plasma concentrations of many prescription medicines [38].

The effect of subsidizing CAM use by third party insurance is also of interest. There are reported associations between having private health insurance and increased CAM use [1, 12]. Many private health insurers in Australia already subsidise CAM therapies and it is likely that ancillary ("extras") cover would incentivise CAM use if demand was sensitive to price. This is important when considering the possibility of increases in demand, were the government to subsidize CAM in the future.

The objective of the paper is to analyse the drivers of CAM use at a population level, paying particular attention to the relationship between CAM and conventional medicine use, the role of chronic illness, and the effect of private health insurance. This is the first analysis to use representative population data from the Australian National Health Survey (NHS) with the aim of informing CAM policy development.

Data and methods

The National Health Survey (NHS) 2007/8 randomly sampled households (20,788 individuals) within urban and rural locations across Australia using a multilevel sampling methodology [39]. Sampling fractions for different States were set to account for sparsely populated areas such as the Northern Territory. Household and individual sampling weights were calculated to adjust for the probability of selection. Person and household weights, adjusted for seasonality, were then calibrated against population benchmarks to compensate for over- or under- enumeration of particular categories and included in the models presented.

Respondents were asked health related information regarding long term medical conditions, health behaviours, their consultations with health professions, and a range of socio-demographic information. Our analysis focuses on the responses of all adults, aged 18 years and over, in the sample (15,779).

Variables: The variable of interest is whether an individual chose to use CAM in the previous 12 months. Here, CAM use is represented by separate variables: either visiting a CAM practitioner, or using a CAM product (that is, taking a vitamin, mineral or herbal supplement regardless of whether it was purchased over the counter or prescribed by a CAM or medical practitioner). For practitioner use, data are available for four types of CAM practitioners only: acupuncturists, naturopaths, chiropractors and osteopaths. Information on other practitioners has been combined into an "other" category in the NHS due to small numbers and therefore could not be included in this analysis.

We consider the influence on CAM use of a range of socio-demographic variables including: age, gender, employment, marital status and education. Cultural background is represented by whether participants were born in Australia or elsewhere and whether English is the main language spoken at home.

The effect of chronic disease is included in the analysis using self-reported presence of cardiovascular disease, diabetes, cancer, arthritis, osteoporosis and asthma (a group of chronic illnesses recognised as part of the National Health Priority Area (NHPA)). The experience of a major stress event in the past 12 months is also included. The influence of general health status is measured using a measure of self-reported health and bodily pain; a five-category self-reported health variable is collapsed into two categories of either "excellent/ very good/ good" or "fair/ poor", while bodily pain experienced in the four weeks prior to the survey is categorised as "moderate/ severe/ very severe" or "mild/ very mild / none". The effect of lifestyle factors

including smoking, exercise, alcohol intake and eating patterns are considered, as is health service utilisation in the previous 12 months. Finally, we also consider the effect of different types of private health insurance coverage by including dummy variables for individuals who had ancillary ("extras") coverage alone, ancillary and hospital cover, or hospital cover alone.

Models: The effect of these variables on CAM use is considered using four different logistic regression models, where the coefficient reflects the odds of an individual using CAM in the last 12 months. The first analysis includes any CAM practitioner use, irrespective of CAM product (vitamin, mineral or herb) use; the second model considers product use exclusive of practitioner use; the third includes individuals who used both practitioner and products and the fourth reports any CAM use. All analyses are undertaken using STATA 10 (StataCorp) and the results are presented as odds ratios with 95% confidence intervals.

Results

Participant characteristics: A summary of the sample characteristics is presented in Table 1. Overall, the prevalence rate for any type of CAM use is around 39% of the adult population. Participants who reported CAM use are more likely to be female, have a post high-school qualification and report a higher number of chronic conditions. There does appear to be more CAM use with increased income.

The age of respondents reporting CAM use broken down by the type of use is shown in Figure 1. The highest proportion of CAM practitioner use is in the 35-39 year age group, however peak usage for vitamins is in the 60-64 year age bracket. Overall, there is a general trend of decreasing use with increasing age.

A summary of participant characteristics, by type of CAM use (practitioner only, vitamin, mineral and herb use only and both) is presented in Table 2. As expected, there are differences in correlations between CAM practitioner and product use and different chronic illnesses, likely reflecting the specific treatments available.

Table 3 summarises key aspects of conventional medicine use by CAM use. CAM users appear to be more likely to use all forms of conventional medicine, including GPs, specialists and allied health professionals, as well as screening tests compared with non-CAM users. However, as CAM users are also more likely to have a chronic condition, we account for this effect, as well as, the effect of other socio-demographic variables.

Consumer choice of different combinations of primary care is presented in Figure 2. It can be seen that the proportion of participants who choose CAM alone is higher than for GP services alone. However the combined use of CAM with different conventional medicine services is also relatively high.

Results of the four logistic regression models are presented in Table 4. As shown elsewhere [4], being female and better educated is associated with a higher likelihood of CAM use, although the association is only found to be statistically significant for users of both products and practitioners. Individuals born in South Asia) are less likely to report CAM use which might be reflective of the restricted definition of CAM in this survey.

In terms of conventional health service utilisation, overall it does not appear that CAM users are more likely to use GP or specialist services when controlling for other factors including health status. They do however, appear more likely to visit allied health practitioners and use a lower number of prescription medicines for chronic illness. Individuals who reported CAM use are generally more likely to report healthy behaviours such as moderate or vigorous exercise, eating fruit and being a non-smoker, although this differs between CAM practitioner and product users.

People with ancillary "extras" private health insurance cover are more likely to use CAM, however having hospital only cover does not affect the probability of use. Being employed is a strong positive predictor of CAM practitioner use, although surprisingly income shows no effect[3]. Individuals living in urban areas are less likely to report CAM practitioner use than those living in rural or remote areas. People who reported having one or more NHPA conditions are more likely than others to report CAM use, although patterns of use across different conditions varies. The number of chronic conditions is not statistically significant. The strongest predictor for CAM use is having a mental health condition. Overall, chronic conditions, apart from cardiovascular disease and cancer, are associated with increased CAM use.

[3] When the model is run without the employment variable, the relationship between higher income and increased probability of CAM use (particularly CAM product use) becomes statistically significant. This is important as CAM product use peaks in the 60-65 year age bracket where the relationship between employment status and income is unclear.

Discussion

The results of this nationally representative sample can be used to offer insights about a policy framework for CAM and the rationale for any government intervention in the market. The overall prevalence rate of CAM use of around 40% is lower than those previously reported in Australia [1, 4], however this is unsurprising given that information on only four types of CAM practitioners (acupuncturists, naturopaths, chiropractors and osteopaths) is available from the NHS and therefore is likely to be an underestimate. As seen in Figure 3, CAM use may or may not be combined with conventional medicine use and thus may be used as a complement by some groups and a substitute by other groups.

However, thinking about all CAM use in a single category is rather misleading. As shown by the results of the separate models in Table 4, results are not uniform for people who only use either CAM products or practitioners, or for those who use both (compared with any CAM use). Other authors have argued that a more prescriptive definition of CAM is helpful [27, 40]. We propose that each CAM modality be considered in its own right in terms of any policy intervention. Important examples of a more focused approach on specific areas of policy and cost-effectiveness are already emerging in the literature [41]. This not only simplifies the direction of any intervention but also means that existing government mechanisms (such as regulatory and subsidy bodies) can be used as appropriate rather than attempting to set up duplicate mechanisms. Some CAM practitioner boards' specific to identifiable groups have already been established (for example, the Chinese Medicine Practitioners Board in the state of Victoria).

In terms of the market not operating 'competitively' there may be justification for government intervention in the CAM market. However, it is important to critically analyse the extent of market failure to determine the merits of any proposed government intervention. From Figure 3, at least 26% of the adult population uses some type of CAM and conventional medicine use concurrently. In a recent survey, only 50% of those using CAM spoke with their doctor about their CAM use [37], meaning that a significant proportion of people in Australia could be at risk of interactions between CAM and conventional medicine use. This reinforces the arguments of others that CAM product and practitioner use should be regulated [42-44].

Conversely, the positive correlation between CAM use and healthy behaviours provides evidence of the potential gain for improved health and has been shown in other representative

populations [45]. Although further research into this association is warranted, at a population level this raises the question of whether certain CAM modalities should be considered for subsidy. What has yet to be investigated is whether CAM use may substitute for more frequent and expensive conventional care which could be cost saving in certain circumstances. There seems to be little reason why the existing bodies that undertake health care technology assessments cannot be used to make individual modality assessments.

In contrast with previous research [11, 12], there appears to be little evidence of a relationship between CAM use and more frequent GP use, however, CAM users do seem to be more likely to visit allied health professionals. CAM users also seem less likely to be using prescription medications for chronic illness after controlling for health status. Again, this may represent a population sub-group that is better at controlling lifestyle risk factors (possibly through CAM use), although lifestyle factors are included in the model. There is, however, a strong correlation between private health insurance cover and increased CAM practitioner use (note that products are not currently subsidised by insurers) which does provide evidence of the possibility for over-consumption if CAM was to be subsidised by the government. In this case, mechanisms for controlling the availability of subsidised interventions could be considered, in the same way as for conventional medicine.

There is a strong correlation between CAM use and many of the NHPA chronic conditions. Having a mental health condition greatly increases the likelihood of an individual to use both CAM products and practitioners. The size of the relative risk ratio presented in Table 4 is large and may represent a large proportion of the population "self-treating" mental health conditions, rather than seeking care from their GP. There may also be a co-morbidity effect, as people who have chronic conditions are more likely to suffer depression [46-47]. Regardless, the question has to be asked as to why such a large proportion of those with mental health issues are accessing CAM. Underfunding of the conventional system could be one reason; effectiveness of CAM another. This question requires further investigation. Overall, however the potential gain from subsidising (proven) cost-effective CAM treatments in this sub-population is large.

Apart from mental health conditions, other chronic conditions such as arthritis, osteoporosis and asthma have a strong correlation with CAM use. This is unsurprising as vitamin, mineral and herbal products are readily available and often specifically marketed for these conditions (eg. glucosamine for arthritis). When this result is considered alongside other evidence suggesting

that most individuals get their information on CAM from family and friends and the internet [37, 48] it strengthens the argument that there are potential benefits of regulating information about CAM by the government. Organisations such as the National Prescribing Service could be supported to circulate evidence-based consumer information as it becomes available.

There are a number of limitations to the analysis presented. Firstly, information on the length of time that individuals had lived with chronic illness and the severity of disease are not available. Secondly, the use of many vitamin, mineral and herb preparations, for example calcium and iron, may be prescribed by a medical doctor. Therefore these products may be viewed and used in the same way as another prescription medication. This cannot be differentiated in the survey from other vitamin, mineral and herb use, and accordingly the results may overestimate CAM product use. Thirdly, as noted, only limited information is available for CAM practitioner use and the survey is likely to underestimate the prevalence. Finally, no information is available on why individuals actually choose to use CAM.

Conclusion

This paper provides a framework for considering whether government intervention would be justified in the CAM market and the possibilities for any such intervention. It seems clear that the reasoning for intervention in the conventional medicine market is equally warranted in the CAM market. Thinking about the existing policy mechanisms for conventional medicine, there is arguably sufficient means for the government to extend existing policies to cover CAM for regulation of practitioners, products and information, as well as to potentially subsidise cost-effective modalities. Political will, funding constraints and various stakeholder opinions are all potential barriers, however inaction is not supported by these results.

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Table 1: Respondent characteristics by any CAM use (N=15,779)

Variable	Persons reporting CAM use		Persons not reporting CAM use		
	N	% total	N	% total	t-test
	6,067	38.4	9,712	61.6	
Age		% category		% category	
18-24 years	316	5.2	1,047	10.8	**
25-44 years	1,968	32.4	3,917	40.3	**
45-64 years	2,317	38.2	3,039	31.3	**
65 years and over	1,466	24.2	1,709	17.6	**
Female	3,628	59.8	4,713	48.5	**
Born in Australia	4,577	75.4	7,180	73.9	*
Education > high school	3,398	56.0	5,039	51.9	**
Household income*					
1st-4th decile (0-564)†	2,737	45.1	4,543	46.8	*
5th-8th decile (565-2,117)	2,116	34.9	3,401	35.0	0.86
9th-10th decile (> 2,118)	1,214	20.0	1,768	18.2	**
Has private health insurance cover	3,617	59.6	4,700	48.4	**
Living in city	4,135	68.2	6,507	67.0	0.13
Health status					
Excellent	930	15.3	2,012	20.7	**
Very good	2,048	33.8	3,389	34.9	0.14
Good	1,849	30.5	2,821	29.0	0.06
Fair	851	14.0	1,094	11.3	**
Poor	389	6.4	396	4.1	**
Chronic conditions					
None	316	5.2	2,529	26.0	**
1 or 2	3,151	51.9	5,744	59.1	**
3 or more	2,600	42.9	1,438	14.8	**

**p<0.01 *p<0.05 †$AUD weekly equivalised cash income (2007 prices)

Table2: Respondent characteristics by type of CAM use (N=6,067)

Variable	Persons reporting CAM practitioner (regardless of product use)		Persons reporting vitamin, mineral and herb use only		Persons reporting both CAM practitioner use and vitamin, mineral and herb use	
	N	**% total**	**N**	**% total**		**% total**
	2,298	**37.9**	**3,769**	**62.1**	**1,018**	**16.8**
Age		% category		% category		% category
18-24 years	146	6.4	170	4.5	43	4.2
25-44 years	1,022	44.5	946	25.1	366	36.0
45-64 years	854	37.2	1,463	38.8	446	43.8
65 years and over	276	12.0	1,190	31.6	163	16.0
Female	1,353	58.9	2,275	60.4	690	67.8
Born in Australia	1,852	80.6	2,725	72.3	806	79.2
Education > high school	1,431	62.3	1,967	52.2	652	64.0
Household income ($AUD weekly equivalised cash income of household)						
1st-4th decile (0-564)	806	35.1	1,931	51.2	370	36.3
5th-8th decile (565-2,117)	889	38.7	1,227	32.6	382	37.5
9th-10th decile (> 2,118)	603	26.2	611	16.2	266	26.1
Living in city	1,573	68.5	2,562	68.0	718	70.5
Health status						
Excellent	408	17.8	522	13.8	152	14.9
Very good	860	37.4	1,188	31.5	380	37.3
Good	680	29.6	1,169	31.0	289	28.4
Fair	241	10.5	610	16.2	131	12.9
Poor	109	4.7	280	7.4	66	6.5

Table 3: Use of conventional medicine by any CAM use

Variable	Persons reporting CAM use		Persons not reporting CAM use		t-test
	N	%	N	%	
	6,067	**38.4**	**9,712**	**61.6**	
Frequency of GP check-ups					
At least once a month	756	12.5	791	8.1	**
Every 3 months	1,197	19.7	1,375	14.2	**
Every 6 months	1,084	17.9	1,421	14.6	**
At least annually	1,076	17.7	1,607	16.5	0.06
Less frequently than annually	258	4.3	422	4.3	0.14
Did not visit	1,696	28.0	4,096	42.2	**
Specialist visit last 12 months	2,110	34.8	2,322	23.9	**
Allied health professional visit last 12 months	3,149	51.9	3,483	35.9	**
Cholesterol check in last 12 months	1,555	25.6	1,486	15.3	**
BP checked in last 12 months	1,893	31.2	1,961	20.2	**
Number of prescription medicines used for chronic conditions (mean, SD)	1.16 (1.70)		0.61 (1.24)		**

**p<0.001 *p<0.05

Table 4: Results of logistic regression models

Variable	CAM Practitioner use			Vitamin, mineral or herb use only			Both CAMPRAC & vitamin, mineral or herb use			Any CAM		
Health service utilisation	**OR**	**lower**	**upper**	**OR**	**lower**	**upper**	**OR**	**lower**	**upper**	**OR**	**lower**	**upper**
GP every month	1.014	0.783	1.314	1.085	0.923	1.608	1.026	0.686	1.534	1.137	0.891	1.451
GP every 3 months	0.951	0.774	1.170	1.172	0.968	1.457	0.974	0.709	1.339	1.038	0.865	1.245
GP every 6 months	0.996	0.828	1.199	**1.109**	**1.041**	1.511	0.977	0.735	1.299	1.144	0.971	1.347
GP once a year	1.026	0.861	1.223	1.065	0.895	1.290	1.138	0.871	1.488	1.042	0.891	1.219
Specialist in last 12 months	1.139	0.986	1.315	1.013	0.819	1.121	1.106	0.897	1.364	1.063	0.926	1.219
Allied health in last 12 months	**1.717**	**1.507**	**1.956**	**0.857**	**0.696**	**0.914**	**1.663**	**1.356**	**2.039**	**1.327**	**1.181**	**1.492**
Cholesterol test in last 12 months	1.281	0.942	1.740	**1.690**	**1.413**	**2.683**	1.105	0.731	1.670	**2.188**	**1.623**	**2.949**
BP test in last 12 months	1.066	0.663	1.714	1.066	0.640	1.625	1.367	0.697	2.680	1.108	0.718	1.709
Number medications	**0.888**	**0.833**	**0.946**	**0.809**	**0.733**	**0.835**	**0.804**	**0.739**	**0.876**	**0.706**	**0.664**	**0.751**
Socio demographics												
Female	1.121	0.983	1.278	1.037	0.909	1.184	**1.249**	**1.010**	**1.546**	**1.135**	**1.010**	**1.276**
Married	**1.169**	**1.025**	**1.333**	0.912	0.795	1.046	1.102	0.899	1.350	1.080	0.956	1.220
Main language not English	0.844	0.591	1.206	0.986	0.741	1.311	1.088	0.661	1.789	0.955	0.751	1.213
Born in SE Asia (excluding China)	0.769	0.409	1.449	1.782	0.989	3.213	0.425	0.156	1.159	1.153	0.708	1.876
Born in South Asia	**0.318**	**0.103**	**0.978**	1.016	0.510	2.024	**0.166**	**0.030**	**0.927**	**0.493**	**0.265**	**0.920**
Education above high school	**1.210**	**1.059**	**1.382**	1.085	0.947	1.244	**1.383**	**1.121**	**1.706**	**1.232**	**1.091**	**1.390**
Employed	**1.447**	**1.207**	**1.734**	1.040	0.877	1.233	**1.408**	**1.059**	**1.874**	**1.406**	**1.209**	**1.634**
Log income	1.006	0.977	1.035	1.002	0.977	1.028	1.005	0.957	1.055	1.005	0.982	1.030
Lives in major city	**0.826**	**0.723**	**0.944**	0.982	0.850	1.134	0.873	0.711	1.071	**0.841**	**0.743**	**0.952**
Health status												
Ex/good self-reported health	1.041	0.846	1.280	1.028	0.840	1.258	1.034	0.786	1.360	1.074	0.885	1.303
Pain in previous four weeks	**1.572**	**1.370**	**1.805**	0.925	0.796	1.076	**1.600**	**1.299**	**1.970**	**1.406**	**1.234**	**1.602**
Major stressor in previous 12 months	**1.144**	**1.007**	**1.300**	0.915	0.802	1.044	1.138	0.928	1.394	1.038	0.927	1.162

Table 4: continued

Risk factors												
Mod/high alcohol consumption	1.138	0.997	1.299	0.956	0.829	1.102	1.121	0.912	1.379	1.074	0.949	1.215
Current smoker	**0.830**	**0.700**	**0.983**	0.867	0.729	1.031	**0.705**	**0.536**	**0.928**	**0.756**	**0.647**	**0.883**
1 or less serve fruit/day	0.882	0.774	1.006	**0.852**	**0.746**	**0.974**	0.839	0.682	1.032	**0.801**	**0.712**	**0.901**
2 or less serve vegetables/day	1.019	0.897	1.159	0.914	0.801	1.044	1.003	0.821	1.225	0.960	0.855	1.079
Low/no exercise last 2 weeks	**0.728**	**0.637**	**0.832**	1.057	0.916	1.221	**0.681**	**0.557**	**0.832**	**0.763**	**0.675**	**0.863**
At risk waist measurement	0.927	0.819	1.051	1.120	0.983	1.277	0.871	0.714	1.064	1.019	0.910	1.142
Chronic illness												
Mental health issue	**1.926**	**1.555**	**2.385**	**24.329**	**19.487**	**30.374**	**18.767**	**12.882**	**27.339**	**25.678**	**21.014**	**31.377**
Cardiovascular disease	0.865	0.558	1.341	1.060	0.699	1.608	0.937	0.483	1.817	0.933	0.637	1.367
Diabetes	0.757	0.521	1.099	**1.437**	**1.030**	**2.006**	0.721	0.420	1.237	1.163	0.850	1.590
Cancer	0.855	0.536	1.362	1.423	0.897	2.256	0.958	0.489	1.877	1.136	0.736	1.753
Asthma	1.170	0.908	1.507	1.208	0.908	1.609	**1.551**	**1.070**	**2.249**	**1.476**	**1.155**	**1.886**
Arthritis	1.180	0.934	1.490	**4.327**	**3.368**	**5.560**	**2.445**	**1.735**	**3.444**	**3.982**	**3.189**	**4.972**
Osteoporosis	1.154	0.821	1.620	**1.875**	**1.264**	**2.781**	1.239	0.736	2.086	**2.297**	**1.598**	**3.302**
Number of chronic conditions	1.039	0.887	1.217	0.985	0.838	1.157	0.993	0.774	1.274	1.017	0.883	1.173
Private health insurance												
PHI - ancilliary only	**2.080**	**1.543**	**2.803**	0.885	0.631	1.242	**1.738**	**1.133**	**2.667**	**1.715**	**1.287**	**2.286**
PHI - hospital only	1.082	0.833	1.407	1.056	0.829	1.346	1.187	0.781	1.806	1.094	0.880	1.359
PHI - ancilliary & hospital	**1.539**	**1.331**	**1.779**	0.996	0.858	1.157	**1.609**	**1.279**	**2.024**	**1.443**	**1.267**	**1.643**
N	**15,715**			**15,715**			**15,715**			**15,715**		

Statistically significant results are **BOLDED**

OR=odds ratio; lower = confidence interval lower bound; upper = confidence interval upper bound; CAMPRAC= complementary medicine practitioner; GP = General Practitioner; BP=blood pressure; PHI = Private Health Insurance; SE = South East

Technical Appendix: Definitions of all variables used in Table 4

Health Service Utilisation

GP: dummy variables for visiting every month; every 3 months; every 6 months; once a year. Base category is > less than once a year

Specialist: 1 if visited in the previous year, 0 otherwise

Allied health: 1 if visited in the previous year, 0 otherwise

Cholesterol test: 1 if had cholesterol test in the previous year, 0 otherwise

BP test: 1 if had blood pressure test in the previous year, 0 otherwise

Number medications: number of medications taken for chronic illness (continuous)

Socio demographics:

Age: (base category 18-24 years); dummy variables for 5 year age brackets from 25_29 years to 80_84 years, then 85 years and over

Female: 1 if yes, 0 otherwise

Married (including de-facto): 1 if yes, 0 otherwise

English (main language spoken): 1 if no, 0 otherwise

Born in SE Asia (excluding China): 1 if yes, 0 otherwise

Born in China: 1 if yes, 0 otherwise

Born in South Asia: 1 if yes, 0 otherwise

Born in Oceania: 1 if yes, 0 otherwise

Born in North Africa: 1 if yes, 0 otherwise

Born in North-East Asia: 1 if yes, 0 otherwise

Education> high school: 1 if obtained a post-high school qualification, 0 otherwise

Employed (currently): 1 if yes, 0 otherwise

Household income (log): $AUD 2007, continuous

Resides in a major city: 1 if yes, 0 otherwise

Health status

Excellent/good self-reported health: (base category fair/poor): 1 if excellent, very good or good, 0 otherwise

Pain in previous 4 weeks: 1 if yes (any level), 0 otherwise

Major stressor in previous 12 months: (includes divorce/separation, death, serious illness, serious accident, alcohol or drug problems, mental illness, serious disability, not able to get a job, involuntary loss of a job, witness to violence, abuse or violent crime, trouble with the police, gambling problem) 1 if yes, 0 otherwise

Risk factors

Mod/high alcohol consumption: dummy variable where 1 is moderate or high alcohol risk based on 3 day average alcohol consumption, year 2000 Guidelines, 0 otherwise

Current smoker: dummy variable where 1 is yes, 0 otherwise

1 or less serve fruit/day: dummy variable where 1 is yes, 0 otherwise

2 or less serve vegetables/day: dummy variable where 1 is yes, 0 otherwise

Low/no exercise last 2 weeks: dummy variable where 1 is yes, 0 otherwise using the level of exercise undertaken for fitness, recreation or sport in the last 2 weeks (includes low, very low and no exercise classifications
At risk waist measurement: dummy variable where 1 is a waist circumference deemed to be of increased health risk, 0 otherwise

Chronic illness
Mental health issue: 1 if disease is current, 0 otherwise
Cardiovascular disease: 1 if disease is current, 0 otherwise
Diabetes: 1 if disease is current, 0 otherwise
Cancer: 1 if disease is current, 0 otherwise
Asthma: 1 if disease is current, 0 otherwise
Arthritis: 1 if disease is current, 0 otherwise
Osteoporosis: 1 if disease is current, 0 otherwise
Number of chronic conditions: number of co-morbid chronic conditions, continuous

Private Health Insurance:

PHI - ancilliary only: dummy variable where 1 is holding ancilliary cover only, 0 otherwise
PHI - hospital only: dummy variable where 1 is holding hospital cover only, 0 otherwise
PHI - ancilliary & hospital: dummy variable where 1 is holding ancilliary and hospital cover , 0 otherwise

Description of final model specification

Variables were identified that may have an association with CAM use based on previous literature. A parsimonious model using ordinary least squares (OLS) with only exogenous variables was then estimated. Sequentially more inclusive models were then used which were compared with the 'base' model for robustness. The final model was deemed to be the most robust to potential confounding and most informative in terms of explaining variation in the models.

Figure 1: CAM use by age category

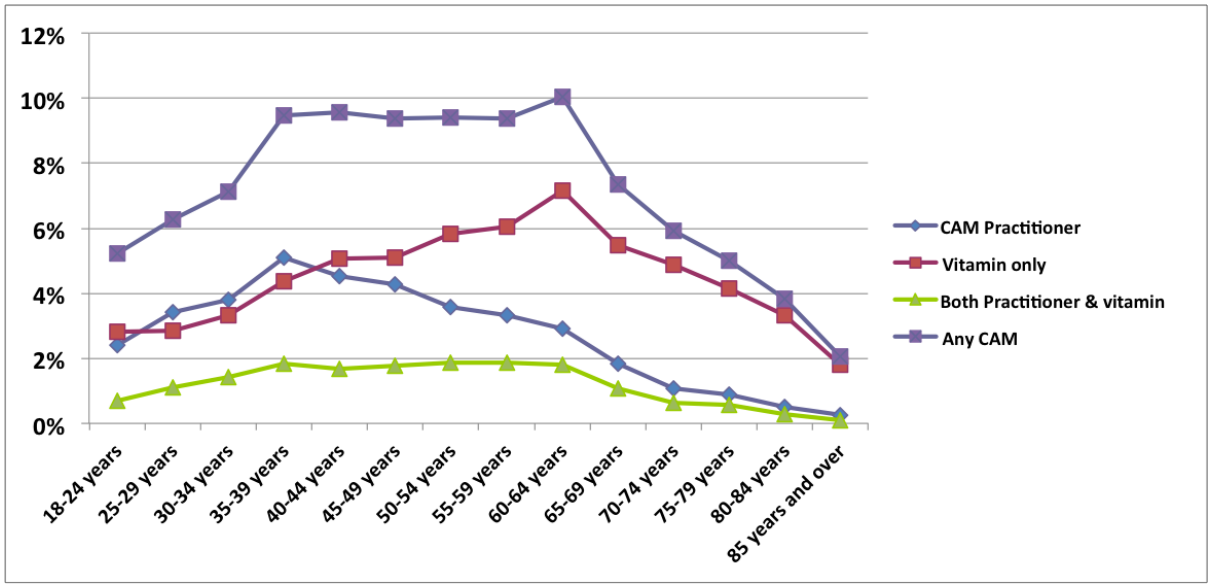
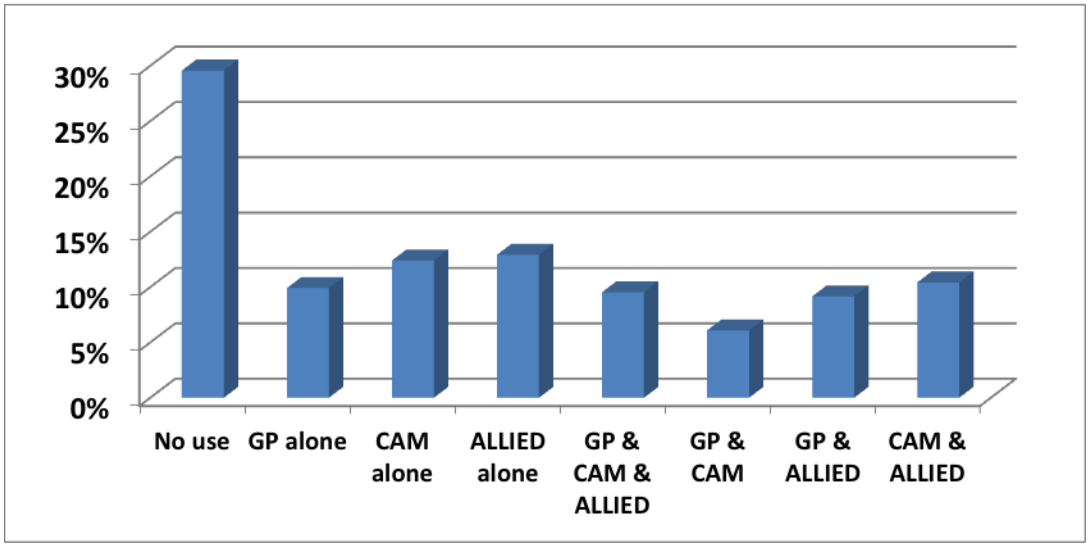


Figure 2: Choice of GP, any CAM and Allied Health Professional use



Specific Declaration Chapter Three

Declaration by candidate

In the case of Chapter Three, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
• Contributed to the original concept for the paper • Wrote the first draft and coordinated all suggested changes • Analysed the data • Submitted the paper (corresponding author)	70

The following co-authors contributed to the work. Co-authors who are students at Monash University must also indicate the extent of their contribution in percentage terms:

Name	Nature of contribution
Pratima Srivastava	Contributed to the original concept for the paper; Analysed the data; Edited and reviewed the manuscript

Candidate's Signature		**Date** 27/11/2013

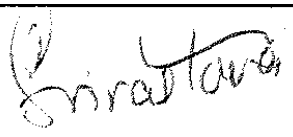
Declaration by co-authors

The undersigned hereby certify that:

(13) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(14) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(15) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(16) there are no other authors of the publication according to these criteria;
(17) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(18) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s)	**School of Economics, Finance and Marketing, RMIT University, Melbourne**

[Please note that the location(s) must be institutional in nature, and should be indicated here as a department, centre or institute, with specific campus identification where relevant.]

Signature 1	 Pratima Srivastava	**Date** 27/11/2013

Chapter Three: Primary care and complementary medicine for those with mental health conditions: an opportunity for engagement?

Abstract

People with mental health conditions may not always feel comfortable seeking care from their family doctor for a range of reasons, yet in many countries, family doctors provide not only an essential diagnostic role, but also a 'gatekeeping' role to other relevant services. Strategies to engage those with undiagnosed and untreated mental health conditions in the general population with appropriate care are required. Complementary and alternative medicine (CAM) practitioners may be preferred by some individuals and may offer an alternative treatment modality for those with undiagnosed and untreated mental health conditions. By definition, these services are not formally recognised as part of primary care; however, such a distinction may not be made by service users. Here, we use nationally representative data from Australia to analyse the use of primary health care providers, including CAM practitioners. We use a system of inter-related equations and account explicitly for private health insurance status. We find that whilst in theory CAM practitioners may provide a possible first contact point with the primary health care system for those with untreated mental health conditions, this is unlikely to be particularly successful from a population perspective given the low rates of substitution. Further, there remains a larger proportion of the population who are not likely to access any type of primary health care provider and it is this latter group that provides the biggest challenge to health policy makers and practitioners.

Research Highlights:

- Mental health conditions are associated with complementary and alternative medicine (CAM) use
- We analyse this relationship within a primary health care framework
- A system of equations is used to account for this complex relationship
- Patterns of practitioner use differ for mental health compared with other chronic conditions

Key words: complementary and alternative medicine (CAM); conventional medicine; mental health; chronic illness; multivariate probit (MVP); instrumental variables (IV); health policy

Background

It is well recognized that mental health conditions are under-reported and under-treated within the general population (Bijl et al., 2003; Ernst et al., 1998; Kessler et al., 2007). Health systems worldwide are struggling with how best to care for people with mental health conditions (Wang et al., 2005), particularly because social stigma and community attitudes may contribute to underreporting and delay the seeking of care (Unutzer et al., 2000). In many countries, family doctors or primary care physicians are the focal point for interventions at the primary care level. However, patients may not always feel comfortable or capable of seeking care from their doctors for a variety of reasons which may include thinking that the doctor does not have enough time; that no effective treatment is available; by feeling embarrassed; or being deterred by the doctors behaviour (Neighbors et al., 2007). As mental health conditions disproportionally affect people in lower socioeconomic circumstances (Druss & Rosenheck, 2000; Wang et al., 2005), a range of problems such as cost, cultural acceptability and geographic accessibility of services may compound access issues. By better understanding both the opportunities and barriers to accessing a variety of care modalities, new strategies may be developed to encourage people with mental health conditions to seek treatment earlier.

The use of complementary and alternative medicine (CAM) is highly prevalent in the general community (Astin, 1998; Barnes et al., 2008; Esmail, 2007; Hunt et al., 2010; Nahin et al., 2009; J Spinks & Hollingsworth, 2012). Although the definition of CAM use varies, it may include the use of complementary products, such as St. Johns Wort, fish oil, vitamin B, Rescue Remedy (Bach flower), multivitamins or other herbal supplements. It may also include visits to CAM practitioners, such as naturopaths, Chinese Medicine Practitioners, acupuncturists or chiropractors. There are numerous reports of a positive association between CAM use and mental health problems, including from a number of US nationally representative samples (Druss & Rosenheck, 2000; Kessler et al., 2001; Unutzer et al., 2000; Wang et al., 2005) – we focus here on the use of CAM practitioners. Prevalence rates from these studies for people diagnosed with a mental health condition for CAM practitioner use ranges from 6.8% (Wang et al., 2005) to 20% (Kessler et al., 2001).

There is evidence that for some people CAM practitioners are preferred to 'conventional' medicine practitioners, such as family physicians, for a variety of reasons including dissatisfaction with conventional care (Avogo et al., 2008); feeling that their treatment beliefs are more aligned with CAM practitioners (Connor, 2004; Furnham & Beard, 1995; Pellegrini & Ruggeri, 2007); and that the cost of conventional care is prohibitive (Avogo et al., 2008; Pagan & Pauly, 2005).

There is also evidence to support the notion that CAM products and services are complementary (rather than alternative) to conventional medical care for those with mental health conditions (Kessler et al., 2001; Wang et al., 2005) and that the predisposing and enabling factors described in Andersen's socio-behaviour model of care (R. Andersen & Newman, 1973; R. M. Andersen, 1995) apply equally to using conventional medicine and CAM (Kelner & Wellman, 1997). Thus, it is unclear if CAM practitioner services are more likely to substitute or complement conventional care; whether such a relationship is health system specific; and whether this has changed over time given an increased emphasis on mental health treatment from conventional services more recently.

The relationship between CAM use and mental health is not straight-forward. Socio-demographic and lifestyle variables such as age, gender, education and health behaviours that predict the likelihood both of having a mental health condition and service utilization may be correlated with unobserved factors such risk preferences, personality and beliefs. The association with private health insurance is also problematic in this context as it may be correlated with the error term in a regression analysis (it may be endogenous) through unobserved factors that may be correlated with the purchase of insurance. If this inter-dependency is not taken into account, regression coefficients may be biased.

Here, we estimate the association between mental health conditions and the likelihood of accessing different types of practitioners, including CAM. We significantly add to the existing literature by using a system of inter-related equations to model the decision to access care within a primary health care framework, accounting for the endogeneity problem described above. Much of the evidence to date comes from the US where universal health insurance is not provided. Here, we use data from a country which has universal health insurance (Australia) for two reasons- (i) that as health care reform in the US is phased in, primary health service utilization patterns may be expected to change (Adashi et al., 2010); and (ii) these results may be more representative of, and generalizable to, other countries with universal access to family doctors.

One of the biggest limitations of survey data describing mental health status is the likelihood to underreport mental health symptoms and therefore prevalence rates. As our data comes from a generic National Health Survey (rather than a mental health survey), mental health conditions are self-reported. Therefore, we use the Kessler 10 (K10) psychological distress scale to identify individuals in the population who are at increased risk of mental health conditions requiring treatment (Wu et al., 2007), using cut-off values determined for Australia. The K10 is widely-

used as a measure of population mental health, see for example (Carter et al., 2011; Chen, 2011). As our results may potentially be influenced by the cut-offs used or by alternative definitions of mental health conditions, we test our preferred model specification using a range of mental health definitions to assess the robustness of our results.

This paper is organised in the following way. Firstly, as data for the analysis comes from Australia, we describe the key elements of the Australian primary health care system. We then describe the data source, the National Health Survey (NHS) and modelling strategy before presenting the principal findings and conclusions.

The Australian primary health care system

The Australian primary health care system represents an interesting mix of public and private insurance. General practitioners (GPs) or family doctors are the main focus of primary care, performing a 'gatekeeper' role to other services, especially specialist doctors. Access to GP's doctors and essential medicines are funded by the federal government under Medicare, a scheme which covers all citizens. The purchase of private health insurance is optional, although there are financial penalties built into the taxation system for those that are considered to be able to afford private health insurance but choose not to take it out (Colombo & Tapay, 2003). Private health insurance provides greater choice of specialist doctor, treatment in a private hospital and partial coverage of items not included in the government system, such as dental care. Many, but not all, private health policies will include cover for ancillary or "extra" items such as visits to some allied health professionals, including CAM practitioners, physiotherapists and psychologists or counsellors.

All 'conventional' allied health practitioners are regulated under a national registration board (Australian Health Practitioner Regulation Agency) and most may be accessed by consumers directly without doctor referral. Currently, three types of CAM practitioner are regulated nationally in Australia – chiropractors, osteopaths and Chinese Medicine Practitioners. All are also available for self-referral by consumers.

Data Source

The National Health Survey (NHS) of Australia is conducted on a semi-regular basis and randomly samples households across rural and urban locations throughout the country using a multilevel sampling methodology (Australian Bureau Statistics, 2007). Respondents are asked health related information regarding long-term medical conditions, health behaviours, their

consultations with health professions, and a range of socio-demographic information. Here we use the most recent data available from the 2007/08 survey drawn from approximately 15,800 households and 20,788 individuals. Participants aged over 18 years for whom a full set of variables were available (13,875) are included in our analysis. Ideally, cross-sections could be pooled to form a time-series, however, inconsistencies in how questions were asked about health service utilization preclude such analysis. A full list of the variables used from the NHS is detailed in Table A1 of the Online Appendix.

CAM and other health service use variables: Data for health service use comes from the following question: '*Excluding any time spent in hospital, have you consulted any of these professionals for your own health in the last 12 months'*. A list of 16 professionals, including CAM professionals, is available as well as an 'other' category. Here, we are only interested in the primary care services which may be directly or indirectly relevant to the treatment of mental health conditions, so optometrists and dentists are not included in this analysis. We combine data for the four included CAM practitioners - acupuncturist, naturopath, chiropractor or osteopath - into one binary variable. Other binary variables are created for GP, pharmacist (for advice, not to dispense medicines) and physiotherapists. Counsellors, social workers and psychologists are combined into a single variable in the same way as CAM practitioners.

Mental health, other chronic disease and lifestyle variables: The Kessler Psychological Distress Scale (K10) has been used repeatedly in national surveys in Australia as it is appropriate to estimate population needs for community mental health services (Australian Bureau of Statistics, 2008). Although it is not a diagnostic tool, a strong association has been found between K10 scores and a diagnosis of anxiety or depression using the Composite International Diagnostics Interview (CIDI)(Andrews & Slade, 2001). K10 does not include questions to identify psychosis; however depression is often a feature of psychosis (Andrews and Slade 2001.)

The ten questions included in the K10 ask about distress in the previous 4 weeks. 'One' is the minimum score for each item and 'five' is the maximum, summing to a total minimum possible score of 10 (lowest distress) to a maximum of 50 (highest distress). In the Australian Bureau of Statistics (ABS) publications, K10 scores of between 10-15 are categorised as 'low distress'; between 16-21 as 'moderate distress'; between 22-29 as 'high distress' and between 30-50 as 'very high distress' (Australian Bureau of Statistics, 2008). Here we construct a dichotomous variable of 'high-distress' which includes both the 'high' and 'very high' categories as our main mental health variable of interest. Not everyone in this group will have a diagnosed mental health

problem and we acknowledge that this variable may potentially over-estimate the prevalence of mental health conditions.

The alternative approach is to use the available self-reported data in the survey on any current mental health illness. However, this is likely to underestimate the prevalence of mental health conditions. Thus, we take an alternative approach and use the K10 as our main outcome variable of interest. To assess the impact of this strategy, we check the robustness of the model by using separate outcomes of (i) depression; (ii) anxiety; (iii) other mood/affective disorders; and, (iv) all three of these conditions combined as an alternative measure of mental health. These three conditions were chosen as they represent the most prevalent mental health conditions in the survey data.

Information on other chronic conditions is self-reported and includes the national health priority areas for 2007 – cardiovascular disease; diabetes mellitus; cancer; arthritis; osteoporosis; and asthma. We include separate binary variables for each of these conditions. These variables are arguably more robust to self-report than mental health conditions as the survey interviewers have more opportunity to ask cross-validating questions compared with mental health reports (Australian Bureau Statistics, 2007). We also include a proxy measure for disease severity by including the number of prescription medications taken for chronic illness.

Lifestyle risk factors such as smoking, diet exercise and alcohol use are important markers of health behaviours and may also influence an individual's decision to use health services, either directly (for advice) or indirectly (for the treatment of related comorbidity). Here, lifestyle variables are included in two ways – each of six reported lifestyle variables (including dummy measures for (i) being a non-smoker; (ii) if the usual daily serves of fruit, and (iii) vegetables eaten, meet Australian guidelines; (iv) if moderate or vigorous exercise was undertaken in the previous week; (v) if the level of alcohol consumption is considered to be in the 'low risk' category; and (vi) if not obese) enter the metal health equation separately, as these are likely to impact on the likelihood of having a mental health condition. We then use an interaction term of these six variables which we call 'health behaviours' which enters into each of the health practitioner equations. This interaction term controls for lifestyle risk factors as well as acting as a proxy for more motivated individuals.

Study design and methods

Model specification: A multivariate probit (MVP) (with a recursive structure) specification was selected as the most appropriate way of analysing the data given the complex inter-relationship

across the equations, a technique increasingly used in health system analysis (Sarma et al., 2012; Whelan & Wright, 2013). In simple terms, this model is a series of binary choice regressions which, when solved simultaneously, allows for correlation of the error terms across all equations giving consistent and unbiased coefficients by accounting for the likelihood for each equation to be related.

We specify five equations for the respective health service (*GP, PHARM, PHYSIO, COUNSEL, CAM*) use as follows:

$$
\begin{aligned}
GP^{*} &= x'_{GP}\beta_{GP} + \eta_{GP}PHI + \delta_{GP}M^{*} + \varepsilon_{GP} \\
PHARM^{*} &= x'_{PHARM}\beta_{PHARM} + \eta_{PHARM}PHI + \gamma_{PHARM}GP + \delta_{PHARM}M^{*} + \varepsilon_{PHARM} \\
PHYSIO^{*} &= x'_{PHYSIO}\beta_{PHYSIO} + \eta_{PHYSIO}PHI + \gamma_{PHYSIO}GP + \delta_{PHYSIO}M^{*} + \varepsilon_{PHYSIO} \\
COUNSEL^{*} &= x'_{COUNSEL}\beta_{COUNSEL} + \eta_{COUNSEL}PHI + \gamma_{COUNSEL}GP + \delta_{COUNSEL}M^{*} + \varepsilon_{COUNSEL} \\
CAM^{*} &= x'_{CAM}\beta_{CAM} + \eta_{CAM}PHI + \gamma_{CAM}GP + \delta_{CAM}M^{*} + \varepsilon_{CAM}
\end{aligned}
\qquad (1)
$$

where *PHI* represents private health insurance, *M** is latent mental health, is a vector of exogenous covariates; and ε_i is a vector of random error terms (*i= GP, PHARM, PHYSIO, COUNSEL, CAM*).

While GPs are regarded as primary care providers and gatekeepers to more expensive specialist services, consumers can access primary care directly from physiotherapists, counsellors, complementary practitioners and others. However, it is very common for patients to be referred to the other primary care practitioners by their GP. We therefore expect GP use to affect the use of the other health service practitioners.

An important determinant of health service use is private health insurance. However insurance is potentially endogenous due to common unobservable factors, such as risk aversion, affecting the decision to purchase insurance and the decision to visit a health practitioner. The endogeneity of insurance may also arise because of moral hazard and adverse selection (Savage & Wright, 2003) such that individuals who decide to purchase insurance are likely to be those who anticipate a higher demand for health service use. The insurance equation is specified as:

$$PHI^{*} = x'_{I}\beta_{PHI} + \delta_{PHI}M^{*} + \varepsilon_{PHI}$$

where x_{PHI} is a vector of exogenous covariates; and ε_{PHI} is a vector of random error terms.

The main focus of this paper is to estimate the association between mental health condition, M^* and the use of health services. Here we use the K10 scores which as noted earlier is not a diagnostic tool but based on a set of questions about distress in the previous month, that may contain reporting errors. Bound (1991) and Bound et al. (1999) propose a way of purging measurement errors from self-reported health measures. The true latent measure of mental health, M^{**}, is specified follows:

$$M^{**} = x'_M \beta_M + \nu_M \tag{2}$$

where x_M is a vector of exogenous covariates; and ν_M is a vector of random error terms. This underlying true measure of mental health, M^{**}, is related to the self-reported measure, M^*, as follows:

$$M^* = M^{**} + \mu_M \tag{3}$$

Substituting Equation 2 in Equation 3 results in:

$$M^* = x'_M \beta_M + \varepsilon_M \tag{4}$$

where $\varepsilon_M = \mu_M + \nu_M$, thus removing the reporting errors from predicted mental health.

The latent dependent variables are all translated into observed binary variables using the following transformation:

$$Y = \begin{cases} 1 & \text{if } Y^* > 0 \\ 0 & \text{otherwise} \end{cases} \qquad ,Y = GP, PHARM, PHYSIO, COUNSEL, CAM, PHI, M$$

We run the model in two stages. The mental health variable (high/very high distress) is modelled in the first stage using a probit and the resulting continuous latent health variable then enters each of the health practitioner and insurance equations. In the second stage we estimate a system of six equations as a recursive multivariate probit model where the error terms jointly follow a multivariate normal distribution. The estimation is carried out using Stata's mvprobit command.

The resulting coefficients from this model are only informative in terms of their sign and significance as probit models are constrained to the standard normal distribution, which is non-linear. The calculation of marginal effects (ME's, which are the expected change in the dependent variable in response to a change in the independent variable of interest) is possible but not straightforward in this context as there are no standard commands to compute these. Further, we only had remote access to the data due to confidentiality of the respondents (a restriction placed by the government). Therefore, we recovered the coefficients and covariance matrix of the system and used them to estimate ME's using Gauss software. Essentially, we estimate them via numerical derivatives of the multivariate normal distribution functions with respect to the exogenous variables. Standard errors of the estimated marginal effects are computed using the delta method.

Identification: Rather than relying on the assumption of non-linearity of the probit function for identification (see, for example, Wilde (2000)), we include instrumental variables (IVs) in all of the equations. This approach is used frequently by economists and increasingly by epidemiologists when assumptions underlying regression models are violated which may lead to inconsistent or biased results. This approach is often used in health – see for example Denny (2011), Grootendorst (2007). To be valid, IV variables are required to be correlated with the dependent of interest but not correlated with the outcome of interest (mental health) and thus the error term of the regression equation. Therefore, for each of the practitioner equations above, IVs are constructed representing the density of each type of practitioner available, by state as well as geographical classification (major city, inner regional and 'other'). This information is obtained from the 2006 Australian Census of Population and Housing (Australian Bureau of Statistics, 2006), using occupation codes (ANZSCO OCC06P) counting persons by usual place of residence. The summary of average rates of each type of practitioner are summarised in the Online Appendix, Table A2.

To identify the private health insurance equation, a price variable is constructed for both hospital and ancillary service insurance policies. Using the methodology of Butler (1999), it is assumed that individuals will choose a level of health coverage which offers zero out-of-pocket expenses. Data from the Private Health Insurance Administration Council (PHIAC) (Private Health Insurance Administration Council, 2013) from the same year as the NHS data (2007/08) is then used to construct the price of insurance, differing by age, gender and state of residence, which is matched to the NHS data. A more detailed explanation is provided in the Online Appendix,

Section A3. The mental health equation is identified by the six lifestyle variables which enter separately into that equation. Although, one may argue that the lifestyle variables are likely to indirectly affect the use of health services, we find no consistent pattern in the correlations between lifestyle factors and practitioner use. We therefore create an interaction term using these life-style variables for use in the practitioner and PHI equations. This variable indicates the intensity of healthy lifestyle which appears to be more relevant for health service use.

CAM use as a substitute: Following the estimation of the system of equation described above, we undertake an additional analysis using simple probit equations in the sub-group of the population who are in high or very high distress and who have not used any practitioners in the previous 12 months, compared with those who have only used a CAM practitioner (and no other practitioner). We do this in order to identify key factors that might explain why people substitute CAM practitioners with conventional care.

Principal findings

Participant characteristics: A summary of survey participant characteristics by type of health practitioner visit and private health insurance (PHI) status is shown in Table 1. For the sample (N=13,875), the most frequently reported practitioner visit type was to a GP (just over 35%), followed by over 14% visiting a CAM practitioner and 13% seeking advice from a pharmacist. More than half the sample has PHI. From the summary statistics it appears that females tend to use more health services than males across all practitioner types, especially counsellors, pharmacists (for advice) and CAM practitioners, a trend which has been reported frequently for example, Bertakis et al. (2000).

Level of distress: The sample is then broken down by the level of distress according to the K10 scores and by whether participants have visited a family doctor (only), CAM practitioner (only), both or neither in the previous 12 months (Table 2).

88% of the sample was classified being in the low or moderate distress groups – the remaining 12% being classified in the high or very high distress groups. Of those in high or very high distress, 16.3% had used a CAM practitioner (2% of the sample). 9% of those who had seen a CAM practitioner but not a GP (1% of the sample) were in high or very high distress. Similarly 18% of those who had seen a GP only (5% of the sample); and 20% who had seen both (1% of the sample) were in this category. Almost 5% of the sample was classified as being in high or very high distress and had not visited either a GP or a CAM practitioner in the previous year.

We then estimate the full system of equations with the binary mental health status described as having high or very high distress, or otherwise. The estimated coefficients and rhos are presented in Table 4A & Table 5A of the Online Appendix. Key marginal effects from the MVP for each equation are presented in Table 3 – full results can be found in Table 6A of the Online Appendix.

High Distress: We find a strongly positive and significant association between being in high or very high distress and the likelihood of CAM practitioner use, with people in high distress being 6.5 percentage points more likely than those without to see a CAM practitioner. This positive and significant relationship is seen for all practitioners included in the analysis and the strength of this analysis is that the marginal effects can be directly compared across different practitioner types. Those in high distress are 18 percentage points more likely to see a GP; 3.7 percentage points more likely to seek advice from a pharmacist; 6.6 percentage points more likely to see a physiotherapist; and 3.2 percentage points more likely to see a counsellor (Table 3). Results from the same model specification but using different definitions of distress or mental health illness show very similar results. These results are available upon request from the author.

Other health chronic conditions and health behaviours: Chronic conditions are independent predictors of health practitioner use and the results show that consumers differentiate between the types of practitioners used for different health conditions. For example, cardiovascular disease, diabetes, cancer and asthmas are all strong predictors of GP visits, whereas arthritis and osteoporosis are key drivers of physiotherapy. Apart from distress, arthritis and osteoporosis are also strong predictors of CAM practitioner use (Table 3).

The number of prescription medications used regularly as a proxy for the severity of illness is positive in each of the GP, pharmacist and counsellor equations (although only significant for counsellors), whilst it is negative and significant in both the CAM practitioner and physiotherapist equations. For these two equations, the healthy behaviours interaction term is negative and significant whilst it is positive and significant in the GP equation, perhaps suggesting that healthier, more motivated people are visiting CAM practitioners and physiotherapists and that sicker, less motivated people are more likely to see GP's. It may also be suggestive of CAM being used for 'wellness' rather than treatment (Table 3).

Private health insurance (PHI): PHI is associated with a higher likelihood of CAM practitioner and physiotherapist use, but not GP use given that these services are subsidised under the public insurance scheme (Table 6A)

Concurrent GP use: As GPs provide a 'gatekeeper' role in the health system, we expect that GP use may predict the use of other health services, but this is only true of visits to pharmacists and counsellors (Table 6A).

Other socio-demographic variables: The age distribution of CAM practitioner use confirms previous findings (Eisenberg et al., 1998) where use peaks in the 35-40 year old age group and decreases as people age. This is in contrast to GP and physiotherapist use where older age groups are more likely to visit than younger age groups. Younger age groups are the most likely to ask pharmacists for advice. More educated people (those who have finished high school) are more likely to access all types of care. A similar pattern is seen for employment (employed people are more likely to be using all services), except for counselling services, which may be a reflection of the correlation between high levels of distress and unemployment (Table 6A).

Those in the lowest socioeconomic groups are less likely to access all practitioners and recent immigrants to Australia (arriving up to six years before the data were collected) are less likely to access CAM practitioners, pharmacists and counsellors. People whose main language is not English are less likely to report using all services. Surprisingly, given the relative shortage of many health professionals in rural and regional Australia (National Health Workforce Taskforce, 2009), significant geographical differences are only found for physiotherapists where people from major cities and regional centre are more likely than those in rural areas to visit (Table 6A).

Instrumental variables (IVs): In terms of the IVs used, statistically significant correlation is found between the dependent variables and each IV, suggesting that the IV's are valid - see Appendix, Table 4A which presents all coefficients. This result shows that people are price sensitive to the purchase of insurance, reflecting the current in-built incentive in the Australian system (Colombo & Tapay, 2003). As expected, increased rates of GPs, pharmacists and counsellors per head of population are associated with increased use of these services. Interestingly however, increased rates of CAM practitioners and physiotherapists are associated with a lower likelihood of use. This may be explained by previous research which indicates that rural Australians may be more likely to use CAM practitioners than their city counterparts (Wardle et al., 2012), either reflecting

a different pattern of preference of healthcare, increased referrals from other health professionals or perhaps a shortage of GP care in some instances. As rural and remote areas are less likely to have as many practitioners the association may be working through one of these mechanisms.

Interactions between the correlated error terms of equations: Positive and significant associations were found between the CAM practitioner equations and all other practitioner equations as well as between a number of other allied health equations – see Appendix Table 5A. A negative correlation would imply that unobserved factors that increase the likelihood of using CAM are negatively associated with the likelihood of using another health practitioner whereas a positive correlation indicates a positive association of the unobserved factors with the CAM use and the use of another health practitioner. The unobserved traits may reflect referral patterns between practitioners, but may also be the result of personality type, risk preference or beliefs.

CAM use as a substitute: Finally, we present the result of a probit model that we ran on the sub-group of people in high or very high distress who have used CAM, but no conventional practitioners (base category is no practitioner use). The specification is identical to that used in the full system for CAM practitioner use (excluding the distress variable as there is no variation here), but without the IV (CAM practitioner rate).

This sub-population only contains 515 people, meaning that the power to detect differences is limited. However, we do find that being in a low-socioeconomic group, as determined by inclusion in the first or second decile of the Index of Relative Socio-Economic Disadvantage (see online Appendix Table A1), makes CAM practitioner use less likely by more than 6 percentage points. In addition, being more educated and employed is predictive of CAM use.

Conclusions

Here, CAM practitioner use is modelled as part of the primary health care system. We are particularly interested in describing substitution versus complementarity patterns of CAM practitioner use and conventional care. By taking a structural approach which allows for interactions between the choice of health services, we are able to more robustly estimate the marginal effect of having a mental health condition on the likelihood of using not only CAM practitioners, but also accessing other primary care practitioners. The results of this analysis show that being in high or very high distress is an independent predictor of CAM practitioner use, even when accounting for other types of chronic illness for which CAM use has been

previously reported. The strength of this analysis is that it allows this finding to be placed in the context of other primary health care use. We find here that people in high distress are most likely to be visiting GPs; the effect of seeing a CAM practitioner is similar to that of seeing a physiotherapist, and least likely to be seeking advice from a pharmacist or seeing a counsellor. Such information is important in explain the preferences of care-seeking from a policy perspective. Our results are also robust to various definitions of mental health conditions. The (unweighted) prevalence rate of CAM use for those in high or very high distress is 16.3%, which falls within the range of earlier findings from the US. Differences in prevalence rates may be attributable to differences in the definitions of mental health conditions and CAM use, as well as differences in the organization and funding of primary health care services.

We are interested here in the relationship between mental health conditions and CAM practitioner use for a number of reasons. Firstly, we know that mental health conditions are under-reported and under-treated in the general population. We are therefore interested in the potential for substitution of conventional care by people in high or very-high distress by CAM practitioner use, as they could be at risk of under-treatment with appropriate referrals and potentially medication. We found that less than 1% of the sample was classified in this way. If we also include those people who are classified as being in moderate distress, this figure is around 4% of the total sample. Whilst it is important to establish if appropriate care for these individuals is being met, it is reassuring that a higher proportion of people do not fall into this category. However, this finding does not mitigate the importance of appropriate training for CAM practitioners to identify and refer patients to other practitioners when necessary. CAM practitioners can also be viewed in an alternative way, as an opportunity to reach out to this group and act as a referral point to more appropriate care (even if this pathway is hypothetical at this point in time). CAM practitioners may continue to supplement care or even substitute it for more mild conditions (increasing health service efficiency); however this is highly dependent on the level of training and regulation of the practitioner and the system within they are operating. More worryingly, a larger percentage of the sample (5%) is classified being in high or very high distress and has not accessed a GP or CAM practitioner in the previous 12 months. This is perhaps the 'hardest to reach' population and eliciting their preferences for the organization of mental health services, as well as any perceived barriers to access, is any area of active research (Dowrick et al., 2009; Proctor et al., 2009).

Other results are also interesting. People from a lower socioeconomic backgrounds are less likely to use CAM practitioners, physiotherapists and pharmacists (for advice), but this effect is not

seen for GP's and counsellors, which are subsidized by the government. Conversely, private health insurance is positively and significantly associated with CAM practitioner, physiotherapist and pharmacist use, arguably (appropriately) improving health system efficiency. However, there is good evidence suggesting poorer mental health is strongly associated with lower socioeconomic indicators (Druss & Rosenheck, 2000; Wang et al., 2005). In the sub-group analysis that we presented here (in Table 4) for the group in high distress who used CAM practitioners as a substitute for conventional care, people from a lower socio-economic group were significantly less likely to be using CAM. As such, it may be that there is greater unmet demand for CAM practitioner services than revealed here, especially in the lower socioeconomic groups. Thus, if the role of CAM practitioners was to be more formally recognised within conventional mental health services by policy makers (given evidence of a positive treatment effect), without a subsequent re-think of funding arrangements, such a situation could further encourage health system inequities.

One of the strengths of this analysis is that we can directly compare key associations not only for CAM use, but also across other primary care practitioners. In terms of other chronic illness, key drivers of CAM use (having arthritis and osteoporosis) were also predictive of using a physiotherapist (usually considered to be a 'conventional' provider). In contrast, those using a GP were more likely to have cardiovascular disease, cancer, diabetes and asthma. People who used CAM practitioners and physiotherapists were more likely to display healthy behaviours - a result that has been shown previously (Hunt et al., 2010; Nahin et al., 2007); people who visited GP's were significantly less so. Further, the use of fewer prescription medications for chronic illnesses – a variable which we argue acts as a proxy for the severity of disease – was negatively and significantly associated with CAM and physiotherapist use. One possible interpretation of this is that consumers may not be making a mental distinction between 'CAM' and 'conventional' modalities as such, rather making decisions based on the appropriateness of the practitioner for their condition/s, their underlying latent health status, as well as on other factors, likely price, availability and acceptability. Mental health conditions are then unique – being highly predictive of all types of primary health care use in this analysis.

We acknowledge some important limitations to our analysis. Firstly, we do not know from the data the specific reasons why individuals visited the different health practitioners in the previous 12 months, nor do we know the frequency or adequacy (quality) of visits. Secondly, we do not have a definitive diagnosis of a mental health condition, instead relying on the K10 instrument as an appropriate population screening tool. Although we are likely to overestimate the prevalence

of mental health conditions using this measure, we argue for the purposes of this analysis that the K10 is an appropriate measure and that it overcomes much of the (downward) bias of using self-reported mental health conditions. Another limitation is that data were not collected in the survey on the full range of CAM practitioners practising in Australia. Notably this includes massage therapists for which the prevalence of use has been estimated to be relatively high in previous Australian studies (Spinks et al., 2013). Thus, the estimates of CAM practitioner use are likely underestimated, although it is difficult to predict how this may affect the results. Lastly, we have not included the use of complementary products in this analysis, mainly due to a lack of detailed data on the type of CAM product used by individuals.

Whilst the analysis presented here uses data from Australia, the implications are generalizable to other developed countries. We find that even after accounting for mental health as an endogenous variable, it remains an independent predictor, not only of CAM practitioner use, but to a greater or lesser extent of other primary health care providers. This analysis complements previous work for thinking about CAM practitioners within a primary heath context (Tovey & Adams, 2001), including how different funding arrangements, regulation and referral patterns are inter-connected. Whilst in theory CAM practitioners may provide a possible first contact point with the primary health care system for those with a mental health condition, as it stands, this is unlikely to be a particularly successful strategy from a population perspective given the low rates of substitution. Further, there remains a larger proportion of the population who are not likely to access any type of primary health care provider and it is this latter group that provides the biggest challenge to policy makers and practitioners.

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Table 1: Participant characteristics by practitioner use

	Total sample	GP	Pharmacist	Physio-therapist	Counsellor	CAMPRAC	PHI
	% [a]	% [b]	% [b]	% [b]	% [b]	% [b]	% [b]
Age 18_29	15.7	11.3	19.0	15.1	18.3	14.4	12.9
Age 30_59	55.7	58.1	58.0	57.5	66.3	65.7	58.7
Age 60 or over	28.5	30.6	23.0	27.4	15.4	20.0	28.5
Female	52.5	52.8	63.7	56.7	63.7	59.0	52.9
Married	51.7	51.6	49.7	53.4	33.8	56.2	61.0
Non-English speaking [e]	7.5	6.2	3.9	4.3	2.0	3.8	6.0
Above school education	53.7	53.9	58.8	63.0	59.5	62.8	62.3
Employed	63.7	60.7	65.4	67.8	59.2	75.5	71.3
Household income [d]	1506.9	1640.9	1384.7	1676.7	1514.1	1794.6	1769.2
Born in Australia or NZ	75.2	76.7	80.5	77.8	84.1	81.2	76.0
Recent immigrant	4.5	3.0	2.5	3.4	1.5	2.3	3.8
Lives in major city	66.8	66.5	67.1	72.0	69.0	68.1	71.6
Lives in Inner Regional	20.8	20.8	20.8	19.9	20.5	20.3	19.0
Low socio-economic [f]	18.8	21.0	17.6	13.7	21.2	11.4	10.1
Cardiovascular disease	27.7	37.8	31.3	29.5	31.3	25.3	27.9
Cancer	2.4	3.5	3.1	2.7	3.2	2.2	2.3
Arthritis	22.9	29.0	24.9	29.8	26.4	23.5	21.7
Osteoporosis	5.0	5.9	6.3	7.6	5.9	5.3	5.0
Diabetes	6.1	11.5	7.0	5.6	6.2	4.0	5.3
Asthma	10.8	13.9	17.3	12.9	19.9	12.6	10.0
Total Sample		**35.0**	**13.7**	**10.0**	**6.6**	**14.7**	**52.5**

NOTES: Table 1

[a] Percentage of total sample
[b] Percentage of practitioner type or PHI
Abbreviations: GP general practitioner (family doctor); CAMPRAC complementary & alternative medicine practitioner; PHI private health insurance; NZ New Zealand
[c] Main language spoken at home is not English
[d] Gross weekly cash income of household, $AUD 2007 prices
[e] As measure by the Socio-economic Index for Areas – Index of Disadvantage (Australian Bureau of Statistics). Here, a dummy variable indicates the lowest two deciles, that is, the most disadvantaged.

Table 2: Grouper Kessler-10 (K10) score by general practitioner (GP) and CAM practitioner use

	No GP or CAMPRAC use		CAMPRAC but no GP		GP but no CAMPRAC		Both GP and CAMPRAC use		Total sample	
K10 Group Score	% sub-grp	% total	% sub-grp	% total	% sub-grp	% total	% sub-grp	% total	Freq.	%
Low distress level	73.3	41.2	68.7	6.1	58.6	17.1	49.2	2.9	9,326	67.2
Moderate distress level	17.9	10.0	22.1	1.9	23.2	6.8	30.7	1.8	2,850	20.5
High distress level	6.5	3.7	7.4	0.6	11.8	3.4	13.9	0.8	1,188	8.6
Very high distress level	2.2	1.2	1.9	0.2	6.3	1.9	6.2	0.4	503	3.6

Abbreviations: K10 Kessler 10 Psychological Distress Scale; GP General Practitioner (family doctor); CAMPRAC complementary & alternative medicine practitioner; Freq. Frequency; sub-grp sub-group

Table 3: Key results (marginal effects) from the multivariate probit

	PHI		Doctor (GP)		Pharmacist		Physiotherapist		Counsellor		CAM Practitioner	
	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE
Female	0.074	(0.012)***	-0.020	(0.009)**	0.061	(0.007)***	0.006	(0.005)	0.019	(0.005)***	0.033	(0.006)***
Education> high school	0.093	(0.010)***	0.027	(0.009)***	0.036	(0.007)***	0.029	(0.005)***	0.027	(0.005)***	0.029	(0.006)***
Employed	0.044	(0.014)***	0.049	(0.012)***	0.013	(0.009)	0.021	(0.007)***	-0.008	(0.006)	0.055	(0.008)***
Household income (log)	0.170	(0.008)***	0.049	(0.007)***	0.026	(0.006)***	0.037	(0.005)***	0.006	(0.004)*	0.026	(0.005)***
Cardiovascular disease	0.025	(0.013)**	0.096	(0.011)***	0.014	(0.008)*	0.0002	(0.006)	-0.010	(0.006)*	0.008	(0.008)
Cancer	0.019	(0.031)	0.054	(0.027)**	0.031	(0.019)	-0.011	(0.015)	0.012	(0.012)	-0.004	(0.019)
Arthritis	0.019	(0.012)	0.030	(0.011)***	0.001	(0.008)	0.033	(0.006)***	-0.006	(0.005)	0.029	(0.007)***
Osteoporosis	0.044	(0.022)**	-0.037	(0.020)*	0.024	(0.014)*	0.032	(0.011)***	-0.006	(0.009)	0.028	(0.014)**
Diabetes	-0.059	(0.021)***	0.239	(0.019)***	-0.003	(0.015)	-0.008	(0.012)	-0.036	(0.011)***	-0.010	(0.016)
Asthma	-0.037	(0.016)**	0.038	(0.014)***	0.039	(0.009)***	0.0001	(0.008)	-0.001	(0.006)	0.017	(0.009)*
High/very high distress	-0.164	(0.014)***	0.181	(0.013)***	0.037	(0.012)***	0.066	(0.008)***	0.032	(0.007)***	0.065	(0.011)***
Healthy behaviours	0.116	(0.024)***	-0.071	(0.023)***	0.030	(0.016)*	0.050	(0.012)***	0.021	(0.011)*	0.021	(0.014)

Abbreviations: PHI Private Health Insurance; CAM Complementary and Alternative Medicine; ME Marginal Effects; SE standard errors. *, **, *** denote significance at 10%, 5% and 1% respectively.

Table 4: Probit analysis of CAM practitioner use in the sub-population who are in high or very high distress and who have used no other health practitioner in the previous 12 months

	Marginal effect	SE
Age 30-59 years	0.005	(0.035)
Age 60 years plus	0.002	(0.052)
Female	0.018	(0.026)
Married	0.031	(0.030)
English not main lang.	0.016	(0.055)
Education> high school	0.051	(0.031)*
Employed	0.085	(0.037)**
Household income (log)	0.008	(0.019)
Born Australia or NZ	0.047	(0.031)
Recent migrant	-0.059	(0.041)
Resides major city	-0.015	(0.046)
Resides inner regional	-0.036	(0.041)
Low socio-economic	-0.066	(0.027)**
Cardiovascular disease	-0.005	(0.033)
Arthritis	0.088	(0.044)**
Osteoporosis	-0.019	(0.048)
Diabetes	0.111	(0.098)
Asthma	0.015	(0.048)
Number prescription	-0.003	(0.009)
Healthy behaviours	-0.056	(0.042)
PHI	0.009	(0.029)

Abbreviations**:** PHI Private Health Insurance; CAM Complementary and Alternative Medicine; SE standard errors. *, **, *** denote significance at 10%, 5% and 1% respectively.

Table A1: Definitions of all variables used in the analysis

Age: (base category 18-29 years); 30-59 years; 60 years plus
Female: 1 if yes, 0 otherwise
Married (including de-facto): 1 if yes, 0 otherwise
English (main language spoken): 1 if no, 0 otherwise
Education> high school: 1 if obtained a post-high school qualification, 0 otherwise
Employed (currently): 1 if yes, 0 otherwise
Household income (log): $AUD 2007, continuous
Born Australia or New Zealand: 1 if yes, 0 otherwise
Recent migrant (within the past 6 years): 1 if yes, 0 otherwise
Resides in a major city: 1 if yes, 0 otherwise
Resides in an inner regional area: 1 if yes, 0 otherwise
Low socio-economic [Using the Socio-economic Indexes for Areas (SEIFA) constructed by the Australian Bureau of Statistics -The Index of Relative Socio-Economic Disadvantage. http://www.abs.gov.au/websitedbs/censushome.nsf/home/seifa?opendocument&navpos=260]: 1 if household is in decile 1 or 2, 0 otherwise
Cardiovascular disease: 1 if disease is current, 0 otherwise
Cancer: 1 if disease is current, 0 otherwise
Arthritis: 1 if disease is current, 0 otherwise
Osteoporosis: 1 if disease is current, 0 otherwise
Diabetes: 1 if disease is current, 0 otherwise
Asthma: 1 if disease is current, 0 otherwise
High/very high distress: 1 if Kessler 10 score is classified as 'high' or 'very high', equating to a score of 22 or higher, 0 otherwise
Number of prescription medications: for chronic illness, continuous
Bodily pain experience in the last 4 weeks: 1 if yes, 0 otherwise
Non-smoker (current): 1 if yes, 0 otherwise
Daily serves of fruit meets Australian guidelines: 1 met guidelines, 0 otherwise
Daily serves of vegetables meets Australian guidelines: 1 met guidelines, 0 otherwise
Moderate or vigorous exercise was undertaken in the previous week: 1 if yes, 0 otherwise
Alcohol consumption is considered to be in the 'low risk' category: 1 if yes, 0 otherwise
Not obese: 1 if yes, 0 otherwise
Healthy behaviours - interaction term of the six lifestyle factors detailed above: non-smoker*fruit*vegetables*exercise*alcohol*obese
GP (Doctor) rate: number of general practitioner doctors per 100,000 population by state and region
Pharmacist rate: number of pharmacists per 100,000 population by state and region
Physiotherapist rate: number of physiotherapists per 100,000 population by state and region
Counsellor rate: number of accredited counsellors, psychologists & social/welfare workers per 100,000 population by state and region
CAMPRAC rate: number of complementary medicine practitioners per 100,000 population by state and region – includes four types of practitioner: naturopath, chiropractor, osteopath, Chinese Medicine Practitioner
Price-hospital private health insurance (PHI): see Section A3 below
Price- ancillary private health insurance (PHI): see Section A3 below

Table A2: Average rates of health professionals, by geographical classification

	Major cities	Inner Regional	Other
GP per 100,000	203	41	19
Pharmacists per 100,000	87	17	8
Physiotherapists per 100,000	120	24	11
Counsellors per 100,000	221	51	24
CAMPRAC per 100,000	47	12	4

Abbreviations: GP General Practitioner (doctor); CAMPRAC Complementary and Alternative Medicine Practitioners

Note: These rates are further broken down by state and used as the instrumental variables to identify each of the structural equations for each type of primary health care service in the main results.

Section A3: Construction of the price of private health insurance for use as an instrumental variable

Using data on the premium revenue, policy type and the number of policies sold by insurance company, premiums are estimated at state level, by age and gender (assumed to be constant due to the community rating regulations). First, an average administrative loading is calculated for each state using the ratio of total premium revenue to total benefits paid. Premiums for family cover are assumed to be double a single policy. Then, if Z is the premium for insurance and B the expected benefit, for an actuarially fair premium, $Z = B$ and $Z/B = 1$. The ratio of premium to expected benefit can be taken as the price of insurance, i.e. the price paid per dollar of expected benefits received. Price is then obtained by dividing the relevant estimated premium with benefits paid in each state, by age group and gender.

Table 4A: Full results (Coefficients) for the multivariate probit

	PHI		Doctor/GP		Pharmacist		Physiotherapist		Counsellor		CAM Practitioner	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Age 30-59 years	0.166	(0.037)***	0.302	(0.036)***	-0.134	(0.042)***	0.038	(0.047)	0.013	(0.052)	0.154	(0.042)***
Age 60 years plus	0.352	(0.064)***	0.443	(0.058)***	-0.193	(0.071)***	0.299	(0.077)***	-0.427	(0.094)***	0.165	(0.070)**
Female	0.185	(0.030)***	-0.050	(0.024)**	0.259	(0.029)***	0.038	(0.032)	0.140	(0.038)***	0.168	(0.029)***
Married	0.180	(0.025)***	0.022	(0.026)	0.036	(0.031)	-0.015	(0.034)	-0.233	(0.041)***	0.055	(0.030)*
English not main lang.	-0.052	(0.050)	-0.216	(0.052)***	-0.335	(0.070)***	-0.303	(0.075)***	-0.583	(0.112)***	-0.204	(0.069)***
Education> high school	0.234	(0.024)***	0.077	(0.025)***	0.147	(0.030)***	0.169	(0.033)***	0.209	(0.039)***	0.141	(0.029)***
Employed	0.110	(0.035)***	0.135	(0.034)***	0.057	(0.041)	0.118	(0.046)***	-0.085	(0.052)	0.264	(0.041)***
Household income (log)	0.426	(0.020)***	0.142	(0.021)***	0.087	(0.026)***	0.212	(0.028)***	0.002	(0.033)	0.128	(0.025)***
Born Australia or NZ	0.032	(0.032)	0.076	(0.031)**	0.073	(0.039)*	0.050	(0.041)	0.105	(0.052)**	0.134	(0.038)***
Recent migrant	-0.250	(0.062)***	0.001	(0.064)	-0.145	(0.084)*	0.098	(0.087)	-0.180	(0.127)	-0.223	(0.085)***
Resides major city	0.314	(0.037)***	-0.092	(0.041)**	-0.056	(0.049)	0.198	(0.059)***	0.070	(0.065)	0.052	(0.050)
Resides inner regional	0.159	(0.041)***	-0.102	(0.042)**	-0.051	(0.052)	0.153	(0.060)**	0.039	(0.068)	0.004	(0.050)
Low socio-economic	-0.447	(0.031)***	0.026	(0.032)	-0.097	(0.040)**	-0.159	(0.046)***	-0.086	(0.050)*	-0.279	(0.042)***
Cardiovascular disease	0.063	(0.032)**	0.263	(0.030)***	0.069	(0.037)*	-0.021	(0.041)	-0.097	(0.048)**	0.025	(0.037)
Cancer	0.049	(0.077)	0.147	(0.073)**	0.140	(0.086)	-0.078	(0.097)	0.102	(0.109)	-0.030	(0.091)
Arthritis	0.049	(0.031)	0.082	(0.030)***	0.003	(0.037)	0.199	(0.039)***	-0.056	(0.048)	0.135	(0.036)***
Osteoporosis	0.111	(0.056)**	-0.099	(0.055)*	0.094	(0.063)	0.204	(0.066)***	-0.072	(0.083)	0.145	(0.065)**
Diabetes	-0.148	(0.052)***	0.647	(0.050)***	0.026	(0.063)	-0.090	(0.072)	-0.288	(0.084)***	-0.094	(0.070)
Asthma	-0.093	(0.039)**	0.103	(0.038)***	0.189	(0.042)***	-0.004	(0.049)	0.003	(0.053)	0.075	(0.044)*
High/very high distress	-0.412	(0.036)***	0.482	(0.036)***	0.220	(0.045)***	0.396	(0.049)***	0.352	(0.058)***	0.270	(0.045)***
Number prescription	0.111	(0.014)***	0.013	(0.013)	0.021	(0.015)	-0.025	(0.017)	0.122	(0.018)***	-0.054	(0.016)***
Healthy behaviours	0.290	(0.062)***	-0.188	(0.063)***	0.106	(0.071)	0.316	(0.071)***	0.148	(0.095)	0.126	(0.067)*

Table 4A: continued

Price-hospital PHI	-1.70E-05	(0.001)										
Price-ancillary PHI	-0.004	(0.002)**										
Doctor (GP) rate			0.0004	(0.000)***								
Pharmacist rate					0.001	(0.000)*						
Physiotherapist rate							-0.002	(0.001)***				
Counsellor rate									0.0004	(0.000)**		
CAMPRAC rate											-0.005	(0.001)***
PHI			-0.054	(0.066)	-0.104	(0.079)	0.174	(0.086)**	-0.053	(0.101)	0.167	(0.075)**
GP					0.212	(0.080)***	0.087	(0.088)	0.360	(0.100)***	-0.075	(0.080)
Constant	-4.257	(0.151)***	-1.275	(0.142)***	-1.688	(0.172)***	-2.815	(0.190)***	-1.399	(0.216)***	-2.122	(0.169)***

Abbreviations: PHI Private Health Insurance; GP General Practitioner; CAM Complementary and Alternative Medicine; NZ New Zealand; SE standard errors. *, **, *** denote significance at 10%, 5% and 1% respectively.

Table 5A: Correlation Coefficients (SE)

	PHI	Doctor/GP	Pharmacist	Physiotherapist	Counsellor	CAMPRAC
PHI	-					
Doctor/GP	0.031	_				
	(0.037)					
Pharmacist	0.086	0.063	_			
	(0.044)*	(0.046)				
Physiotherapist	0.093	0.048	0.159	_		
	(0.047)**	(0.050)	(0.020)***			
Counsellor	0.035	-0.048	0.175	0.101	_	
	(0.056)	(0.056)	(0.023)***	(0.025)***		
CAM Practitioner	0.065	0.126	0.136	0.11	0.128	_
	(0.041)	(0.046)***	(0.019)***	(0.019)***	(0.021)***	

Standard errors are given in parentheses. *, **, *** denote significance at 10%, 5% and 1% respectively.

Abbreviations: PHI Private Health Insurance; GP General Practitioner; CAMPRAC Complementary and Alternative Medicine Practitioner; SE

Table 6A: Full results (marginal effects - MEs) for the multivariate probit

	PHI		Doctor (GP)		Pharmacist		Physiotherapist		Counsellor		CAM Practitioner	
	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE	ME	SE
Age 30-59 years	0.066	(0.015)***	0.110	(0.013)***	-0.029	(0.009)***	0.010	(0.007)	0.003	(0.006)	0.035	(0.008)***
Age 60 years plus	0.140	(0.026)***	0.160	(0.021)***	-0.040	(0.015)***	0.054	(0.012)***	-0.043	(0.011)***	0.038	(0.014)***
Female	0.074	(0.012)***	-0.020	(0.009)**	0.061	(0.007)***	0.006	(0.005)	0.019	(0.005)***	0.033	(0.006)***
Married	0.072	(0.010)***	0.007	(0.009)	0.011	(0.007)	-0.001	(0.005)	-0.023	(0.004)***	0.010	(0.006)
English not main lang.	-0.021	(0.020)	-0.079	(0.019)***	-0.073	(0.015)***	-0.051	(0.012)***	-0.065	(0.013)***	-0.044	(0.014)***
Education> high school	0.093	(0.010)***	0.027	(0.009)***	0.036	(0.007)***	0.029	(0.005)***	0.027	(0.005)***	0.029	(0.006)***
Employed	0.044	(0.014)***	0.049	(0.012)***	0.013	(0.009)	0.021	(0.007)***	-0.008	(0.006)	0.055	(0.008)***
Household income (log)	0.170	(0.008)***	0.049	(0.007)***	0.026	(0.006)***	0.037	(0.005)***	0.006	(0.004)*	0.026	(0.005)***
Born Australia or NZ	0.013	(0.013)	0.028	(0.011)**	0.016	(0.009)*	0.009	(0.006)	0.012	(0.006)**	0.028	(0.008)***
Recent migrant	-0.099	(0.024)***	0.002	(0.024)	-0.036	(0.019)*	0.014	(0.014)	-0.024	(0.014)*	-0.044	(0.018)**
Resides major city	0.125	(0.015)***	-0.036	(0.015)**	-0.006	(0.011)	0.032	(0.010)***	0.013	(0.008)	0.007	(0.011)
Resides inner regional	0.063	(0.016)***	-0.039	(0.015)**	-0.008	(0.012)	0.024	(0.010)**	0.007	(0.008)	-0.002	(0.010)
Low socio-economic	-0.178	(0.012)***	0.013	(0.011)	-0.030	(0.010)***	-0.027	(0.008)***	-0.017	(0.006)**	-0.054	(0.010)***
Cardiovascular disease	0.025	(0.013)**	0.096	(0.011)***	0.014	(0.008)*	-0.0002	(0.006)	-0.010	(0.006)*	0.008	(0.008)
Cancer	0.019	(0.031)	0.054	(0.027)**	0.031	(0.019)	-0.011	(0.015)	0.012	(0.012)	-0.004	(0.019)
Arthritis	0.019	(0.012)	0.030	(0.011)***	0.001	(0.008)	0.033	(0.006)***	-0.006	(0.005)	0.029	(0.007)***
Osteoporosis	0.044	(0.022)**	-0.037	(0.020)*	0.024	(0.014)*	0.032	(0.011)***	-0.006	(0.009)	0.028	(0.014)**
Diabetes	-0.059	(0.021)***	0.239	(0.019)***	-0.003	(0.015)	-0.008	(0.012)	-0.036	(0.011)***	-0.010	(0.016)
Asthma	-0.037	(0.016)**	0.038	(0.014)***	0.039	(0.009)***	-0.0001	(0.008)	-0.001	(0.006)	0.017	(0.009)*
High/very high distress	-0.164	(0.014)***	0.181	(0.013)***	0.037	(0.012)***	0.066	(0.008)***	0.032	(0.007)***	0.065	(0.011)***
Number prescription	0.044	(0.005)***	0.004	(0.005)	0.007	(0.003)*	-0.003	(0.003)	0.015	(0.003)***	-0.012	(0.003)***
Healthy behaviours	0.116	(0.024)***	-0.071	(0.023)***	0.030	(0.016)*	0.050	(0.012)***	0.021	(0.011)*	0.021	(0.014)

Table 6A: continued

Price-hospital PHI	-6.77E-06	(0.001)***	1.33E-07	(0.000)***	-3.14E-07	(0.000)***	-8.79E-08	(0.000)	-2.61E-07	(0.000)	1.10E-07	(0.000)***
Price-ancillary PHI	-0.002	(0.001)***	3.04E-05	(0.000)***	-7.14E-05	(0.000)***	-2.00E-05	(0.000)***	-5.93E-05	(0.000)***	2.48E-05	(0.000)***
Doctor (GP) rate	-	-	1.56E-04	(0.000)***	-3.59E-06	(0.000)	4.54E-06	(0.000)	-8.78E-07	(0.000)	5.80E-06	(0.000)*
Pharmacist rate	-	-	-	-	1.93E-04	(0.000)*	-	-	-	-	-	-
Physiotherapist rate	-	-	-	-	-	-	-2.83E-04	(0.000)**	-	-	-	-
Counsellor rate	-	-	-	-	-	-	-	-	4.78E-05	(0.000)**	-	-
CAMPRAC rate	-	-	-	-	-	-	-	-	-	-	-0.001	(0.000)***
PHI			-0.020	(0.024)	-0.021	(0.016)	0.028	(0.013)**	-0.005	(0.010)	0.036	(0.016)**
GP					0.045	(0.018)**	0.014	(0.015)	0.038	(0.012)***	-0.016	(0.017)
Constant	-1.695	(0.060)***	-0.435	(0.050)***	-0.439	(0.053)***	-0.481	(0.046)***	-0.219	(0.038)***	-0.426	(0.048)***

Standard errors are given in parentheses. *, **, *** denote significance at 10%, 5% and 1% respectively.

Abbreviations: PHI Private Health Insurance; GP General Practitioner; CAM Complementary and Alternative Medicine; NZ New Zealand; ME Marginal Effect; SE standard errors

Note: Because of the endogenous structure of the model, marginal effects of an independent variable may comprise of more than one component, i.e either a direct effect or an indirect effect(s) thorough the endogenous variable(s) or both. Consider, for example, *gender*, that appears in all three equations. If we were to compute the marginal effect of *gender* on say CAM use, this would comprise of a direct effect of *gender* on CAM use and indirect effects through the insurance and GP equations. On the other hand, a variable such as *cam rate* will only have a direct effect while *doctor rate* will only have an indirect effect on CAM use through the GP equation.

Specific Declaration Chapter Four

Declaration by candidate

In the case of Chapter Four, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
• Contributed to the original concept for the paper • Wrote the first draft and coordinated all suggested changes • Analysed the data • Submitted the paper (corresponding author)	70

The following co-authors contributed to the work. Co-authors who are students at Monash University must also indicate the extent of their contribution in percentage terms:

Name	Nature of contribution
Bruce Hollingsworth	Contributed to the original concept for the paper; Edited and reviewed the manuscript; Analysed the data
Lenore Manderson	Contributed to the original concept for the paper; Edited and reviewed the manuscript
Vivian Lin	Contributed to the original concept for the paper; Edited and reviewed the manuscript
Rachel Canaway	Contributed to the original concept for the paper; Edited and reviewed the manuscript

Candidate's Signature		**Date** 17/03/2013

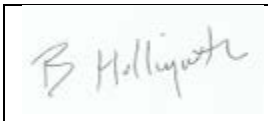
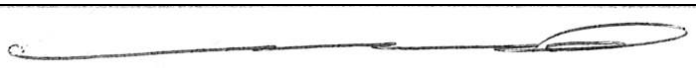
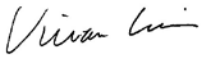
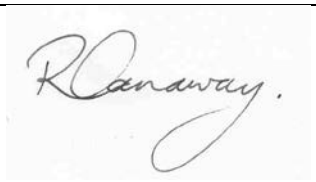
Declaration by co-authors

The undersigned hereby certify that:

(19) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(20) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(21) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(22) there are no other authors of the publication according to these criteria;
(23) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(24) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s)	**School of Psychology and Psychiatry, Monash University, Caulfield Campus**

[Please note that the location(s) must be institutional in nature, and should be indicated here as a department, centre or institute, with specific campus identification where relevant.]

Signature 1	 Bruce Hollingsworth	**Date** 27/03/2013
Signature 2	 Lenore Manderson	02/05/2013
Signature 3	 Vivian Lin	30/05/2013
Signature 4	 Rachel Canaway	3/05/2013

Chapter Four: Costs and drivers of Complementary and Alternative Medicine (CAM) use in people with type 2 diabetes or cardiovascular disease

Abstract

Aim: To describe the key drivers and costs to individuals of complementary and alternative medicine (CAM) use in a population with type 2 diabetes and/or cardiovascular disease.

Methods: Two datasets were utilized. The first derived from a purpose-designed survey of individuals in Australia, all with type 2 diabetes and/or cardiovascular disease (n=2,705). As the vast majority (91%) of the sample had type 2 diabetes, socio-demographic variables were compared with those of people with type 2 diabetes and the general population using the National Health Survey (NHS) of Australia. Step-wise multinomial logit and ordered logit regressions were used for the main analysis.

Results: People with type 2 diabetes and/or cardiovascular disease appear more likely than the general population to use both CAM products and practitioners. Concurrent chronic conditions appear to be the key motivators of CAM use, however, CAM use is also associated with lower quality of life. Previous attendance at a chronic disease self-management program and current attendance at a social or health-related support group were also associated with an increased likelihood of CAM use. Median CAM expenditure was estimated at AUD$240 per annum for practitioner use, and AUD$360 per annum for product use.

Conclusions: Chronic conditions appear to be strong independent predictors of CAM use in this population, raising many issues for integrative medicine. In particular, health professionals should be aware that this population are more likely to be using both conventional medicine and CAM, highlighting the need for coordination of care and communication between professionals.

Keywords: Complementary therapies; Health expenditures; National Health Survey (Australia); Type 2 diabetes mellitus; Cardiovascular disease

Introduction

Type 2 diabetes and cardiovascular disease are major public health concerns, accounting for over 1 million and 17 million global deaths respectively in 2008 [1]. To manage these chronic conditions, people may present to a range of practitioners and use various medications and other treatments, often combining different complementary, alternative and biomedical treatments including nutritional supplements, mass manufactured herbs, vitamins and minerals, institutionalized and professional practices (for example, chiropractic or naturopathic services), non-professionalized practices, and meditation and spiritual practices (including prayer) [2-7]. Complementary and alternative medicine (CAM) may offer cost-effective treatment for various health complaints experienced by those with chronic illness [8], although the side-effects from certain CAM products and practices, and interactions with prescription medications, may occur [9, 10]. People with chronic conditions reportedly use CAM more frequently than others in the general population [11-14]. However, estimates of CAM use by people with diabetes, for example, vary widely due to differences in definitions of CAM use and study design [15], including figures of 57% [6], 48% [5] and 73% including, or 34% excluding individual prayer [2]. These estimates are from the United States. Comparable data from Australia has not been published for this important population sub-group, with previous work limiting the definition of CAM to certain types of product use [14], or to use of CAM in other disease states, such as asthma [16] or cancer [17].

In this article, we estimate the prevalence of CAM use in the population living with type 2 diabetes or cardiovascular disease in Australia, elicit the key drivers and motivations for use, and estimate the out-of-pocket expenditure by consumers. We include both type 2 diabetes and cardiovascular disease due to the high rate of co-morbidity. We differentiate between presentation to and treatment by practitioners (for example, naturopaths, acupuncturists, Chinese Medicine Practitioners), and use of CAM products, either prescribed or purchased over-the-counter, to avoid the conceptual difficulty [3] of treating CAM products and practitioners as equivalent. We also restrict the definition of CAM to those practices and products which are amenable to the development of guidelines, recommendations and policy interventions, partly because of their training, accreditation and self-regulation. For this reason, we have not included individual prayer.

Patients and Methods

Survey development: The survey was developed by the CAMELOT Research Group [18], with guidance from interdisciplinary practitioners and members of a research reference group and following the guidelines of the Declarations of Helsinki and Tokyo for humans (Monash University Ethics Reference: CF08/2381 – 2008001235). Key themes incorporated in the survey instrument were identified through ethnographic research conducted in the first year of the study [19], which included participant observation and semi-structured in-depth interviews conducted with a comparable population group. Measures of CAM and conventional medicine use were developed from these interviews and a relevant literature review. Validated measures of illness perception [20, 21] and quality of life [22] were included in the questionnaire. The survey questionnaire was piloted and refined before data collection [23].

CAM use variables: A broad definition of CAM was used and participants were asked to specify types of CAMs used, if appropriate [18]. In the analysis we present here, CAM use was grouped into two broad categories of 'practitioner use' and 'product use'. Information was also requested on the types and frequency of different types of CAM modalities. Participants were asked to report if they had ever used CAM; if they had used CAM in the previous 12 months; the type and frequency of CAM use; out-of-pocket expenditure on CAM practitioner and products in the previous month; key motivations for using CAM; if they had told their general practitioners about their use of CAM; and reasons for not using (more) CAM [23].

Socio-demographic variables: Socio-demographic variables included: age, sex, country of birth, language spoken at home, area of residence (postcode), occupation, income and education. Economic questions included the respondents' estimate of the average amount spent per month on CAM and on conventional medicine, private health insurance status, and whether or not they held a government concession card. Participants were asked a series of questions related to their health status. Health was self-assessed [24] using a five-point scale (where 1 was 'excellent' and 5 was 'poor'), and quality of life was self-assessed by the Assessment of Quality of Life (AQoL4D) instrument [22]. Participants were asked if they had concomitant chronic conditions including cancer, mental health conditions, food allergy or intolerance, any chronic respiratory condition or 'other' condition. Of the 273 participants who indicated 'other', 81% specified arthritis, back pain or muscular-skeletal problems. Health behaviour and risk factor variables such as smoking, exercise, and height and weight measures were also elicited.

Main Data: The data were collected in 2010 via a survey available online or in hardcopy. The majority of respondents (N=2,203) were recruited through a mail-out of the survey sent to a randomly selected sample of registrants on the National Diabetes Services Scheme (NDSS) database in the state of Victoria, Australia. Others were recruited through Heart Support Australia (N=166), advertising in seniors newspapers, and through community organisations [21]. The response rate for all mail-out surveys was 22%. For inclusion, all participants had a diagnosis of type 2 diabetes or cardiovascular disease. Of the total sample (N=2,915), only those for whom full data were available are made use of here (N=2,705).

Comparative data: Our survey data are presented alongside the results of the most recent National Health Survey (NHS) of Australia, undertaken in 2007 [25]. The NHS is a nationally representative sample undertaken on a semi-regular basis, as occurs with the National Health Interview Survey (NHIS) in the United States. Analysis of CAM use in the general population using the NHS data has been presented in detail elsewhere [13]. Here, for comparison, we present NHS data from both the general population (over 18 years), and the sub-population who have type 2 diabetes, with or without cardiovascular disease (as this population most closely resemble the CAMELOT survey respondents), alongside our survey data.

Statistical analysis: Chi-squared hypothesis tests were used to compare the CAMELOT survey results with those of the NHS. A multinomial logit analysis was undertaken to determine key drivers for (i) using CAM, but not in the past 12 months; (ii) using both a CAM practitioner and product in the past 12 months; (iii) using only a CAM practitioner in the past 12 months; and (iv) using only a CAM product in the past 12 months. These categories are compared against those who reported never having used CAM (reference category).

Explanatory variables included lifestyle factors and a range of socio-demographic variables known to affect CAM use. These were incorporated in a step-wise fashion in the following specifications of the model:

1. Using only exogenous socio-demographic variables (such as gender, age and highest level of educational attainment);
2. Model 1, with the addition of income, employment status and private health insurance;
3. Model 2, with chronic illness variables, including the number of chronic illnesses as a continuous variable and the number of prescription medications;
4. Model 3, with the addition of lifestyle risk factors such as body mass index (BMI), exercise and smoking status.

Estimates from the multinomial logit are presented against an ordered logit model, for the frequency of both CAM practitioner and product (modelled separately) use respectively.

Categories of the dependent variable are for the use of 1-3, 4-6 and 7 or more modalities, with zero as the reference category. Finally, separate logistic regressions are presented for different types of CAM use. All statistical analysis was undertaken using STATA (Version 11, StataCorp, College Station TX).

Results

Sample characteristics

As shown in Table 1, the CAMELOT sample broadly shows comparability with the sub-group with Type 2 diabetes (with or without cardiovascular disease) from the NHS in terms of gender, age, country of birth, language spoken at home, geographical location and education level. Although less people have a bachelor's degree in the CAMELOT sample and more have a postgraduate degree, 17% of both samples report a "college degree or higher" (the sum of these two categories), and so the difference in the more disaggregated categories is unlikely to be of great concern. Individuals in the CAMELOT sample are more likely to be currently married.

However, the CAMELOT sample reports both more people in the lower income bracket, and more people with private health insurance. In terms of any likely effect on prevalence rates of CAM use, we might expect lower incomes to correlate with less CAM use, and therefore the prevalence in the CAMELOT group to be underestimated. Private health insurance (PHI) may incentivise CAM use. However, reasons for holding PHI in Australia are complex [26], and we know that 1,216 (45%) of the CAMELOT group held PHI for "security, protection and peace of mind", as opposed to just 728 (27%) to gain subsidised access to "ancillary services" (which include dental, optical, physiotherapy and CAM services). So, whilst higher PHI coverage may potentially be correlated with higher CAM use, this relationship is not straightforward.

Overall prevalence of CAM use

The prevalence of CAM practitioner use (Table 2) was higher in the CAMELOT survey group than in the NHS, whether or not the sub-population was defined as having type 2 diabetes (plus or minus CVD) or cardiovascular disease (plus or minus type 2 diabetes). It was also higher than for that of the general population, and response bias (upwards) cannot be excluded. On the other hand, practitioner use in the NHS survey is underestimated, as only four types of practitioner were included in this estimate (due to data limitations) [25]. The exclusion of massage therapy is notable. Overall, the estimate of practitioner use may lie between these two estimates. However, the estimate of CAM product use is very similar amongst all the chronic

population groups included, providing some evidence that response bias may be less of an issue than thought. Product use estimates for all chronic disease groups are substantially larger than that for the general population. Over 31% of individuals in the CAMELOT survey reported using between one and three products, while over 9% reported using four or more products concurrently. The majority of products were classified as "nutritional supplements not prescribed by a medical doctor" (25%), "vitamin, mineral or herbal supplements prescribed by a medical doctor" (16%), Western herbal medicine (9%), Chinese or Oriental Medicine (3%), and homeopathy (3%).

Those with chronic disease were (as expected) more likely to report a visit to their general practitioner (GP) in the previous 12 months (98.9 % in the CAMELOT survey, 94.2% in the NHS) compared with the general population (44.8%), making it unlikely that CAM use is substituting for conventional care in the main (but it cannot be excluded for particular comorbidity treatments).

Socio-demographic drivers of CAM use

Results of the multinomial logit regression analysis to identify some of the key drivers of CAM use are presented in Table 3. Interpretation of the relative risk ratio (RRR) presented for the multinomial logit is in reference to the base category of having never used CAM. Thus, for women compared with men, the relative risk of reporting the use of both a CAM practitioner and product in the previous 12 months compared with having never used CAM is more likely by a factor of 2.78, all else being equal (first line, Table 3). Interpretation of the odds ratio (OR) for the ordered probit coefficients are less straightforward, where (for practitioner use), the odds of women using one or more practitioner (combined categories of frequency of use) is 2.18 times greater than for men. Similarly, for women compared with men, the use of 4 or more practitioners compared with 1-3 practitioners is 2.18 times greater, all else being equal (first line, Table 3). Results of the step-wise inclusion of additional sets of explanatory variables, as specified in the 'Methods' section above, are remarkably robust to all four specifications of the model in terms of direction, magnitude and statistical significance of coefficients. Thus, we have some confidence that confounding is less likely to be causing biased estimates in this case. For brevity, selected results of the full specification (Model 4) are presented here exclusively. Full results of the step-wise approach are available upon request from the authors.

As demonstrated in other studies, gender [12, 27], education [12, 28] and private health insurance [2, 13] are all important predictors of CAM use; however, in this instance, we did not

see an age-effect [4], perhaps due to the relatively homogeneity of the sample. More educated women tended to use more CAM in this population, despite more men than women having type 2 diabetes [29]. However, this does not hold true for the 'practitioner use only group'. Private health insurance provides some incentive for the use of practitioners only, as some insurers offer rebates on practitioner visits; in contrast, CAM products are not usually covered.

Co-morbidity emerged as an important factor in predicting both practitioner and product use, even after controlling for other factors. In particular, mental health problems and other chronic health issues (including arthritis) were important. This is consistent with the findings of others who have used a nationally representative sample [13]. However, an increasing number of comorbid chronic conditions were associated with a lower likelihood of using both CAM practitioner and products, potentially as a result of individuals becoming concerned with interactions between conventional and CAM treatments.

Previously reported associations between QoL and CAM use have been mixed [30-34]. However, lower QoL might provide an explanatory pathway to use (whereby CAM use may not decrease the prevalence of chronic disease, but is used instead to mitigate symptoms and improve quality of life). QoL may be a confounder in such a situation, although we would argue that chronic illness is not in this case as it is unlikely that CAM use decreases the prevalence of chronic illness. Consistent with our hypothesis, we found QoL to have a negative association with all CAM use categories although the effect was significant only for those reporting combined practitioner and product use in the past year. Due to the potential for confounding in this relationship (chronic disease is correlated with both CAM use and worse QoL, especially depression) [35], longitudinal data analysis is required to better explain this finding. However, we did control for a range of current chronic diseases, as well as the number of disease and prescription medications used, and this trend was robust across all specifications of the model. This finding warrants further investigation.

A positive and significant association between increased CAM use and ever having attended a chronic disease self-management course (for any diabetes, cardiovascular disease, or generic chronic illness) was found for those using both practitioners and products, as was the association between currently attending a social or health related support group across all categories of CAM use in the past year. People with higher BMIs appeared to be less likely to use CAM, although the size of the effect was small. Some CAM users also appeared more likely to exercise.

Associations between positive health behaviours and increased CAM use have been found previously [13, 36], and may be a proxy for other characteristics, such as personality traits and health care preferences.

Results from the ordered logit specification for the frequency of CAM practitioner and product use concur well with the multinomial logit in terms of the signs and magnitude of coefficients. In particular, a dose-response type relationship is seen for AQoL coefficients, where higher frequency of use is associated with worse quality of life.

Use of particular CAM modalities

Separate logistic regressions are presented for each of the particular types of CAM use for which data were collected in the survey, and are presented in Table 4. These disaggregated findings are informative regarding the types of modalities being accessed for different types of comorbidities, and identify their relative contributions made to the overall results. In general, results are consistent with those reported in Table 3. Results for gender, age and marriage status are insignificant and have been excluded from the table for brevity. The particular types of CAM use incentivised by PHI coverage are chiropractic and homeopathy, consistent with the types of rebates offered in Australia at the time of the survey. The negative trend showing lower QoL with CAM use appears robust, with several modalities reaching statistical significance. The positive association between attending a self-management and/or social support group also appears to be consistent.

Respondents reporting CAM use in the previous 12 months in the CAMELOT survey were asked their reasons for choosing to use CAM. The reason most frequently given was to improve general health and wellbeing (18%). A smaller proportion (14%) reported that they used CAM specifically to treat their type 2 diabetes or cardiovascular disease, and a much smaller proportion reported using CAM for acute illness (5%). A doctor or pharmacist had suggested the use of CAM for 17%, while some participants believed that CAM was 'natural' (9%) or less harmful than conventional medicine (5%), and a small percentage reported using CAM because their conventional medicine treatments where causing unwanted side effects (2%). A proportion of the sample reported that they never (10%) or only sometimes (15%) discussed their CAM use with their family doctor or medical specialist(s).

Out of pocket expenditure on CAM use

Out-of-pocket expenditure for the CAMELOT population is summarised in Table 5. Median expenditure is used, as the cost data are not normally distributed. Extrapolated estimates are adjusted for age and gender, based on data from the 2007-08 NHS [29], as this is the most recenty reported prevelence data with sufficient detail. The prevalence of CAM practitioner use is standardised to that of the NHS, providing a conservative figure, as the NHS did not collect information on all types of CAM practitioners (for example, massage therapists). Our conservative estimate for total out-of-pocket CAM expenditure in the Australian population by individuals with type 2 diabetes and or cardiovascular disease is AUS$91 million per annum. Based on the median monthly spend estimates of our sample (Table 5), the annual out of pocket expenditures for this population are $240 per year for practitioner use, and $360 per year for CAM products.

Discussion

This study builds on earlier work describing CAM use in populations with diabetes or cardiovascular disease [2-7, 28] and is the first to use comprehensive CAM use data for this specific sub-population in Australia. Here, a rich data set with larger numbers than available from the NHS survey is used not only to estimate the prevalence of CAM use by this population, but also to identify some of the key drivers for use. The research findings of this work confirm earlier studies [2, 4], establishing that people with type 2 diabetes were more likely to use CAM, although this depended on the definition of CAM use. CAM use was significant in the CAMELOT sample, with over 23% reporting a visit to a CAM practitioner in the previous 12 months and 40% reporting CAM product use. In comparison to national data, people with type 2 diabetes were just as likely as the general population to use CAM practitioners, and were more likely to use CAM products.

CAM use does not preclude this population from seeking conventional care. An overwhelming majority (over 98%) reported at least one visit to their family doctor in the previous 12 months. However, efforts are needed to improve the communication about CAM use between doctors and their patients, as a considerable proportion of respondents reported never (12%) or only sometimes (18%) discussing their CAM use with their family doctor. This is important as a large proportion of respondents (approximately 68%) reported taking four or more prescription medications, increasing the potential for possible drug-CAM interactions, although only seven

people (0.3%) in this study reported side-effects from CAM treatments that warranted discontinuation.

Although we have confirmed previously-known associations with more CAM use (being female, educated and having private health insurance for example [13, 30, 37]), we also identified a number of new findings for this important sub-group. Even after controlling for key drivers of CAM use, namely, other chronic comorbidities, as well as checking for the robustness of findings using different model specifications, a negative association between CAM use and QoL is found (Table 3), which is also reflected in the frequency of CAM use (Tables 3 & 4). This may support the hypothesis that lower QoL is also a potential driver of use. Whilst we could not address the potential endogeneity of this relationship with cross-sectional data, our step-wise approach to the introduction of explanatory variables showed that coefficients were stable across model specifications, providing some evidence that our findings may not be significantly affected by this problem. We do not have information on whether individuals selected appropriate CAM modalities to treat their conditions, whether they had any negative interactions between conventional and CAM care, or if comorbid depression (which may be under-reported) are linked with lower QoL. This raises a number of important hypotheses worthy of further investigation.

People who have attended a chronic self-management group or a social or health related support group were more likely to use CAM. When analysed beside the reported motivations for using CAM, this result was consistent with the hypothesis that both CAM product and practitioner use were viewed by consumers as part of their self-management of diabetes and cardiovascular disease. This may also explain a potential pathway for increased use, whereby people who attend these groups may be recommending products or practitioners to others, as word of mouth is influential for increased CAM use [38]. From another perspective, self-management groups may provide excellent opportunities to provide education regarding appropriate CAM use, and this is also worthy of further investigation.

There are limitations to the study on which we draw. By restricting the inclusion criteria to people with diabetes or cardiovascular disease, we cannot strictly determine relative contributions of other illnesses. Additional limitations are the potential for self-selection and the

self-reported nature of postal surveys, along with a response rate of 22% [23][4]. Mediating this concern is our comparison with the nationally representative population of the NHS, for which our sample is largely representative for most variables. Also, as the differences in income are likely to underestimate the prevalence of CAM use in the CAMELOT group, we believe our estimates are conservative. A further limitation is that we could not adjust for any seasonal differences in CAM expenditure, as estimates were collected from one time-point. However, as less than 7% of the sample reported using CAM to treat acute conditions (compared with 28% treating chronic illness and 27% for 'health and wellbeing' purposes), any such effect may be reduced.

Conclusion

Many people in the study population reported that their CAM use was integral in the treatment and prevention of chronic illness, as well as with associated co-morbidities such as mental health problems and overweight. This has important implications for integrative medicine and public health, as it is likely that this important chronic disease sub-group do not distinguish clearly between CAM and non-CAM alternatives for care, rather discriminating on other characteristics such as perceived efficacy, accessibility, cost and appropriateness. The complex decision-making process of individuals relating to the use of conventional, CAM and integrative medicine is not fully understood. However, it is clear from these results that patients are likely to benefit from improved communication between all health care providers, decreasing the opportunity for harm and optimising potential health gains. 'Integration' from the consumer perspective already exists – arguably what we now need is a better partnership from both CAM and conventional practitioners to communicate and coordinate patient care.

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[4] We also acknowledge that the way participants interpreted and answered the questions with regard to chronic illness and the currency of these illnesses (especially for mental health conditions) may have affected results, although the direction of any effect is uncertain. Longitudinal data which includes more detailed chronic illness information (including the time since diagnosis / severity of the condition) would be helpful in testing the robustness of these findings.

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Table 1: Socio-demographic variables, CAMELOT survey and the National Health Survey (NHS) by different categories of CAM use (%)

	Never	More than 12 mths ago	Practitioner & product	Practitioner only	Product only	CAMELOT (total)	NHS T2DM
N	**1417**	**142**	**582**	**45**	**519**	**2705**	**747**
Female	37	45	62	38	49	45	44
Age 18-39	1	1	3	4	1	2	**3***
Age 40-59	25	42	36	31	24	29	29
Age 60-79	62	52	55	53	66	61	**56***
Age 80 plus	11	5	6	11	9	9	11
Born in Australia	66	67	71	76	68	68	65
1st language English	89	90	93	96	92	91	89
Lives in rural area	38	33	37	33	37	38	38
Diploma or certificate	22	23	30	27	27	25	28
Bachelor degree	8	14	12	4	9	9	**13*****
Postgraduate degree	6	11	10	7	10	8	**4*****
Married	70	68	68	76	69	69	**53*****
Income 25-100†	43	49	49	49	50	46	49
Income 100 plus†	7	6	10	9	6	7	**21*****
Private health insurance	50	53	63	64	52	54	**47*****
Currently employed	31	35	41	33	28	33	30
Type 2 diabetes	94	88	83	87	92	91	***100***
CVD‡	81	82	84	73	86	83	70
Mental health problem	21	37	36	27	25	26	
Respirator condition	10	13	14	16	13	12	
Cancer	8	11	7	2	11	9	
Other chronic condition	13	21	32	16	29	20	
No. chronic conditions	2	3	3	2	3	2	
BMI §	31	31	31	30	30	30	
Current smoker	9	10	6	11	8	8	

† Household income per annum ('000) in 2010 Australian dollars

‡ CVD = cardiovascular disease

§ BMI = Body Mass Index, continuous

Difference based chi-squared test * p<0.05 ** p<0.01 *** p<0.001

Table 2: Prevalence of CAM use in previous 12 months, by practitioner and products

	CAMELOT (T2DM & CVD)	NHS (T2DM +/- CVD)	NHS (CVD+/-T2DM)	NHS (General population)
Sample size	2,705	747	4,277	20,788
CAM practitioner used in last 12 months (%)	23.2	8.3*	13.3*	11.4*
Chiropractor	10.8	5.2	7.8	6.8
Acupuncturist	3.4	1.7	2.7	2.1
Naturopath	3.8	0.8	3.5	2.8
Osteopath	*not available*†	0.9	1.8	1.4
Massage therapist	10.7	*not available*	*not available*	*not available*
Integrative GP	4.0	*not available*	*not available*	*not available*
Chinese medicine practitioner	1.6	*not available*	*not available*	*not available*
Other‡	3.5	*not available*	*not available*	*not available*
If CAM product used in last 12 months (%)	40.7	40.1	42.5	23.3
Visited GP in last 12 months (%)	98.8	94.2	83.0	44.8

* Only measures the use of 4 types of CAM practitioner and likely to underestimate
† Chiropractor and osteopath included as a single category in the survey
‡ Includes Western herbalist, Homeopath, Hypnotherapist, Spiritual healer, Music or art therapist, Energy healer, Indigenous healer, other

Table 3: Predictors of CAM use – Multinomial logit regression of CAM use by category of use and ordered logits of CAM use frequency (selected results)

		USED CAM IN LAST 12 MTHS				
		Multinomial logit (RRR)			Ordered logit (OR)	
	Used CAM but more than 12 months ago	Practitioner & product	Practitioner only	Product only	Practitioner frequency	Product frequency
Female	1.38	2.78***	0.89	1.65***	2.18***	2.05***
	(1.67)	(8.70)	(-0.34)	(4.03)	(7.41)	(8.20)
Year 12	0.67	1.45*	1.01	1.25	1.37*	1.36**
(REF less than high school)	(-1.39)	(2.39)	(0.03)	(1.47)	(2.24)	(2.68)
Diploma or certificate	1.08	2.00***	1.03	1.49**	1.72***	1.70***
	(0.32)	(4.70)	(0.07)	(2.78)	(4.09)	(4.89)
Bachelor's degree	1.80	2.04***	0.40	1.36	1.64**	1.54**
	(1.94)	(3.53)	(-1.17)	(1.48)	(2.73)	(2.87)
Postdoctoral degree	2.01*	2.40***	0.84	2.20***	1.67**	1.85***
	(2.00)	(3.92)	(-0.26)	(3.56)	(2.64)	(3.79)
Married	1.16	1.19	1.39	1.01	1.16	1.08
	(0.70)	(1.36)	(0.85)	(0.11)	(1.34)	(0.84)
Income 25-100 k p.a. †	1.08	1.25	1.24	1.56***	1.05	1.35**
	(0.36)	(1.66)	(0.59)	(3.50)	(0.40)	(3.07)
Income 100K plus p.a. †	0.57	1.50	1.45	1.41	1.41	1.73**
	(-1.22)	(1.71)	(0.54)	(1.32)	(1.61)	(2.97)
Has private health insurance	1.07	1.35*	1.64	0.88	1.42**	1.08
	(0.32)	(2.50)	(1.41)	(-1.13)	(3.23)	(0.86)
Currently employed	0.97	1.52**	0.93	0.91	1.55***	1.22
	(-0.14)	(2.85)	(-0.16)	(-0.65)	(3.30)	(1.82)

Table 3: continued

Cardiovascular disease	2.49*	2.67***	1.00	1.40	1.97***	1.80***
	(2.52)	(4.47)	(0.00)	(1.34)	(3.62)	(3.54)
Food allergy	2.27	4.16***	1.90	1.47	3.05***	2.47***
	(1.72)	(5.38)	(0.80)	(1.32)	(5.00)	(4.58)
Mental health issue	5.29***	5.04***	2.55	1.35	3.48***	2.08***
	(4.40)	(7.07)	(1.48)	(1.19)	(6.39)	(4.28)
Respiratory condition	3.18**	3.13***	3.03	1.16	2.51***	1.76**
	(2.75)	(4.50)	(1.64)	(0.52)	(4.23)	(2.96)
Cancer	4.23**	2.30**	0.46	1.43	1.53	1.61*
	(3.25)	(2.91)	(-0.68)	(1.25)	(1.66)	(2.31)
Other chronic illness	3.94***	6.65***	2.07	2.65***	3.54***	3.37***
	(3.52)	(8.25)	(1.09)	(3.85)	(6.53)	(7.06)
Number of chronic conditions	0.41**	0.40***	0.56	0.96	0.47***	0.67**
(continuous)	(-2.85)	(-4.95)	(-1.14)	(-0.19)	(-4.73)	(-2.77)
Takes 1-3 prescription	0.94	1.36*	0.70	1.27	1.20	1.28*
medications (REF none)	(-0.25)	(1.96)	(-0.78)	(1.53)	(1.27)	(2.12)
Takes 4 or more prescription	0.90	1.14	1.07	1.12	1.09	1.07
medications (REF none)	(-0.49)	(0.98)	(0.18)	(0.83)	(0.69)	(0.65)

Table 3: continued

AQoL measure	0.75	0.50**	0.94	0.93	0.53**	0.68*
(continuous)	(-0.69)	(-2.67)	(-0.09)	(-0.29)	(-2.75)	(-2.00)
BMI	0.99	0.99	0.97	0.98*	0.99	0.99*
(continuous)	(-0.75)	(-1.70)	(-1.25)	(-2.16)	(-1.16)	(-2.27)
Current smoker	1.00	0.71	1.34	0.86	0.79	0.80
	(0.01)	(-1.61)	(0.57)	(-0.73)	(-1.22)	(-1.46)
Currently undertakes no	0.442***	0.68**	1.03	0.91	0.77*	0.86
exercise	(-3.33)	(-2.96)	(0.08)	(-0.76)	(-2.23)	(-1.62)
Ever undertaken a chronic	1.36	1.35**	0.73	1.11	1.21	1.234*
disease SM‡ course	(1.58)	(2.63)	(-0.98)	(0.93)	(1.89)	(2.53)
Currently attends a social	1.04	1.85***	4.06***	1.84***	1.63***	1.62***
health related support group	(0.16)	(4.51)	(3.94)	(4.50)	(4.12)	(4.76)
N	**2705**	**2705**	**2705**	**2705**	**2705**	**2705**

Exponentiated coefficients (RRR – relative risk ratio for the multinomial logit specification; and OR - odds ratios for the ordered probit specification); t statistics in parentheses (confidence intervals available upon request from the authors)
* p<0.05 **p<0.01 ***p<0.001
† 2010 prices in Australian dollars
‡ SM = self-management

Table 4: Separate logistic regressions for predictors of different types of CAM use (selected results)

	PRACTITIONER USE IN LAST 12 MONTHS (OR)					PRODUCT USE IN LAST 12 MONTHS (OR)				
	Chiropractor	**Acupuncture**	**Massage**	**Naturopath**	**Integrat GP**	**Nutritionist**	**Prescribed by doctor**	**Self-selected**	**Western herbal medicine**	**Homeopathy**
Income 25-100 k p.a.	0.99	1.03	1.06	1.16	0.68	1.13	0.97	1.46***	1.11	0.83
	(-0.09)	(0.10)	(0.36)	(0.57)	(-1.48)	(0.58)	(-0.24)	(3.51)	(0.69)	(-0.73)
Income 100K plus p.a.	1.20	3.16**	2.13**	1.58	1.90	1.48	0.99	1.61*	1.20	0.80
	(0.68)	(2.82)	(2.78)	(1.08)	(1.55)	(1.06)	(-0.06)	(2.36)	(0.64)	(-0.53)
PHI†	2.05***	1.24	1.31	1.47	0.99	1.12	0.93	1.10	1.11	1.71*
	(4.78)	(0.84)	(1.77)	(1.56)	(-0.04)	(0.59)	(-0.62)	(0.92)	(0.71)	(2.21)
Currently employed	1.36	1.81*	2.40***	1.57	0.80	1.27	1.19	1.11	1.09	2.42**
	(1.80)	(1.97)	(4.85)	(1.62)	(-0.77)	(1.04)	(1.18)	(0.82)	(0.48)	(3.13)
Cardiovascular disease	1.25	1.56	1.82*	3.88***	1.92	0.88	1.28	1.71**	3.06***	2.43*
	(0.90)	(1.01)	(2.41)	(3.62)	(1.56)	(-0.33)	(1.12)	(2.90)	(4.22)	(2.37)
Food allergy	2.37**	2.14	2.86***	6.51***	1.89	0.67	1.44	2.17***	2.92***	4.14***
	(3.05)	(1.59)	(3.64)	(4.59)	(1.49)	(-0.96)	(1.47)	(3.55)	(3.86)	(3.31)
Mental health issue	1.762*	1.75	4.26***	5.37***	1.92	0.94	1.21	2.16***	3.15***	3.90***
	(2.21)	(1.26)	(5.63)	(4.54)	(1.67)	(-0.17)	(0.87)	(4.09)	(4.63)	(3.48)
Respiratory condition	1.30	1.04	2.39**	1.83	1.47	0.61	1.55	1.37	1.83*	3.00*
	(0.91)	(0.07)	(3.04)	(1.26)	(0.89)	(-1.24)	(1.85)	(1.51)	(2.16)	(2.45)
Cancer	0.82	0.31	1.15	2.37	1.20	0.67	1.47	1.47	1.60	2.13
	(-0.57)	(-1.43)	(0.37)	(1.51)	(0.35)	(-0.87)	(1.47)	(1.69)	(1.46)	(1.34)

Table 4: continued

Other chronic illness	1.83*	2.13	4.23***	2.45*	1.55	1.07	2.30***	2.49***	2.68***	4.42***
	(2.38)	(1.72)	(5.67)	(2.32)	(1.11)	(0.19)	(3.85)	(4.86)	(3.99)	(3.80)
Num chronic conditions	0.75	0.73	0.51**	0.28***	0.86	1.59	0.92	0.75	0.56**	0.37**
(continuous)	(-1.36)	(-0.86)	(-3.23)	(-4.47)	(-0.45)	(1.46)	(-0.47)	(-1.87)	(-2.88)	(-3.19)
Takes 1-3 prescription	1.14	0.90	0.84	0.99	1.72	1.73*	0.89	1.65***	1.30	1.61
medications (REF none)	(0.69)	(-0.34)	(-0.91)	(-0.03)	(1.92)	(2.20)	(-0.74)	(3.83)	(1.41)	(1.66)
4 or more prescription	1.18	0.82	0.87	0.74	0.97	1.44	1.08	1.27*	1.42*	0.94
meds (REF ≤3)	(0.99)	(-0.74)	(-0.85)	(-1.13)	(-0.11)	(1.66)	(0.56)	(2.06)	(2.18)	(-0.23)
AQoL measure	0.71	0.16***	0.91	0.39	0.26**	0.32**	0.64	0.68	0.53*	0.24**
(continuous)	(-1.10)	(-3.68)	(-0.28)	(-1.86)	(-2.91)	(-2.85)	(-1.82)	(-1.82)	(-2.19)	(-2.98)
Ever undertaken a chronic	1.39*	0.97	1.36*	1.63*	1.05	1.96***	1.13	1.22*	1.20	1.11
disease SM‡ course	(2.36)	(-0.11)	(2.12)	(2.12)	(0.24)	(3.49)	(1.10)	(2.11)	(1.36)	(0.48)
Currently attends a social	1.52**	1.23	1.60**	1.24	2.07**	2.15***	1.69***	1.65***	1.07	0.84
/health support group	(2.72)	(0.74)	(2.90)	(0.82)	(3.10)	(3.97)	(4.19)	(4.54)	(0.40)	(-0.63)
N	**2705**	**2705**	**2705**	**2705**	**2705**	**2705**	**2705**	**2705**	**2705**	**2705**

* p<0.05 **p<0.01 ***p<0.001

Exponentiated coefficients (OR - odds ratio); t statistics in parentheses (confidence intervals available upon request from the authors)

† PHI = Private health insurance; ‡ SM = self-management

Table 5: Summary of monthly out-of-pocket expenditure on CAM

	CAM Practitioners	CAM Products
Mean (se)	47.02 (3.27)	44.51 (1.89)
95% CI	40.61-53.44	40.80-48.22
Median	20	30
Extrapolated* cost, adjusted†, p.a.	11,421,000	79,787,000
Total CAM, adjusted p.a.	**91,208,000**	

Prices are in 2010 Australian dollars.

* Extraopolated to the Australian population with type 2 diabetes using published estimates of prevelence, by age and gender, rounded to nearest thousand [20].

† CAMELOT survey prevalence of CAM use and costs determined by age and gender, rounded to nearest thousand. Estimates of the prevalence of CAM practitioner use are standardised to the NHS (lower estimate); CAMELOT prevalence of CAM product use are used (lower estimate). This provides very conservative estimates of CAM use.

p.a. = per annum

Technical Appendix: Full results of the step-wise multinomial logit models presented in Table 3 – RRR (relative risk ratios)

1= Use CAM but more than 12 months ago; 2= Practitioner and product use; 3= Practitioner only use; 4 = Product only use

	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Female	1.452*	3.099***	1.074	1.762***	1.378	3.163***	1.048	1.766***	1.309	2.729***	1.005	1.641***	1.381	2.776***	0.888	1.595***
	(2.02)	(10.48)	(0.22)	(5.21)	(1.72)	(10.50)	(0.14)	(5.17)	(1.42)	(8.81)	(0.01)	(4.39)	(1.67)	(8.70)	(-0.34)	(4.03)
Year 12	0.667	1.593**	1.102	1.341*	0.677	1.498**	1.041	1.309	0.665	1.431*	1.045	1.255	0.674	1.448*	1.011	1.246
(REF < high school)	(-1.45)	(3.18)	(0.24)	(2.03)	(-1.38)	(2.73)	(0.10)	(1.85)	(-1.44)	(2.34)	(0.11)	(1.53)	(-1.39)	(2.39)	(0.03)	(1.47)
Diploma or certificate	1.093	2.446***	1.167	1.695***	1.134	2.252***	1.092	1.662***	1.104	2.062***	1.109	1.544**	1.081	2.002***	1.030	1.491**
	(0.38)	(6.52)	(0.40)	(3.84)	(0.52)	(5.80)	(0.22)	(3.63)	(0.41)	(4.97)	(0.26)	(3.04)	(0.32)	(4.70)	(0.07)	(2.78)
Bachelor's degree	1.779*	2.633***	0.498	1.561*	1.952*	2.322***	0.447	1.515*	1.906*	2.042***	0.424	1.398	1.801	2.035***	0.400	1.364
	(1.99)	(5.21)	(-0.91)	(2.22)	(2.25)	(4.42)	(-1.03)	(2.02)	(2.14)	(3.58)	(-1.10)	(1.61)	(1.94)	(3.53)	(-1.17)	(1.48)
Postdoctoral degree	1.861	3.269***	1.172	2.588***	2.187*	2.693***	1.019	2.526***	2.154*	2.489***	1.007	2.353***	2.011*	2.399***	0.836	2.197***
	(1.91)	(5.83)	(0.24)	(4.65)	(2.29)	(4.64)	(0.03)	(4.32)	(2.22)	(4.15)	(0.01)	(3.92)	(2.00)	(3.92)	(-0.26)	(3.56)
Married	0.979	1.159	1.495	1.019	1.040	1.052	1.377	0.965	1.143	1.153	1.397	1.010	1.159	1.188	1.392	1.014
	(-0.11)	(1.29)	(1.11)	(0.16)	(0.19)	(0.42)	(0.85)	(-0.29)	(0.64)	(1.15)	(0.88)	(0.08)	(0.70)	(1.36)	(0.85)	(0.11)
Income 25-100k p.a.†					1.011	1.108	1.095	1.499**	1.081	1.208	1.210	1.559***	1.082	1.245	1.244	1.563***
					(0.05)	(0.82)	(0.25)	(3.26)	(0.35)	(1.45)	(0.52)	(3.51)	(0.36)	(1.66)	(0.59)	(3.50)
Income >100k p.a. †					0.528	1.227	1.143	1.297	0.581	1.415	1.338	1.395	0.571	1.500	1.450	1.409
					(-1.41)	(0.91)	(0.20)	(1.02)	(-1.19)	(1.48)	(0.43)	(1.29)	(-1.22)	(1.71)	(0.54)	(1.32)
Has PHI					1.078	1.411**	1.660	0.925	1.084	1.366**	1.675	0.898	1.065	1.353*	1.640	0.876
					(0.39)	(3.04)	(1.49)	(-0.69)	(0.41)	(2.64)	(1.50)	(-0.93)	(0.32)	(2.50)	(1.41)	(-1.13)
Currently employed					0.739	1.049	0.722	0.731*	0.894	1.283	0.757	0.821	0.966	1.523**	0.933	0.907
					(-1.28)	(0.35)	(-0.79)	(-2.20)	(-0.46)	(1.74)	(-0.66)	(-1.34)	(-0.14)	(2.85)	(-0.16)	(-0.65)
CVD									2.764**	3.407***	1.677	1.793*	2.490*	2.663***	1.002	1.396
									(2.88)	(5.77)	(0.96)	(2.40)	(2.52)	(4.47)	(0.00)	(1.34)
Food allergy									2.439	5.101***	3.543	1.871*	2.266	4.157***	1.897	1.471
									(1.91)	(6.32)	(1.63)	(2.19)	(1.72)	(5.38)	(0.80)	(1.32)
Mental health issue									5.689***	6.556***	4.177*	1.674*	5.294***	5.043***	2.549	1.354
									(4.75)	(8.51)	(2.33)	(2.08)	(4.40)	(7.07)	(1.48)	(1.19)
Respiratory condition									3.511**	4.154***	4.862*	1.482	3.182**	3.131***	3.033	1.155
									(3.06)	(5.78)	(2.41)	(1.46)	(2.75)	(4.50)	(1.64)	(0.52)

Technical Appendix continued

Cancer									4.580***	2.915***	0.735	1.826*	4.228**	2.301**	0.457	1.429
									(3.51)	(3.83)	(-0.27)	(2.16)	(3.25)	(2.91)	(-0.68)	(1.25)
Other chronic illness									4.268***	8.803***	3.511	3.405***	3.937***	6.650***	2.066	2.652***
									(3.84)	(9.77)	(1.96)	(4.97)	(3.52)	(8.25)	(1.09)	(3.85)
Number of chronic									0.372**	0.317***	0.333*	0.751	0.409**	0.396***	0.562	0.959
conditions (cont)									(-3.29)	(-6.40)	(-2.27)	(-1.37)	(-2.85)	(-4.95)	(-1.14)	(-0.19)
Takes 1-3									0.954	1.270	0.743	1.271	0.937	1.360*	0.701	1.269
meds (REF none)									(-0.18)	(1.58)	(-0.66)	(1.58)	(-0.25)	(1.96)	(-0.78)	(1.53)
Takes 4 or more									0.897	1.082	1.061	1.103	0.897	1.144	1.070	1.117
meds (REF none)									(-0.49)	(0.59)	(0.16)	(0.75)	(-0.49)	(0.98)	(0.18)	(0.83)
AQoL measure													0.747	0.504**	0.937	0.929
(continuous)													(-0.69)	(-2.67)	(-0.09)	(-0.29)
BMI													0.989	0.985	0.965	0.980*
(continuous)													(-0.75)	(-1.70)	(-1.25)	(-2.16)
Current smoker													1.004	0.710	1.343	0.864
													(0.01)	(-1.61)	(0.57)	(-0.73)
Currently undertakes													0.442***	0.676**	1.031	0.910
no exercise													(-3.33)	(-2.96)	(0.08)	(-0.76)
Ever undertaken a													1.357	1.351**	0.727	1.110
SM course													(1.58)	(2.63)	(-0.98)	(0.93)
Currently attends a													1.041	1.853***	4.055***	1.836***
support group													(0.16)	(4.51)	(3.94)	(4.50)
N	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**	**2,705**

Exponentiated coefficients (RRR – relative risk ratio); t statistics in parentheses
* p<0.05 **p<0.01 ***p<0.001
† 2010 prices in Australian dollars
PHI – private health insurance; CVD = cardiovascular disease; AQoL – assessment of quality of life (4 dimension); BMI = body mass index; SM = self-management

Specific Declaration Chapter Five

Declaration by candidate

In the case of Chapter Five, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
• Contributed to the original concept for the paper • Wrote the first draft and coordinated all suggested changes • Analysed the data • Submitted the paper (corresponding author)	70

The following co-authors contributed to the work. Co-authors who are students at Monash University must also indicate the extent of their contribution in percentage terms:

Name	Nature of contribution
David Johnston	Analysed the data; Edited and reviewed the manuscript
Bruce Hollingsworth	Contributed to the original concept for the paper; Edited and reviewed the manuscript; Analysed the data

Candidate's Signature		**Date** 17/03/2013

Declaration by co-authors

The undersigned hereby certify that:

(25) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(26) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(27) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(28) there are no other authors of the publication according to these criteria;
(29) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(30) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s)	**Centre for Health Economics, Monash University, Clayton Campus**

Signature 1	 David Johnston	**Date** 27/03/2013
Signature 2	 Bruce Hollingsworth	27/03/2013

Chapter Five: Complementary and Alternative Medicine (CAM) use and Quality of Life in people with type 2 diabetes and/or cardiovascular disease

Abstract

Objectives: To quantify the association between complementary and alternative medicine (CAM) use and quality of life in a population with type 2 diabetes and/or cardiovascular disease, accounting for demographics, socioeconomic status, health and lifestyle factors.

Design & setting: Data are from a purpose-designed survey of 2,915 individuals aged 18 years and over, all with type 2 diabetes and/or cardiovascular disease (CVD), collected in 2010. Key variables are compared for comparability with nationally representative data.

It was hypothesised that CAM use would be associated with higher quality of life, as measured by the Assessment of Quality of Life – 4 dimension (AQoL-4D) instrument. Three key variables are used for CAM use in the previous twelve months. In the robustness analysis, CAM use is further disaggregated into the types of practitioner or product used, the frequency of use, the reason for use and expenditure on CAM.

Results: CAM use is not associated with higher QoL for this sub-population, and in fact intensive use of CAM practitioners is associated with significantly lower QoL.

Conclusions: It is important not to assume that patients have sufficient information with which to make optimal choices regarding CAM use in the absence of accessible and relevant evidence-based guidance.

Keywords: complementary therapies; quality of life; chronic illness; health behaviours; health services

Introduction

To manage chronic conditions, including type 2 diabetes and cardiovascular disease, people may present to a range of practitioners and use medications and other treatments, often combining different complementary, alternative and biomedical treatments [1-5]. Estimates of the prevalence of CAM use by people with diabetes, for example, consequently differ widely with the definition of CAM, and include figures of 57% [5], 48% [4] and between 73% including, or 34% excluding, prayer [1].

The popularity of CAM has given rise to a body of literature describing possible motivations for use, for example, out of a preventative paradigm or to promote 'general health and wellbeing' [6-8]. Others propose CAM use may substitute for conventional care, where the latter is poorly accessible due to cost or other access issues [9-12]. Belief systems, including a belief in more 'natural' therapies [13] or in 'holistic' care appear to be important [14], as may an individuals' 'world view' [15, 16]. Less studied are individual characteristics such as personality traits [17], 'health literacy'[18] or 'cognitive processing ability' [19]. When making CAM purchase decisions, a vast and often conflicting array of information may be available, the navigation of which may also involve differences in risk preferences [20], as well as the understanding and rating of scientific sources of evidence either consciously, or by using heuristics [21].

The number of rigorously conducted clinical trials that evaluate the health effects of CAM use has increased in recent years [22], however, the vast majority of evidence measuring the association of CAM use and quality of life or subjective health comes from non-experimental studies [9, 23-25]. The results from these studies are decidedly mixed, with CAM use found to be both positively associated with health outcomes in some studies and negatively associated in others. The mixed findings may be due to institutional and cultural differences between countries in which the studies are based. A further possibility is that the estimated effects are sensitive to the definition of CAM utilisation – given the heterogeneous nature of CAM products and services, the health effects of *any* CAM use are likely to differ from the health effects of more specific CAM *product* use, and from CAM *practitioner* use. Another possibility is that estimated health effects differ depending upon the set of variables used in the regression analyses. For example, a parsimonious specification containing covariates for only age and gender may find significant CAM health effects, whereas a broader specification containing additional covariates, such as socioeconomic status, health insurance status and lifestyle may not.

In this context, we add clarification on the issue using a unique dataset with a variety of CAM utilisation measures, in order to better understand the association between CAM on quality of life (QoL) and general self-assessed health (SAH). Measures of CAM use are disaggregated by type, frequency, reasons for use and expenditure, and we assess the effect of using these different measures on our conclusions. We also investigate the potential for results to be confounded by the relationship between health status, CAM use and QoL. Data come from a population with chronic illness therefore almost all participants will be under the care of at least a primary care general practitioner (family doctor) and CAM use will be additional to this care.

Methods

Data

Data come from a purpose-designed, cross-sectional survey of 2,915 individuals aged 18 years and over from Australia in 2010, all with type 2 diabetes and/or cardiovascular disease (CVD). The survey was developed with guidance from interdisciplinary practitioners and members of a research reference group[5]. These two health conditions were chosen for their high prevalence and public health importance. For this analysis, the sample is restricted to those individuals with data on QoL and SAH (N=2,669), of which 91% have type 2 diabetes and 83% have cardiovascular disease.

The main recruitment occurred via postal survey, although there was an online option. Surveys were sent to a random sample of registrants on the National Diabetes Supply Scheme (NDSS), which supplies subsidised diabetes-related products to all Australians diagnosed with diabetes (free registration). A rolling recruitment strategy and advertisements in local support groups and newspapers supplemented the main recruitment. Of the final sample of complete and valid responses, 76% were in response to the mail out. As mail or online recruitment may lead to systematic differences in the analysis, this is explored in the sensitivity analysis. To confirm the representativeness of the sample, key socio-demographic variables are compared with the sub-population with type 2 diabetes from the most recent representative National Health Survey of Australia [26].

[5] Following the guidelines of the Declarations of Helsinki and Tokyo for humans (Monash University Ethics Reference: CF08/2381 – 2008001235).

CAM Variables

The survey contains a wide range of questions about CAM use, health status, and conventional medicine use, expenditure on both CAM and conventional medicine and the expected socio-demographic variables likely to influence CAM use.

For the main analysis, CAM is defined as: never used CAM, used CAM but more than 12 months ago, or used CAM in the previous 12 months. For the latter group, CAM use is initially disaggregated under the headings of "have visited a CAM practitioner" or "have taken a CAM product (medicine)" as the two paradigms of care are substantially different. Three variables are then created for CAM use in the previous twelve months: having used only a practitioner, having used only a product, or having used both. CAM practitioners include the use of Integrative General Practitioners (medical doctors trained in CAM), acupuncturists, naturopaths, chiropractors, osteopaths, massage therapists, herbalists, homeopaths, spiritual healers and others. CAM products include the use of vitamins, minerals, herbs and nutritional supplements, distinguishable between being prescribed by a doctor, a CAM practitioner, or self-selected. In the robustness analysis, CAM use is further disaggregated into the types of practitioner or product used, the frequency of use, the reason for use and expenditure on CAM. Detailed information on the survey content is available from the corresponding author.

Health Outcome Measures

As CAM use might be expected to impact upon a number of dimensions of QoL concurrently, it was considered appropriate to use a multi-attribute utility instrument (MAUI). The Assessment of Quality of Life – 4D (AQoL-4D)[27], was chosen for inclusion as the primary outcome measure, as its preference weights were derived from an Australian population, a consideration which may affect the validity of QoL estimates. It has been previously used to measure QoL in a population with diabetes [28]. Further, AQoL-4D can be disaggregated into its requisite dimensions, which are independent living, relationships, senses and mental health, which arguably, may be important stand-alone outcomes arising from CAM use, potentially incorporating improvements in 'wellness' not easily identified using disease-specific measures. The questions forming the basis of the AQoL-4D are scored and then transformed using preference weights on a scale between -0.04-1 where values less then zero represent health states

valued as 'worse than death' and 1 is full health [27]. A self-assessed health status 5 point scale is included as a secondary outcome for comparison, as it is one of the most widely used measures in large, population surveys.

Control variables

We group control variables into four categories and introduce each group in a step-wise fashion to assess the additional contribution of each group. Category one includes age, gender geographic location, education and marital status. Category two includes additional measures of income and current employment status. Category three includes further measures of objective health, including six variables for chronic illness, as well as the number of chronic illnesses and the current number of prescription medications. Category four includes all of the above plus lifestyle factors and a variable for private health insurance (some CAM practitioners are covered by private insurance in Australia, but not products). Lifestyle variables include smoking status, body mass index (calculated from self-reported height and weight), and exercise in the previous two weeks. All have previously been correlated with CAM use [29-31] and collectively may be a marker of more motivated, more health literate individuals, willing and capable of making changes to counteract their condition. Variables are also included for having participated in a chronic diseases self-management group, as well as current participation in a group-exercise or social/support group.

Methods

The initial analysis employs ordinary least squares (OLS) regression for the continuous Assessment of Quality of Life – 4D (AQoL-4D) measure, and an ordered probit specification for the 5-point self-assessed health scale, where 'poor' health is coded 1 and 'excellent' health is coded as 5. For the main results, CAM use is defined using five separate categories: as having never used CAM (base level); used CAM - but more than 12 months ago; used a CAM practitioner (only) in the previous 12 months; used a CAM product (only) in the previous 12 months; and used both a CAM practitioner and a CAM product in the previous 12 months.

The main empirical issue in any non-experimental CAM analysis is overcoming the confounding impact of health status on both CAM use and QoL; that is, less healthy people typically use more CAM and have lower QoL. Another potential difficulty is overcoming the confounding impact

of personality type. Personality has been shown to be associated with CAM use and QoL [32, 33] and is not observed in our dataset. Our initial strategy is to sequentially estimate increasingly broader models using OLS in order to test the robustness of the CAM effects with the final specification, including lifestyle variables to proxy for certain personality traits. Whilst this approach will not completely overcome potential limitations, it does provide the opportunity to assess the consistency of the direction and magnitude of associations. The four estimated models include the four CAM use variables and the following covariates:

1. Gender, age, immigration status, English language ability, area of residence, education and marital status;
2. Model (1) with the addition of income and employment status, as well as eligibility for government health concessions (available to low income earners and pension card holders);
3. Model (2) with the addition of objective indicators for different types of chronic illness, number of illness and number of prescription medications; and
4. Model (3) with lifestyle risk factors, such as smoking, exercise and BMI.

In the main robustness analysis, AQol-4D is broken into its requisite 4 dimensions - independent living, relationships, senses, and mental health - all of which are then modelled separately as dependent variables, using model specification (4). This allows for interpretation of the relative effects of each dimension on the overall utility score, and whether CAM use may be correlated with particular trends across dimensions. CAM use is also disaggregated in order to test the effect of different modalities, which may, to a greater or lesser extent, be expected to impact upon particular QoL dimensions.

In addition, a subsequent robustness analysis is undertaken using a system of equations to better account for the possibility of confounding due to the cross-sectional nature of the data. One way of thinking about the problem is to view CAM as a 'treatment' into which people self-select and the use of CAM to have a subsequent effect on QoL. The most appropriate way to address this problem is to use a model that accounts for selection explicitly and adjusts the coefficients in the outcome regression accordingly – here we use the 'treatment effect' model [34]. We use the full set of covariates specified above (Model 4) to estimate the model with the addition of two variables to 'identify' the CAM selection equation. Data for these variables are from the survey in response to the question "I would be more likely to see a CAM practitioner if…" where two

responses are used – "If my doctor suggested I should" and "If someone with the same condition suggested it". For these variables to be valid exclusion restrictions in the model, they must be strongly correlated with the selection equation (CAM use) but uncorrelated with the outcome (QoL). The results from this model can be compared with the OLS results to assess if our findings are robust to different model specifications.

Results and Discussion

Summary variables (Table 1) are very similar with respect to gender, age, ethnicity and area of residence; although the NHS sample is better educated and have a higher income.

As found in previous studies, females are more likely than males to use both CAM practitioners and products [14, 35], as are those with higher education levels [14, 35] and higher income [36]. Presence of particular chronic illnesses is also positively associated with CAM use. CAM users report a statistically significantly higher mean number of chronic conditions, but a lower mean number of prescription medications. In general, as expected in a group with type 2 diabetes, the mean (self-reported) body mass index (BMI) is high; however, this does not appear to differ with CAM use. Between a quarter and third of participants are recorded as undertaking no exercise in the previous 2 weeks, with CAM users more likely to report having exercised in the past two weeks. CAM users are also more likely to report current attendance at a group exercise program, or a social/support group.

A comparison of the AQoL-4D sample means, disaggregated by CAM use is shown in Table 2. Whilst CAM users appear to report lower overall quality of life than non-users, this difference is not statistically significant, except for the mental health dimension for people reporting both practitioner and product use in the previous 12 months.

Table 3 summarizes the main results of interest, that is, the coefficients on the CAM use variables for the step-wise regression analysis. Full results are made available in the Online Appendix. Coefficients on the AQol-4D models can be intuitively interpreted as a percentage point change in quality of life (where 0.01 = 1% change) as AQoL-4D is constrained on a scale between 0 and 1. Coefficients on the SAH can only be interpreted in terms of their sign and significance due to the required use of the ordered probit model.

The first thing to note is that the size of the effect of CAM on QoL is not large. Secondly, the effect also appears to be largely negative (although less so for the SAH measure). Most notably, this effect is strongest for those who used both CAM practitioners and products. In Model (4) the estimated effect equals -0.034, and is significant at the 1% level. This figure suggests that individuals who used both CAM practitioners and products in the past 12 months have a QoL that is 3.4 percentage points lower than individuals who have never used CAM. Testing the robustness of this model using the treatment effect model, the effect is stronger and remains statistically significant at the 1% level (-0.152, s.e. 0.049)[6], suggesting the results are significant, and if anything conservative.

Other coefficients move in the expected direction – see Online Appendix. Being female, having higher education, higher income, being employed and married, are all positive contributors to quality of life. Chronic illness is associated with negative quality of life, as are factors associated with negative lifestyle behaviours, such as smoking, no exercise, and a higher body mass index. Taking a higher amount of prescription medications, which we include here as a proxy for disease severity, is also associated with lowerQoL. Specification 4 is the preferred model in this case as the lifestyle factors added in this specification have a strong relationship with QoL and the exclusion of these factors may bias estimated CAM effects. Results of the SAH models generally show good concurrence with the AQol-4D models (see also the Online Appendix).

In order to test the robustness of these results, the preferred specification (Model 4) is re-estimated using alternative definitions of CAM use, including the type of CAM used in the previous 12 months, the number of CAM practitioners and/or products used, the reasons for seeking CAM treatment, and expenditure on CAM. Results are presented in Table 4 for (a) the total sample; (b) the total sample by gender (as gender has a strong influence in the main regression results); (c) only for those participants with type 2 diabetes recruited through the NDSS mail-out survey, with online respondents excluded; and (d) the total sample, but using the requisite dimensions of the AQol-4D measure(independent living, relationships, senses and mental health), rather than the total score, as the dependent variable.

Overall, the relationship between CAM use and QoL remains predominantly negative, although the effect is small. No large difference is seen between different CAM types, although homeopathy and acupuncture both have negative and statistically significant correlations. There

[6] Full results are available from the corresponding author upon request.

is an apparent dose-effect of higher frequency of CAM use – after controlling for all other variables, those reporting visits to 4 or more types of CAM practitioner, or taking 7 or more CAM products report worse QoL. This is similar to the negative effect of higher use of prescription medication (see Online Appendix). When the reason for CAM use is used as the dependent variable – males, and those in the mail-out survey have positive coefficients, while this is negative for people using CAM to treat chronic illness. CAM expenditure appears to have a similar negative association. Overall, these results suggest that there is a persistent, small negative relationship between CAM use and QoL, and that more intense CAM use strengthens the negative effects.

Conclusions

Overall, the results do not support the hypothesis that CAM use is associated with better QoL. From the main analysis (Table 3) and robustness analysis (Table 4), the trend is negative. If CAM use is considered to be a type of patient 'self-management', employed by (more motivated) individuals to mitigate some of the negative effects of chronic illness, these results are surprising. Due to the potential for survey responder bias, it was hypothesised that CAM use would have a positive association with QoL, similar to other lifestyle factors, such as not smoking, exercising, attending a group exercise program or attending a social/support group.

As shown in the stepwise modelling in Table 3 (full results in the Online Appendix) and the results of the treatment model, some of the negative correlation between CAM use and QoL is explained by the positive and negative effects of chronic health conditions on CAM use and QoL, respectively. This finding suggests that chronic illness is a potentially confounding factor and may explain some of the negative correlations found previously between quality of life and CAM use [23, 25]. Importantly however, even after controlling for a large range of chronic conditions, a statistically significant negative effect is found.

Another important finding is that there appears to be a dose-response relationship, whereby higher CAM use results in a more negative QoL. This relationship could be due to the negative effects of using multiple therapies, which may also be interacting with conventional care. Further, although mental health issues were accounted for in the analysis, these were self-reported, and potentially susceptible to under-reporting. As people living with diabetes are known to be at increased risk of developing depression and subsequent lower QoL [37], it is

possible that our findings are affected by undiagnosed depressed individuals self-caring with CAM therapies.

The analyses also show that it is important to consider type of CAM use when characterising the relationship with QoL. More positive results were shown for some types of therapies, such as massage. Simply using CAM as an 'umbrella' term may be somewhat misleading. Finally, there is evidence that using CAM for prevention, rather than the treatment of chronic illness, has a correlation with higher QoL.

There are limitations with this analysis. Most notably, no causal inference is identified between CAM use and worse QoL due to the cross-sectional nature of the data. However, the associations found are robust across a number of model specifications and using uniquely detailed CAM use data. Analysis here also adds to the current literature by suggesting reasons why the results from previous studies investigating the association between QoL and CAM use are so mixed.

More research, preferentially using longitudinal data, is required to identify a causal pathway for this association. CAM users may be choosing ineffective or inappropriate CAM's for their condition, meaning little or no improvement in QoL, with the potential for a decrease in QoL as a result of poor choices or significant expenditure. Alternatively, there may be issues with the way consumer's process available information. When people become overwhelmed with information, decision rules, or 'stopping rules' may be employed to simplify decisions [38].This means that consumers may place undue weight on less reliable sources of information, such as advertising, or family and friends [39].

It is encouraged that both conventional and CAM practitioners maintain an open dialogue about treatment choices with their patients, so they are in a position to better advise and to maximise the health gains for consumers by considered and appropriate CAM use.

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http://www.camelot.monash.edu/

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Table 1: Socio-demographic variables by CAM use, compared with type 2 diabetes population from Australian National Health Survey 2007

	Never used CAM	Used CAM more than 12 mths ago	Used CAM in previous 12 mths	Total sample	NHS T2DM
	%	%	%	%	%
N	**1,386**	**142**	**1,141**	**2,669**	**747**
Female	37	45	55	45	44
Age 18-39	1	1	2	2	3
Age 40-59	26	42	31	29	29
Age 60-79	62	52	60	61	56
Age 80 plus	11	5	7	9	11
Born in Australia	66	67	70	68	65
1st language English	89	90	93	91	89
Lives in rural area	38	33	37	38	38
Diploma or certificate	22	23	28	25	28
Bachelor degree	8	14	10	9	13
Postgraduate degree	5	11	10	8	4
Married	70	68	68	69	53
Lives alone	19	18	21	19	36
Income 25-100[a]	43	49	50	46	49
Income 100 plus[a]	7	6	8	7	21
Health concession card	64	56	61	62	71
Currently employed	31	35	35	33	30
Type 2 diabetes	95	88	87	91	
CVD[b]	81	82	84	83	
Food allergy	5	6	11	8	
Mental health problem	20	37	31	26	
Respiratory condition	10	13	13	12	
Cancer	9	11	9	9	
Other chronic condition	12	21	30	20	
Private health insurance	50	53	58	54	
BMI [c]	30	31	30	30	
Current smoker	9	10	7	8	
Exercise in previous 2 weeks	68	83	75	72	
Previous CDSM course[d]	57	63	60	59	
Group-exercise program	34	37	45	38	
Social or support group	15	18	29	21	

a Household income per annum ('000) in 2010 Australian dollars

b CVD = cardiovascular disease

c BMI (Body Mass Index)

d CDSM = chronic disease self-management course (for diabetes, cardiovascular disease, or another chronic illness)

Table 2: Comparison of AQoL-4D sample means, disaggregated by CAM use

	Total sample	Never used CAM	Used CAM but more than 12 mths ago	Practitioner (only) in past 12 mths	Product (only) in past 12 mths	Practitioner & Product in past 12 mths
N	**2,669**	**1,386**	**142**	**43**	**514**	**572**
AQoL-4D (overall)[a]	0.645	**0.652**	0.627	0.661	0.644	0.633
Independent living	0.863	**0.884**	0.888	0.893	0.860	0.879
Relationships	0.860	**0.861**	0.834	0.836	0.871	0.858
Senses	0.905	**0.904**	0.894	0.930	0.902	0.911
Mental health	0.863	**0.871**	0.856	0.856	0.860	**0.849****
Self-assessed health[b]	2.794	**2.793**	2.754	2.837	2.761	2.830

* p<0.05 ** p<0.01 *** p<0.001 for difference between estimate and base category (never used CAM)

[a] Utility score. Dimension values are not utilities as they have not been evaluated on a life / death scale.

[b]SAH coded as 1= poor health, 5=excellent health

Table 3: Main results table – coefficients on CAM use for each of the four model specifications for AQoL-4D & SAH

	Model 1	(s.e.)	Model 2	(s.e.)	Model 3	(s.e.)	Model 4	(s.e.)
AQoL-4D (N=2,669)								
CAM more than 12 months ago	**-0.045***	(0.022)	-0.037	(0.022)	-0.007	(0.019)	-0.019	(0.019)
CAM practitioner (only) in past 12 mths	-0.009	(0.039)	-0.009	(0.038)	0.008	(0.034)	-0.000	(0.033)
CAM product (only) in past 12 mths	-0.022	(0.013)	-0.022	(0.013)	0.001	(0.012)	-0.004	(0.011)
CAM practitioner and product in past 12 mths	**-0.048*** **	(0.013)	**-0.054*** **	(0.013)	**-0.023***	(0.012)	**-0.034****	(0.011)
SAH (N=2,669)								
CAM more than 12 months ago	-0.073	(0.094)	-0.050	(0.095)	0.023	(0.097)	-0.038	(0.098)
CAM practitioner (only) in past 12 mths	0.007	(0.165)	0.010	(0.165)	0.071	(0.168)	0.024	(0.170)
CAM product (only) in past 12 mths	-0.091	(0.055)	-0.089	(0.056)	-0.007	(0.057)	-0.041	(0.058)
CAM practitioner and product in past 12 mths	-0.020	(0.055)	-0.036	(0.055)	0.036	(0.058)	-0.044	(0.059)

* p<0.05 ** p<0.01 *** p<0.001 for difference between estimate and base category (never used CAM)
s.e. = standard error

Table 4: Robustness analysis – The effect of different definitions of CAM use on AQol - 4D total score and separate Dimensions

	Dependent variable = AQoL-4D (total)				Dependent variable = AQoL-4D dimensions			
	(a) Total sample	(b) Total sample by gender		(c) Mail-out sample	(d) Total sample by AQoL-4D dimensions			
		Male	Female		Independent living	Relation-ships	Senses	Mental health
	N=2,669	N=1,470	N=1,199	N=2,029	N=2,669	N=2,669	N=2,669	N=2,669
CAM practitioner or product used in previous 12 months[a]								
Used CAM more than 12 months ago	-0.019	-0.031	0.006	-0.001	-0.008	-0.014	-0.013	-0.004
Used practitioner only last 12 months	-0.000	0.003	0.004	-0.005	0.001	-0.031	0.023	-0.016
Used product only last 12 months	-0.004	-0.002	0.001	0.002	0.005	0.011	-0.007	-0.005
Used both product and practitioner in the last 12 months	**-0.034****	**-0.035***	-0.028	-0.026	-0.016	-0.007	-0.007	**-0.018****
Type of CAM practitioner or product used in previous 12 months								
Used CAM more than 12 months ago	-0.020	-0.033	0.005	0.001	-0.011	-0.015	-0.014	-0.003
Acupuncture	**-0.059***	-0.028	**-0.073***	-0.042	-0.033	-0.036	-0.002	-0.028
Traditional Chinese Medicine	-0.010	-0.03	0.001	-0.029	0.009	-0.035	-0.02	0.001
Nutritionalist (eg. dietary counselling)	-0.026	-0.052	-0.01	-0.003	**-0.040***	-0.017	-0.008	-0.004
Naturopath	-0.035	-0.009	-0.043	-0.052	-0.03	-0.009	-0.011	0.000
Chiropractor	-0.001	0.005	-0.014	0.003	-0.003	0.011	0.01	-0.013
Massage therapist	0.020	-0.005	0.037	0.016	0.007	0.011	0.006	0.005
Vitamin, mineral or herb NOT prescribed by a doctor	-0.011	0.003	-0.024	-0.005	0.004	0.008	**-0.013***	-0.006
Western herbal medicines (including herbal teas)	-0.009	0.003	-0.015	-0.01	0.004	-0.018	0.001	-0.008
Homeopathy, tissue or mineral salts, Bach flower remedies	-0.038	**-0.096***	0.002	-0.049	**-0.043***	-0.016	-0.001	-0.017
Vitamin, mineral or herb prescribed by a doctor	-0.002	-0.016	0.015	0.013	-0.006	0.005	0.002	0.004
Number of CAM practitioners or products used								
Used CAM more than 12 months ago	-0.020	-0.032	0.005	-0.002	-0.009	-0.014	-0.014	-0.004
Used 1-3 practitioners in last 12 months	-0.020	-0.020	-0.021	-0.020	-0.011	-0.016	0.004	-0.01
Used 4 or more practitioners in last 12 months	**-0.072***	-0.110	-0.067	**-0.113***	**-0.062***	**-0.076***	-0.007	**-0.048***
Used 1-3 products in last 12 months	-0.003	0.000	0.000	0.000	0.007	0.013	-0.009	-0.004
Used 4-6 products in last 12 months	-0.022	-0.036	-0.004	-0.005	-0.011	0.014	-0.014	-0.005
Used 7 or more products in last 12 months	-0.042	-0.038	-0.034	0.000	**-0.053***	0.000	-0.013	-0.019
Reason for CAM treatment in the previous 12 months								
Used CAM more than 12 months ago	-0.013	-0.022	0.003	0.003	-0.007	-0.013	-0.012	-0.001
Treat a chronic condition in the previous 12 months	**-0.023***	**-0.033***	-0.015	**-0.025***	**-0.018***	-0.002	0.000	**-0.015***
Treat an acute illness in the previous 12 months	**-0.037***	-0.049	-0.017	-0.034	-0.015	-0.027	**-0.019***	-0.015
Prevent illness / improve general health & wellbeing	0.017	**0.050****	-0.013	**0.027***	0.011	0.013	-0.001	0.005
Expenditure on CAM in previous 12 months								
(log) Monthly expenditure on CAM practitioners	-0.005	-0.005	-0.005	-0.004	-0.003	-0.005	0.002	-0.003
(log) Monthly expenditure on CAM products	-0.005	-0.007	-0.002	-0.004	-0.001	0.001	**-0.004****	-0.002

* p<0.05 ** p<0.01 *** p<0.001 for difference between estimate and base category (never used CAM)

[a] As specified by model 4 in Table 3. Results for the total sample for this model can be found in Table 3 and Online Appendix.

Appendix to Chapter Five

This model uses a system of equations, firstly modelling the 'self-selection' into 'treatment' (here, CAM use) before allowing the results of this equation to enter into the measurement model for the outcome of interest (here, quality of life (QoL)). This can be represented by the system of equations below:

The regression equation of interest is:

$$y_i = x_i\beta + w_i\delta + \varepsilon_i$$

where: y_i= outcome variable

x_i = explanatory variables

w_i= treatment dummy variable

ε_i = error term

Then, the selection equation is:

$$w_i^* = z_i\delta + \mu_i\,, w_i = 1\ if\ w_i^* > 0\ and\ w_i = 0\ otherwise$$

where: w_i^*= is a latent variable

z_i= explanatory variables

μ_i = error term

And it is assumed: $\varepsilon \sim N(0, \sigma)$

$u \sim N(0, 1)$

$corr\ (\varepsilon, \mu) = rho$

Two instrumental variables are used to identify the selection equation and appear in z_i. Data for these dummy variables are from the survey in response to the question "I would be more likely to see a CAM practitioner if…" where two responses are used – "If my doctor suggested I should" and "If someone with the same condition suggested it".

Full version of main OLS results table (Table III) – including coefficients for all variables included in the models

	Model 1	(s.e.)	Model 2	(s.e.)	Model 3	(s.e.)	Model 4	(s.e.)	Model 1	(s.e.)	Model 2	(s.e.)	Model 3	(s.e.)	Model 4	(s.e.)
	Dependent variable is AQoL – 4D (N=2,669)								Dependent variable is SAH (N=2,669)							
Used CAM more than 12 months ago	-0.045*	(0.022)	-0.037	(0.022)	-0.007	(0.019)	-0.019	(0.019)	-0.073	(0.094)	-0.050	(0.095)	0.023	(0.097)	-0.038	(0.098)
Used CAM practitioner only in last 12 mths	-0.009	(0.039)	-0.009	(0.038)	0.008	(0.034)	-0.000	(0.033)	0.007	(0.165)	0.010	(0.165)	0.071	(0.168)	0.024	(0.170)
Used CAM product only in last 12 mths	-0.022	(0.013)	-0.022	(0.013)	0.001	(0.012)	-0.004	(0.011)	-0.091	(0.055)	-0.089	(0.056)	-0.007	(0.057)	-0.041	(0.058)
Used practitioner & product in last 12 mths	-0.048***	(0.013)	-0.054***	(0.013)	-0.023*	(0.012)	-0.034**	(0.011)	-0.020	(0.055)	-0.036	(0.055)	0.036	(0.058)	-0.044	(0.059)
Female	0.010	(0.010)	0.028**	(0.010)	0.042***	(0.009)	0.044***	(0.009)	-0.009	(0.044)	0.039	(0.044)	0.119**	(0.046)	0.123**	(0.047)
Age 40-59 years	0.002	(0.039)	-0.000	(0.038)	0.001	(0.034)	-0.009	(0.033)	0.008	(0.165)	0.008	(0.165)	0.180	(0.170)	0.125	(0.171)
Age 60-79 years	-0.019	(0.039)	0.044	(0.038)	0.032	(0.035)	0.007	(0.034)	0.106	(0.164)	0.295	(0.168)	0.504**	(0.173)	0.359*	(0.176)
Age 80 or more years	-0.120**	(0.042)	-0.041	(0.041)	-0.067	(0.038)	-0.099**	(0.038)	-0.092	(0.176)	0.145	(0.182)	0.336	(0.188)	0.126	(0.193)
Born in Australia	0.021	(0.012)	0.016	(0.011)	0.030**	(0.010)	0.023*	(0.010)	0.105*	(0.049)	0.094	(0.050)	0.176***	(0.051)	0.147**	(0.051)
1st language English	0.087***	(0.019)	0.063***	(0.018)	0.080***	(0.017)	0.076***	(0.016)	0.412***	(0.081)	0.357***	(0.081)	0.485***	(0.083)	0.488***	(0.084)
Lives rural location	0.015	(0.011)	0.020*	(0.010)	0.010	(0.009)	0.016	(0.009)	0.135**	(0.044)	0.153***	(0.045)	0.124**	(0.046)	0.167***	(0.047)
High school or lower	0.033*	(0.014)	0.018	(0.013)	0.013	(0.012)	0.009	(0.012)	0.083	(0.058)	0.047	(0.058)	0.009	(0.059)	-0.017	(0.060)
Diploma or certificate	0.059***	(0.013)	0.034**	(0.013)	0.032**	(0.011)	0.022*	(0.011)	0.213***	(0.055)	0.151**	(0.056)	0.156**	(0.057)	0.095	(0.058)
Bachelor degree	0.103***	(0.018)	0.062***	(0.018)	0.050**	(0.016)	0.036*	(0.016)	0.229**	(0.077)	0.127	(0.079)	0.084	(0.081)	0.002	(0.082)
Postgraduate degree	0.152***	(0.020)	0.089***	(0.020)	0.079***	(0.018)	0.057**	(0.018)	0.560***	(0.084)	0.403***	(0.088)	0.405***	(0.089)	0.284**	(0.090)
Married	0.111***	(0.016)	0.084***	(0.015)	0.064***	(0.014)	0.052***	(0.014)	0.365***	(0.067)	0.305***	(0.068)	0.266***	(0.069)	0.207**	(0.070)
Lives alone	0.016	(0.018)	0.017	(0.017)	0.015	(0.016)	0.004	(0.015)	0.217**	(0.076)	0.230**	(0.077)	0.246**	(0.078)	0.196*	(0.079)
Income 25,000-100,000†			0.055***	(0.011)	0.038***	(0.010)	0.028**	(0.010)			0.139**	(0.050)	0.099	(0.051)	0.054	(0.052)
Income 100,000++†			0.089***	(0.022)	0.067***	(0.020)	0.043*	(0.020)			0.229*	(0.097)	0.185	(0.099)	0.029	(0.101)
Health concession card			-0.028*	(0.013)	-0.011	(0.011)	-0.008	(0.011)			-0.045	(0.056)	0.056	(0.057)	0.076	(0.057)
Currently employed			0.189***	(0.021)	0.124***	(0.019)	0.119***	(0.019)			0.464***	(0.094)	0.235*	(0.097)	0.207*	(0.098)
Retired or student			0.095***	(0.021)	0.080***	(0.019)	0.066***	(0.019)			0.168	(0.093)	0.151	(0.095)	0.055	(0.097)

Table III: continued

Cardiovascular disease	0.007	(0.018)	-0.012	(0.018)	0.048	(0.089)	-0.087	(0.092)
Food allergy	0.013	(0.022)	-0.001	(0.022)	0.049	(0.109)	-0.060	(0.112)
Mental health problem	**-0.140*** **	(0.019)	**-0.149*** **	(0.019)	-0.140	(0.093)	-0.221*	(0.095)
Respiratory condition	**-0.043***	(0.021)	**-0.061****	(0.020)	**-0.283****	(0.103)	**-0.420*** **	(0.105)
Cancer	-0.034	(0.022)	**-0.054***	(0.022)	-0.038	(0.110)	-0.183	(0.113)
Other chronic condition	**-0.067*** **	(0.019)	**-0.083*** **	(0.019)	-0.099	(0.094)	**-0.220***	(0.097)
No. chronic conditions	-0.017	(0.016)	0.003	(0.016)	**-0.235****	(0.077)	-0.106	(0.080)
No. prescription meds	**-0.073*** **	(0.006)	**-0.062*** **	(0.006)	**-0.469*** **	(0.031)	**-0.421*** **	(0.031)
Private health insurance			**0.038*** **	(0.009)			**0.196*** **	(0.047)
Body mass index			**-0.003*** **	(0.001)			**-0.024*** **	(0.004)
Current smoker			**-0.037***	(0.015)			**-0.278*** **	(0.079)
No exercise			**-0.071*** **	(0.010)			**-0.322*** **	(0.053)
Previous CDSM course¥			0.003	(0.009)			-0.008	(0.045)
Group-exercise program			0.005	(0.009)			**0.205*** **	(0.049)
Social or support group			0.002	(0.011)			0.028	(0.057)

AQoL-4D – Assessment of Quality of Life – four dimension
SAH – self-assessed health
s.e. = standard error
* p<0.05 ** p<0.01 *** p<0.001 for difference between estimate and base category (never used CAM)
† Household income per annum ('000) in 2010 Australian dollars
¥ CDSM = chronic disease self-management course (for diabetes, cardiovascular disease, or another chronic illness

Robustness analysis – The effect of different definitions of CAM use on AQoL - 4D total score and separate Dimensions

	Dependent variable = AQoL-4D (total)				Dependent variable = AQoL-4D dimensions			
	(a) Total sample	(b) Total sample by gender		(c) Mail-out sample	(d) Total sample by AQoL-4D dimensions			
		Male	Female		Independent living	Relation-ships	Senses	Mental health
	N=2,669	N=1,470	N=1,199	N=2,029	N=2,669	N=2,669	N=2,669	N=2,669
CAM practitioner or product used in previous 12 months*								
Used CAM more than 12 months ago	-0.019	-0.031	0.006	-0.001	-0.008	-0.014	-0.013	-0.004
Used practitioner only last 12 months	-0.000	0.003	0.004	-0.005	0.001	-0.031	0.023	-0.016
Used product only last 12 months	-0.004	-0.002	0.001	0.002	0.005	0.011	-0.007	-0.005
Used both product and practitioner in the last 12 months	**-0.034****	**-0.035***	-0.028	-0.026	-0.016	-0.007	-0.007	**-0.018****
Type of CAM practitioner or product used in previous 12 months								
Used CAM more than 12 months ago	-0.020	-0.033	0.005	0.001	-0.011	-0.015	-0.014	-0.003
Acupuncture	**-0.059***	-0.028	**-0.073***	-0.042	-0.033	-0.036	-0.002	-0.028
Traditional Chinese Medicine	-0.010	-0.03	0.001	-0.029	0.009	-0.035	-0.02	0.001
Nutritionalist (eg. dietary counselling)	-0.026	-0.052	-0.01	-0.003	**-0.040***	-0.017	-0.008	-0.004
Naturopath	-0.035	-0.009	-0.043	-0.052	-0.03	-0.009	-0.011	0.000
Chiropractor	-0.001	0.005	-0.014	0.003	-0.003	0.011	0.01	-0.013
Massage therapist	0.020	-0.005	0.037	0.016	0.007	0.011	0.006	0.005
Vitamin, mineral or herb NOT prescribed by a doctor	-0.011	0.003	-0.024	-0.005	0.004	0.008	**-0.013***	-0.006
Western herbal medicines (including herbal teas)	-0.009	0.003	-0.015	-0.01	0.004	-0.018	0.001	-0.008
Homeopathy, tissue or mineral salts, Bach flower remedies	-0.038	**-0.096***	0.002	-0.049	**-0.043***	-0.016	-0.001	-0.017
Vitamin, mineral or herb prescribed by a doctor	-0.002	-0.016	0.015	0.013	-0.006	0.005	0.002	0.004
Number of CAM practitioners or products used								
Used CAM more than 12 months ago	-0.020	-0.032	0.005	-0.002	-0.009	-0.014	-0.014	-0.004
Used 1-3 practitioners in last 12 months	-0.020	-0.020	-0.021	-0.020	-0.011	-0.016	0.004	-0.01
Used 4 or more practitioners in last 12 months	**-0.072***	-0.110	-0.067	**-0.113***	**-0.062***	**-0.076***	-0.007	**-0.048***
Used 1-3 products in last 12 months	-0.003	0.000	0.000	0.000	0.007	0.013	-0.009	-0.004
Used 4-6 products in last 12 months	-0.022	-0.036	-0.004	-0.005	-0.011	0.014	-0.014	-0.005
Used 7 or more products in last 12 months	-0.042	-0.038	-0.034	0.000	**-0.053***	0.000	-0.013	-0.019
Reason for CAM treatment in the previous 12 months								
Used CAM more than 12 months ago	-0.013	-0.022	0.003	0.003	-0.007	-0.013	-0.012	-0.001
Treat a chronic condition in the previous 12 months	**-0.023***	**-0.033***	-0.015	**-0.025***	**-0.018***	-0.002	0.000	**-0.015***
Treat an acute illness in the previous 12 months	**-0.037***	-0.049	-0.017	-0.034	-0.015	-0.027	**-0.019***	-0.015
Prevent illness / improve general health & wellbeing	0.017	**0.050****	-0.013	**0.027***	0.011	0.013	-0.001	0.005
Expenditure on CAM in previous 12 months								
(log) Monthly expenditure on CAM practitioners	-0.005	-0.005	-0.005	-0.004	-0.003	-0.005	0.002	-0.003
(log) Monthly expenditure on CAM products	-0.005	-0.007	-0.002	-0.004	-0.001	0.001	**-0.004****	-0.002

* p<0.05 ** p<0.01 *** p<0.001 for difference between estimate and base category (never used CAM)

* As specified by model 4 in Table 3. Results for the total sample for this model can be found in Table 3 and Online Appendix.

Two-step treatment effects model for practitioner and product use in the previous 12 months

	Coefficient regression equation	Std. Err.	Coefficient selection eqation	Std. Err.
Used practitioner & product in last 12 mths	-0.152	(0.049)***		
Female	0.060	(0.011)***	0.449	(0.063)***
Age40-59	-0.003	(0.034)	0.174	(0.214)
Age 60-79	0.010	(0.035)	0.115	(0.222)
Age 80 or more years	-0.098	(0.038)***	0.031	(0.252)
Born in Australia	0.024	(0.010)**	0.009	(0.071)
1st language English	0.078	(0.017)***	0.086	(0.122)
Lives rural location	0.017	(0.009)*	0.046	(0.064)
High school or lower	0.014	(0.012)	0.145	(0.085)*
Diploma or certificate	0.033	(0.012)***	0.282	(0.080)***
Bachelor degree	0.045	(0.017)***	0.306	(0.109)***
Postgraduate degree	0.066	(0.018)***	0.219	(0.120)*
Married	0.053	(0.014)***	0.043	(0.097)
Lives alone	0.002	(0.016)	-0.088	(0.109)
Income 25,000-100,000†	0.029	(0.010)***	0.056	(0.073)
Income 100,000+†	0.051	(0.020)**	0.204	(0.135)
Health concession card	-0.005	(0.011)	0.115	(0.081)
Currently employed	0.127	(0.020)***	0.224	(0.134)*
Retired or student	0.069	(0.019)***	-0.010	(0.133)
Cardiovascular disease	0.009	(0.020)	0.440	(0.118)***
Food allergy	0.027	(0.025)	0.585	(0.143)***
Mental health problem	-0.118	(0.022)***	0.767	(0.121)***
Respiratory condition	-0.036	(0.023)	0.535	(0.136)***
Cancer	-0.038	(0.023)*	0.295	(0.153)*
Other chronic condition	-0.050	(0.023)**	0.808	(0.122)***
No. chronic conditions	-0.017	(0.017)	-0.409	(0.101)***
No. prescription meds	-0.066	(0.006)***	-0.112	(0.042)***
Private health insurance	0.043	(0.010)***	0.186	(0.066)***
Body mass index	-0.003	(0.001)***	-0.001	(0.005)
Current smoker	-0.042	(0.016)***	-0.113	(0.114)
No exercise	-0.078	(0.010)***	-0.041	(0.076)
Previous CDSM course¥			0.147	(0.063)***
Group-exercise program			0.259	(0.066)***
Social or support group			0.174	(0.074)***
Doctor recom CAM			-0.408	(0.069)***
Someone with same condition recom CAM			0.369	(0.074)***
rho	0.335			
N	**2,669**		**2,669**	

Specific Declaration Chapter Six

Declaration by candidate

In the case of Chapter Six, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
• Contributed to the original concept for the paper • Wrote the first draft and coordinated all suggested changes • Analysed the data • Submitted the paper (corresponding author)	70

The following co-authors contributed to the work. Co-authors who are students at Monash University must also indicate the extent of their contribution in percentage terms:

Name	Nature of contribution
Duncan Mortimer	Contributed to the original concept for the paper; Analysed the data; Edited and reviewed the manuscript

Candidate's Signature		**Date** 06/01/2014

Declaration by co-authors

The undersigned hereby certify that:

(31) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(32) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(33) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(34) there are no other authors of the publication according to these criteria;
(35) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(36) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s)	**Centre for Health Economics, Monash University, Clayton**

[Please note that the location(s) must be institutional in nature, and should be indicated here as a department, centre or institute, with specific campus identification where relevant.]

Signature 1	 Duncan Mortimer	**Date** 06/01/2014

Chapter Six: Can we make your decision easier? Using eye-tracking to investigate the effect of complexity on attribute non-attendance in discrete choice experiments

Abstract

The provision of information is often assumed to improve consumption decisions, allowing consumers to more accurately weigh the costs and benefits of alternatives. However, increasing the complexity of decision problems may prompt changes in information processing. The primary aim of this study is to test whether consumers actually process additional information in an already complex decision problem; here, additional information embedded in labels on complementary and conventional medicines. Discrete choice experiments (DCEs) assume that consumers consider all relevant information when making purchasing decisions and while there is increasing evidence that this assumption does not hold in many situations, little is known about the extent of any deviation and some of the key drivers. Using eye-tracking technology, which captures the number of times and the duration that a participant looks at any part of a computer screen during the completion of a DCE survey, we can analyse what has become known in the DCE literature as 'attribute non-attendance' (ANA). Using this approach we analyse the effect of choice set complexity and respondent characteristics on the likelihood of ANA using fixed and random effects models to account for repeated choice set completion. We find that complexity is strongly related to ANA as well as some evidence of heterogeneity in decision making processes. We conclude that, for already complex decisions such as the choice between CAM and conventional medicines, the provision of additional information may not have the desired effect on decision-making.

JEL Classification Codes: I100, I180

Introduction

Mainstream economic models typically assume that consumption choices can be improved simply by providing people with more and better information. There are, however, many situations where this assumption may not hold due to limits on information-processing capacity [1, 2]. For very complex problems, consumers may be boundedly (rather than fully) rational [1, 2] and there is evidence to suggest that consumers attempting to evaluate all available information and all available options are increasingly likely to make mistakes through this process [3]. Many consumers will instead employ a 'satisficing' [4] or 'fast and frugal' [5] heuristic whereby the mental task of calculating the cost and consequences of all possible options is overwhelming; taking mental short-cuts to make decisions easier [6]. Recent findings from behavioural economics confirm that increases in the complexity of decision tasks may paralyse decision-making [7], although others argue that it is the nature of the information that is important, rather than the absolute amount [8]. More generally, decision-making processes have turned out to be much more heterogeneous than assumed by the underlying economic theory [9, 10].

The use of discrete choice experiments (DCEs) in health care has increased dramatically over the past decade [11-13]. Arising from the disciplines of psychology [14, 15] and economics [16, 17], the theoretical basis for DCEs can be found in random utility theory (RUT), developed by McFadden [18] and later Hanemann [19]. Whilst the assumptions of RUT *per se* are quite flexible, the relationship between the assumptions of consumer theory (whether from the choice-based or preference-based approach) and choice modelling are less well defined [20]. However, as outlined above, there is evidence to suggest that decision making of the type emulated by DCEs is prone to diversions from the underlying theory, in particular, breaches in the assumption of the 'continuity axiom' [21]. What is less well understood is whether such deviations, if present, can be captured, analysed and potentially corrected for within a DCE analysis.

One area of recent research activity focuses on so-called 'attribute non-attendance' [22, 23] which in simple terms means that individuals may either ignore or attach threshold values to certain product characteristics before considering them. Empirically, two main methods have been employed to assess the existence and extent of attribute non-attendance - (i) using qualitative methods such as think-aloud protocols alongside stated-preference surveys [24], in-depth interviews and other supplementary questioning [25] to directly question the respondent about their cognitive processing strategy in answering stated-preference surveys; and (ii) using quantitative models that allow the researcher some latitude for inference, such as latent-class models, to analyse stated-preference data [26-29] . From this growing literature it does appear

that attribute non-attendance may in fact be important when assessing the validity of stated-preference studies [30, 31] and that modelled coefficients should be adjusted accordingly. However, there are limitations when using both methods to assess attribute non-attendance and research in this area is far from conclusive.

Recent advances in eye-tracking technology, which was first described in the 1970s [32], show promise as an alternative way of assessing attribute non-attendance and other departures from the underlying theory such as non-trading behaviour (where an individual always chooses the same alternative) or satisficing behaviour (where an individual scans alternatives until selecting the first deemed 'satisfactory') under conditions of uncertainty [33, 34]. Arising within a number of disciplines such as psychology, Judgement and Decision Making (JDM) and marketing, eye-tracking technology allows the researcher to record where and for how long a respondent to a computer-based survey focuses their eyes. This means that researchers can assess if, and for how long, each attribute or choice is focused relative to all else, including the sequence of focusing. Theoretically, if this information can be meaningfully interpreted, it may be used to determine whether attribute non-attendance is directly evident.

Here, we make use of eye-tracking, which was undertaken alongside semi-structured interviews, in simulated consumption decisions using a DCE framework to understand the process of consumer decision making in complex health environments. As suggested by Lagarde [29], information processing is "likely to be influenced by the decision problem itself (e.g. its complexity), respondent specific characteristics (e.g. familiarity to the choice task, cognitive skills) and the broader context in which the choice task is taken (e.g. time pressure)". Following this framework, we aim to analyse ANA as it relates to complexity, respondent characteristics and time pressure. We also test the assumption made in previous work in this area [27] that respondents are consistent with their information processing rules, that is, "the decision on which attributes to consider does not change over the choices made by the same respondent" (page 205).

Our data were collected alongside the pilot study of a DCE which tests the effect of the addition of (i) regulatory statements; and /or (ii) information in the form of a 'traffic light' logo, on the choice between complementary or conventional medicines for two common conditions: sleep problems and joint pain [see Figures A1 and A2 in the Online Appendix].

Methods

Study context

That treatment decisions for even minor illnesses are complex and prone to error has long been accepted by health economists and health policy makers alike [35]. Ideally, consumers (or their agents) would make 'rational' or 'evidence-based' choices from among the dizzying array of treatments and practitioners available. In the choice between conventional and complementary medicines, a range of factors may mitigate against this occurring.

Firstly, there is limited high-level evidence for complementary medicines in terms of quality, safety and efficacy. Consequently, both health professionals [36, 37] and consumers [38, 39] find it difficult to give evidence-based advice or make evidence-based decisions. In such circumstances, it should not be surprising that consumption decisions are influenced by information obtained via advertising [40] or that recommendations from family and friends, or someone with a similar condition, may be just as influential or even more so than the opinion of a health professional [40]. Second, there is evidence that a vast majority of consumers misinterpret concepts such as probability that are necessary for understanding the expected outcomes from consumption of complementary as well as conventional medicines [41]. Third, the amount of information which has to be processed may be overwhelming. Apart from the obvious potential problems with self-evaluation of the health condition of concern (type, frequency, severity and possible treatment options)[42, 43], consumers may be influenced by product characteristics such as price, quality and brand. Thus, consumers are at risk of making a choice that may be adverse to their health, of making a poor purchasing decision, and/or potentially delaying more effective care [44].

The typical government response in such situations is to impose regulation. For example, complementary medicines in Canada are subject to various guidelines and safeguards [45], including labelling requirements [46]. In Australia, proposed changes to the labelling of complementary medicines have arisen as a result of perceived weaknesses in the existing regulatory process [47-49]. One of the arguments in favour of additional labelling in Australia is that consumers believe complementary medicine to be more rigorously evaluated by the national regulatory body, the Therapeutic Goods Administration (TGA), than is actually the case, a claim which is backed by some evidence [40, 50].

In an attempt to better inform consumers, proposals have been made to add a compulsory statement on the labels of all complementary medicines with the aim of describing the limits of

the regulatory approvals process. Different wordings of the proposed statement have appeared in the literature or the media [48, 51, 52] [see Figure A1 Online Appendix for descriptions]. Here, we aim to test the potential effect on information processing of adding such statements to the already large amount of information that must be processed by consumers. As an alternative to regulatory statements, we also investigate the addition of a traffic-light system, similar to what is being used on many foods [53, 54] as a way of highlighting key information for consumers [see Figure A2 Online Appendix].

Participants

As geographical proximity was required (the eye-trackers were located at Monash University, Melbourne), a local recruitment strategy was necessary. Members of the University Staff (both academic and administrative) were invited to participate through a regular university e-newsletter. We focused on staff rather than undergraduate students (although PhD students were allowed to participate) so as to gain a more representative group in terms of demographics such as age and health status. However, the recruited sample remained better educated and from higher socioeconomic circumstances than the general population. For this presumably less 'boundedly' rational sample, we might expect additional information to evoke fewer changes in information processing than for the general population [55].

Choice Scenarios

A discrete choice experiment (DCE) is one way of simulating the consumption choice and estimating how consumers may behave when characteristics (attributes) of the different choices (alternatives) are altered. By accounting statistically for the different levels of attributes presented, researchers can estimate the relative contributions of the different attributes towards the chosen alternative. The intention of the present study is not, however, to estimate part-worth utilities. In the present study, we used purposefully constructed choice scenarios (that is, an underlying DCE design was not used) to simulate decisions for complementary medicine and to allow observation and recollection of decision-processes using eye-tracking and semi-structured interviews[7]. Methods and results from the larger DCE using a statistical design (including part-worth utilities) are reported elsewhere [56].

[7] This study was also used to pilot test the attributes and levels of the DCE for use in a subsequent study using a larger sample size.

Participants in the present study were asked to consider one of two scenarios – both of which describe mild health conditions (insomnia or joint pain) for which a range of self-care options are available. These two conditions were chosen due to their prevalence in the general population as well as the availability of both complementary and conventional medicines for self-selection and treatment. Within each condition, participants were asked to choose between three alternatives - a conventional medicine, a complementary medicine and 'something else' (opt out option).

As this study forms part of a larger, multi-disciplinary project focused on complementary and alternative medicine (CAM) use in people with chronic illness [57], the identification of attributes and levels drew on previous results of this project including qualitative work as well as a survey in the target population (N=2,915) describing motivations for and use of CAM alongside conventional medicine [58-60]. A summary of all identified attributes and levels tested in the pilot is available in the Online Appendix (Table A1).

Some of the attributes, such as 'who recommended the product' and 'where it is available', were arranged (formatted) in a number of boxes underneath the initial health scenario description. The remaining attributes, apart from price, were displayed as part of a product label, designed to be as realistic as possible and group related attributes. Price was displayed under the labels, to represent how items are usually displayed on shop shelves. An example scenario is available in the Online Appendix (Table A2). Choice scenarios were uploaded as an online survey. Participants were asked to complete the online survey on specialized computers with eye-tracking capabilities as their first task. No specific training materials were provided to participants apart from a general introduction and a practice DCE choice set and no prior mention of the traffic light or regulatory statements was made before the survey commenced.

Eye-tracking

Eye-tracking technology has evolved rapidly in recent years. Earlier prototypes required participants to wear bulky headwear and/or electrodes and stay in relatively uncomfortable positions for periods of time. Newer eye-trackers can be installed into regular-looking desktop computers and do not require the use of additional external hardware. Informed consent was obtained from all participants to use the eye-tracking technology, which required a short calibration of each individual's eyes to the screen (about 30 seconds). Apart from being asked to remain as still as possible during the survey to maximise the likelihood of being detected by the eye-tracker, there is no requirement for headwear or electrodes and participants remain relatively

unaware that they are working on anything other than a regular computer. Here we used a Tobii T120 eye-tracker and associated software (Studio Version 2.3.2.0) to formulate the raw data which was then exported and analysed in Stata 13 statistical software [61]. The eye-tracking data so obtained consists of fixations (unique observations for each time a participant focuses or fixates on anything within the calibrated screen) and saccades and allowed identification of area of fixations, duration of fixations and order of fixations. Data for pupil dilation was also available but not made use of in this analysis.

Experimental design and measurement of ANA

The on-line survey included eight choice scenarios per respondent, split equally across the two health conditions. To test the influence of complexity of the choice scenario (and cognitive burden), we allowed the number of attributes presented in choice scenarios to vary from three to eight. Half the participants were presented with an increasing number of attributes (increasing complexity); the other half was shown a decreasing number of attributes (decreasing complexity). In an attempt to minimise unthinking /mechanical choice, levels of attributes were varied across choice scenarios to obtain as much attribute balance as possible given the purposeful design.

Using the specialised Tobii software, we can build a matrix of "areas of interest" (AOI) overlaying the image for each choice set. Each AOI represents one cell and here the cells of interest are alternative-specific attributes. An example of an AOI coded choice set is provided in the Online Appendix (Figure A5). The software can then calculate a number of metrics for each AOI including the number of times each attribute was visited, how long each 'fixation'[8] (look) lasted and the size of the pupil. Given the large amount of data available, we limit our analysis here to the number of times an attribute was visited. From this we can calculate the inverse – whether the attribute was fixated at all during the choice set. As the level of an attribute can only theoretically be influential on choice if that attribute is fixated, here we leave aside attribute levels as predictors of ANA.

[8] The eye-tracker collects raw data every 16.7 milliseconds and assigns to each data point a location. A fixation filter is then applied to determine if each data point is a 'fixation' or 'saccade' (for two points to be considered as part of the same fixation, the distance between two data points must be below a minimal threshold). We used the default 'ClearView' settings for the I-VT (Velocity Threshold Identification) fixation filter [Tobii Studio 2.X, Release 2.2, User Manual (2010). http://www.tobii.com/].

Statistical analysis

Following Lagarde [29], we hypothesis that ANA will be influenced by the complexity of the decision problem (here, the number of attributes in each choice set), the context within which the survey was undertaken (including time pressure) and respondent specific characteristics. A dummy variable which indicates whether the survey was seen in increasing order of complexity (forward) or decreasing order of complexity (reverse) is included in the model. The time taken to complete each choice set was recorded during the experiment, however, as this measure is likely to be highly correlated with complexity and therefore prone to estimation bias, a suitable proxy for time pressure was identified. As the appointment time for each participant varied, we reasoned that appointments later in the day were more likely to be associated with greater time pressure as changes in traffic conditions and outside work activities are more likely to be given higher consideration around this time.

Firstly, we estimate the effect of complexity on attribute non-attendance using both fixed and random effects panel regressions. Equation (1) specifies this model investigating the effect of complexity on attribute non-attendance:

$$(1)\quad ANA_{ij} = \alpha_i + \delta complexity_{ij} + \tau condition_{ij} + \eta time\_pressure_i + \gamma direction_i + \omega W_i + \varepsilon_{ij}$$

where ANA_{it} (attribute non-attendance) is the number of attributes with zero fixations for participant *i* in choice-set *j*; α_i captures individual-specific fixed/random effects controlling for observed and unobserved respondent characteristics; $complexity_j$ is the number of attributes present in choice-set *t*; $condition_j$ is a dummy indicator coded as 1if choice-set *j* relates to the joint pain scenario (and 0 for the insomnia scenario)*;* time_pressure is a dummy indicator of whether the appointment time was late (after 5.30pm)[9]; $direction_i$ is a dummy indicator of whether the participant received choice-sets ordered in increasing (forward) or decreasing (reverse) complexity; W_i is the matrix of respondent characteristics; and ε_{ij} is an idiosyncratic error. The intention here is not to estimate part-worth utilities and the parameter of primary interest is δ. Where δ is positive and significant, attribute non-attendance increases with

[9] This cut-off was chosen as it is a time when most people have finished work for the day. Only three individuals were classified as having a late appointment using this definition. The robustness of the cut-off is tested during the analysis and reported in the results section.

complexity. We also include complexity as a quadratic term to allow a non-linear relationship between ANA and complexity.

Included in the matrix of respondent characteristics are dummy variables for gender; a continuous measure for age (and age squared to allow for non-linear effects); a dummy variable coded 1 for education levels below university level[10]; and a dummy variable coded 1 for post-graduate students[11]. Also included is a dummy variable indicating if the participant reported using different CM products in the previous 12 months to account for prior experience and proxy for *a priori* preferences. Three variables are included:

i. vitamin (self-selected) = taken a vitamin, mineral or herbal supplement not prescribed by a medical doctor in the past 12 months;
ii. vitamin (prescribed) = taken a vitamin, mineral or herbal supplement prescribed by a medical doctor in the past 12 months;
iii. other CAM = used other complementary and alternative medicine products or therapies (here it includes Western herbal medicines; Chinese medicines; acupuncture or indigenous or traditional folk therapies)

We hypothesised that participants' *a priori* preferences may make them more inclined towards choosing particular alternatives, and as the alternatives here are labelled (that is, they are specified to be '*conventional*' and '*complementary*' medicines rather than a generic option of '*Medicine A'* versus '*Medicine B*'), then we may also expect ANA to vary within alternative, as well as across alternatives. To account for this potential labelling effect, we also run the regression specified in Equation (1), but with ANA now 'alternative specific' – that is, the dependent variable is now the number of attributes not attended to within an alternative, rather than across all alternatives. This is expressed in equations (2) and (3) below:

$$(2)\ ANA\_conv_{ij} = \alpha_i + \delta complexity_j + \tau condition_j + \eta time\_pressure_i + \gamma direction_i + \omega W_i + \varepsilon_{ij}$$

$$(3)\ ANA\_CM_{ij} = \alpha_i + \delta complexity_j + \tau condition_j + \eta time\_pressure_i + \gamma direction_i + \omega W_i + \varepsilon_{ij}$$

Definitions of explanatory variables remain consistent with equation (1).

[10] Due to the sample being drawn from a university, this variable is also likely to indicate professional (non-academic) staff status.

[11] Undergraduate students were excluded from participating.

Finally, we also test a previous assumption made by others investigating ANA [27] whereby participants are consistent with regard to which attributes they consider across choice sets (and by implication, which to ignore). To do this, we construct a measure of 'consistency' of individual *i*, detailed in Equation (4):

(4) $\text{consistency}_i = \text{mean}(s_{ij}-S_i)^2$

where *s* is the proportion of attributes attended to in choice set *j* by individual *i* and S_i is the mean of *s* for individual *i*. Here, a higher value indicates less consistency across choice sets and more deviation in terms of the number of available attributes attended/not attended to. We then regress consistency as the dependent variable with the same set of explanatory variables detailed in equations 1, 2 and 3, with the exclusion of complexity and condition (which are invariant when considering consistency across choice-sets), as detailed in Equation (5) below:

(5) $\text{consistency}_i = \alpha_i + \eta\text{time\_pressure}_i + \gamma\text{direction}_i + \omega W_i + \varepsilon_{ij}$

Results

Thirty-nine participants completed both the survey using eye-tracking and the semi-structured interview. However, the quality of eye-tracking data were insufficient in the case of seven participants, and their data is excluded in this analysis[12]. Table 1 details the participant characteristics. As mentioned previously, the sample is not representative of the general population. The majority of participants are female (75%), highly educated and in higher income groups. The majority also report having taken a self-selected vitamin, mineral or herbal product in the previous 12 months, which is higher than reports in the literature for Australian populations [62].

We summarise attribute attendance in Table 2 where it can be shown that attendance is relatively high for the first four questions, but drops from 100% (all attributes attended to when considering combined alternatives) in question 1 down to 50% in question 8. However, participants may only have attended to the levels of each attribute in one of the alternatives and not the other. The mean number of attributes not attended to across all choice sets is 0.45 (sd

[12] The eye-tracking software provides a percentage of the time over the duration of the survey for which eye-tracking data were collected. If participants did not remain still enough, for example, and data were not able to be captured for some of the time, the percentage was less than 100%. As a general rule, we excluded participants for this analysis if their percentage tracked was 50% or less, however, this is an overall figure which includes time spent on both the DCE choice sets and introduction/demographics sections, and it was relaxed in the case of six participants where it was deemed there was sufficient data capture during the DCE section for them to be included.

0.93, skewness 2.50, kutosis 9.61). For the conventional alternative the mean is 0.74 (sd 1.18, skewness 1.87, kurtosis 6.39) and for the CM alternative 0.75 (sd 1.12, skewness 1.82, kurtosis 6.04). The paired t-test for the mean difference of the two alternatives is significant (p=0.05) and may reflect that the CM alternative was on the right-hand side of the choice set consistently across all choice sets.

The effect of viewing the questions in forward (increasing complexity) compared with reverse order is shown in Figure 1. Mean ANA is zero for question 1 when the survey is completed in either direction, however, there is slightly less ANA at question 8 by those participants who completed the survey in reverse order, which may indicate responder fatigue. Mean ANA by alternative is shown in Figure 2. Both figures show a relatively large ANA increase/drop between questions 4 and 5 which is where the product labels appear/disappear for the first time, greatly increasing the amount of information to be considered. The mean time taken to answer each choice set is shown in Figure 3 and shows that, on average, more time was spent on answering question 1 if the survey was shown in forward order, and more time on question 8 if the survey was seen in reverse order. Both forward and reverse order curves are broadly u-shaped, perhaps suggesting both are subject to a learning effect which means the time taken decreases to a point before fatigue starts to increase.

We then look to see if there are particular attributes which are more prone to ANA than others and this is presented in Table 3. Notably, price was missed by just over 16% of participants on average for the 5 questions in which it was available, a phenomenon that has been found by others [29] and a concern for willingness-to-pay estimates from DCEs. Other attributes that appeared more likely to be missed included where the product was available and the caution and warnings on the labels. Surprisingly, given its bold colours and relative size, the traffic light was missed by 15 and 22% of participants in question 7 and 8 respectively.

Results from the main regressions are presented in Table 4. Our main interest is the relationship between ANA and complexity, which shows a positive and significant relationship for models 1-4, with a negative and significant quadratic term (that is, ANA is increasing with complexity but at a diminishing rate over the number of attributes we tested here). The fixed and random effects models (models 1 and 2, respectively) provided similar estimates and tests for the appropriateness of using the random effects model did not reject the null that results are consistent (see the footnote to Table 4 for details). We also re-run the model after centring the mean of complexity at zero and although the beta coefficients on complexity differ, the sign and significance are unchanged.

ANA was less likely for the joint scenario and more likely for participants who had a late appointment (both significant at the 10% level in model 2), although the effect of the late appointment was not robust to different cut-off times. The order in which the survey was completed was not found to be associated with ANA. Some variation was shown in the relationship between socio-demographic variables and alternative specific ANA: lower levels of education were associated with higher ANA in the conventional medicine alternative and those who had taken a vitamin prescribed by a medical doctor in the previous 12 months were more likely to miss attributes in the CM alternative.

The mean for the measure of consistency across the sample was 0.016 (sd 0.020, skewness 1.76, kutosis 5.84), with 10 participants having a mean of zero (that is, they were entirely consistent in terms of how many attributes were missed across all choice sets). In terms of the consistency regression (model 5), younger age was associated with greater consistency, although as shown by the positive and significant coefficient on the corresponding quadratic term, this effect decreases as age increases.

Discussion and conclusions

This paper adds to the growing literature regarding attribute non-attendance in DCEs and to our knowledge is the first to explicitly focus on the relationship between complexity and ANA in the health literature. Our results show there is a strong positive and statistically significant relationship between ANA and complexity and that this relationship is robust to a number of different model specifications. Importantly, we find that complexity is the strongest predictor of ANA when other possible influences, such as time pressure, ordering effects, survey specific effects and socio-demographic variables (including proxies for prior experience of the decision problem) are considered. We also find that ANA, as well as the consistency with which attribute attendance is applied across choice sets, does show some evidence of heterogeneity across different socioeconomic variables, specifically for education and age. Like others, we do find considerable departure from the assumptions underpinning RUT which assumes consumers maximise their utility based on all available information [29, 33]. Similar to Balcombe [33], we found that full attendance to all attributes across all choice sets is unusual, however, ANA was significantly less present for choice sets with fewer attributes[13].

[13] It is also important to note that Balcombe used a different definition of ANA whereby meeting or exceeding the threshold of two fixations per attribute defined attendance, whereas we used the stricter definition of zero fixations to define non-attendance.

Interpretation of this finding should be taken within the context of this particular study. In general participants reported being engaged with the survey and although many stated that the choice sets with more information took longer to process, the information itself was not difficult to understand. Most also reported that they thought all attributes were potentially relevant to their decision – there were no recommendations to remove particular attributes (only to change one of the levels of one of the attributes).

What has yet to be clearly determined in the literature is whether, and the extent to which, utility functions should be adjusted for ANA. As we used a purposeful DCE design so that we could incorporate different numbers of attributes across choice sets, we could not account for the effect of attribute levels and therefore estimate utility functions here. Lagarde [29] found that whilst willingness-to-pay estimates were sensitive to ANA, the behavioural prediction of DCE models was not affected by ANA. One explanation for this may be that consumers are so accustomed to using heuristics or decision rules in complex or uncertain situations that they are well practised to seek out information that will be useful to them in their final decision (in essence, conferring zero utility for any attributes superfluous to their needs). Thus, reading attribute and alternative labels may be sufficient for some consumers to decide if the subsequent information available is worthwhile attending to or not.

We did, however, find evidence that ANA differed across alternatives, although the mean effect was shown to be small. It is likely that this effect be more present in a labelled as opposed to an unlabelled experiment, which is another interesting hypothesis to be tested. We cannot rule out here that this effect may also represent left-right logographical ordering .The effect of alternative-specific ANA on utility functions, as compared with 'total' ANA for a given attribute is worthy of further consideration. Alternative-specific ANA may also offer additional insights into the decision processing strategy used by participants during DCEs.

The finding that 'consistency' with regard to the number of attributes attended to across choice sets decreased with age may be potentially explained by a decrease in cognitive function over time, although this cannot be tested here. Results are not consistent with the assumption made by Hole [27] that the decision of which attribute/s to consider is stable across choice sets and are instead more supportive of the notion that this varies, as suggested by others [31].

This study also offers has some important implications for the design of DCEs measuring health and health-care preferences more generally. This study, which also acted as a pilot for a larger DCE, highlights the design complexity of some of the scenarios encountered by health

researchers and raises further questions about how the qualitative properties of the survey, such as the description of attributes and levels, presentation of choice sets and clarity of instructions may impact on ANA.

One of the obvious limitations of this analysis is the small and unrepresentative sample size. As we would expect higher levels of education to decrease ANA, our results are likely to underestimate ANA in the general population. Additionally, we only tested complexity over a range of 3-8 attributes, which is the upper limit of attributes reported to be routinely included in DCEs in the health setting [12]. Thus, caution should be exercised in drawing conclusions regarding the effect of additional attributes in other DCE studies.

The rapid advancements in eye-tracking technology over recent years has meant that this technology is likely to be used more extensively to investigate questions of information processing across a range of disciplines, including in health economics. Alongside this, methodological questions also need to be answered regarding the use of the available metrics (fixations, saccades, pupil dilation), the definitions applied (for example, ANA) and how these may be linked to neurological process to provide greater insight into decision-making processes. Its use alongside other qualitative and quantitative methods is likely to be informative in many other research questions.

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Table 1: Summary of participant demographics (N=32)

Female		24/32 (75%)
Age	mean	37.4 years
	median	32 years
	range	20-70 years
Born in Australia		17/32 (53%)
Language spoken at home	English	28/32 (88%)
Government concession card*		10/32 (31%)
Highest level of education	High school† or vocational training	5/32 (16%)
(Higher than 100% due to rounding)	Undergraduate degree	15/32 (47%)
	Postgraduate degree	12/32 (38%)
Full-time student		5/32 16%
Current household income‡		
(Higher than 100% due to rounding)	<$50,000	7/32 (22%)
	$50,000-<$100,000	13/32 (41%)
	$100,000+	12/32 (38%)
Used vitamin last 12 months - self$^{\alpha}$	yes	24/32 (75%)
Used vitamin last 12 months - dr$^{\beta}$	yes	7/25 (22%)
Used other CAM last 12 months$^{\gamma}$	yes	18/32 (56%)

* Indicates the individual is eligible for low-income government assistance

† Year 11 or 12 in the Australian system (final years) – no one reported a lower level

‡Australian dollars, 2011 (before tax)

α vitamin (self-selected) = taken a vitamin, mineral or herbal supplement not prescribed by a medical doctor in the past 12 months

β vitamin (prescribed) = taken a vitamin, mineral or herbal supplement prescribed by a medical doctor in the past 12 months

γ other CAM = used other complementary and alternative medicine products or therapies (here it includes Western herbal medicine; Chinese medicine; CAM practitioners, or indigenous or traditional folk therapies)

Table 2: Number of participants who attended to every attribute for both conventional & CM alternatives combined, and each alternative alone (N=32)

Question	Number attributes	Health condition	Alts combined† # participants (%)	Conv alternative # participants (%)	CM alternative # participants (%)
1	3	joint	32 (100)	28 (88)	29 (91)
2	3	insomnia	28 (88)	24 (75)	20 (63)
3	4	joint	32 (100)	26 (81)	24 (75)
4	4	insomnia	25 (78)	24 (75)	18 (56)
5	5	joint	20 (63)	13 (41)	14 (44)
6	6	insomnia	18 (56)	13 (41)	12 (38)
7	8	joint	17 (53)	13 (41)	12 (38)
8	8	insomnia	16 (50)	15 (47)	13 (41)

Abbreviations: Alts = alternatives; conv = conventional; CM = complementary medicine; # = number

† For a participant to have attended to an attribute, they had to have one or more fixations on that attribute, irrespective of whether they looked at the levels of the attribute in both choices

Note: The 'do something else' option did not have any attributes specified and is excluded from this analysis.

Figure 1: Mean attribute non-attendance by question order

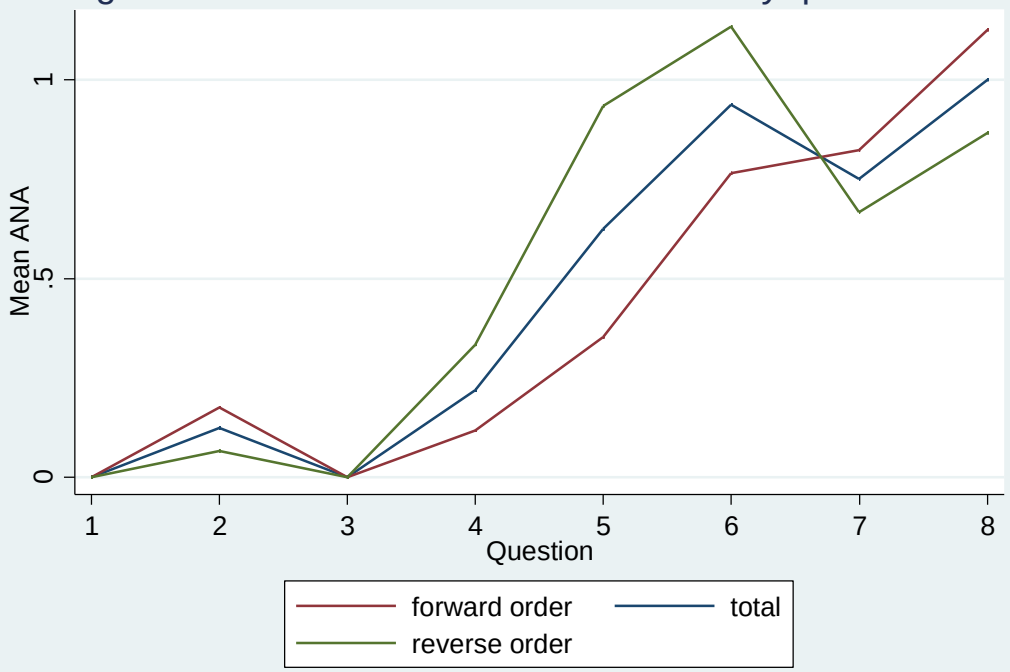
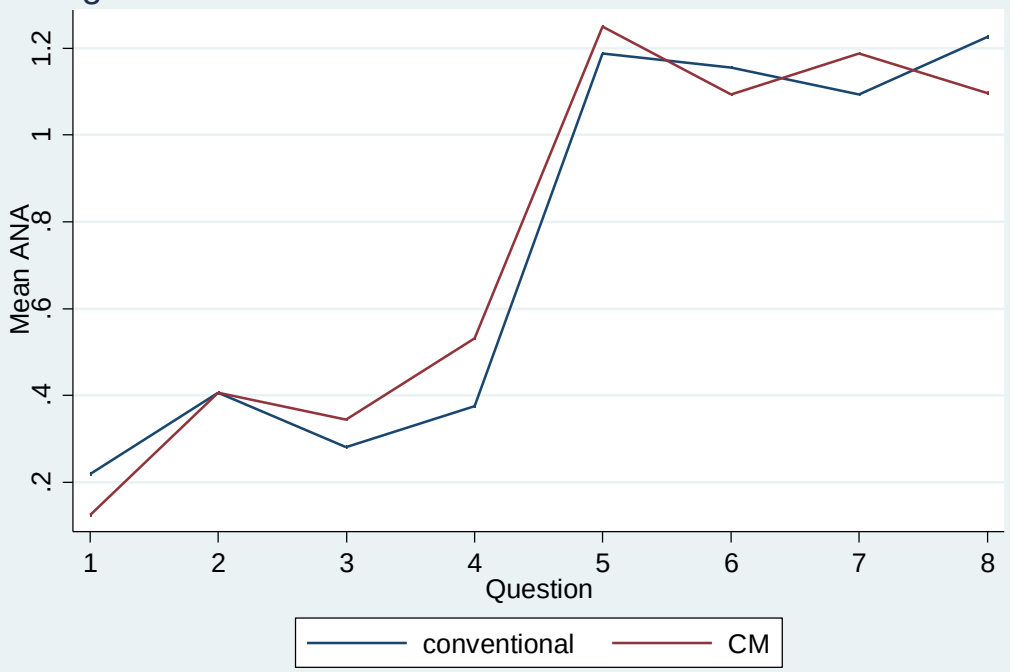


Figure 2: Mean conventional & CM attribute non-attendance



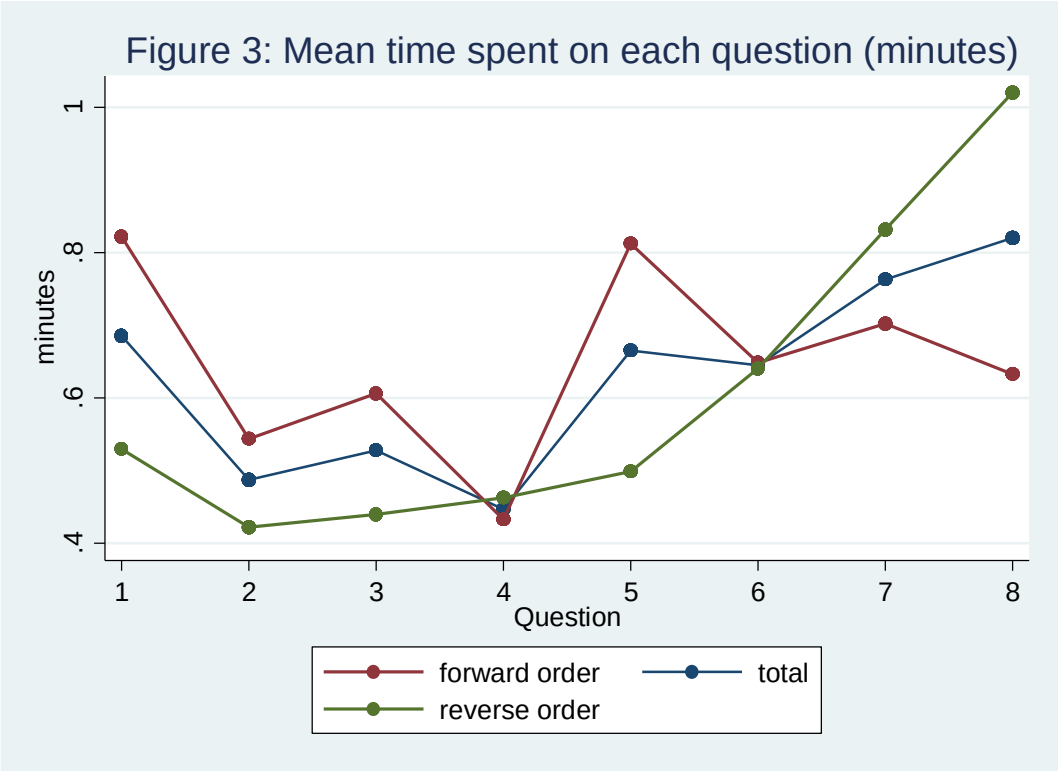


Figure 3: Mean time spent on each question (minutes)
minutes
.4
.6
.8
1
1
2
3
4
5
6
7
8
Question
forward order
total
reverse order

Table 3: Eye-tracking results – percent participants who did not attend to each attribute, broken down by within alternative non-attendance

	Question number							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Attribute								
Recommendation	**0**	**3.13**	**0**	**0**	**3.13**	**6.25**	**0**	**0‡**
Recommendation - conv	3.13	6.25	3.13	0	9.38	9.38	6.25	9.68
Recommendation - CM	6.25	15.63	12.50	15.63	18.75	18.75	18.75	19.35
Side effects	**0**	**3.13**	**0**	**0**	**12.50**	**3.13**	**6.25**	**6.45**
Side effects - conv	9.38	12.50	6.25	6.25	15.63	12.50	12.50	16.13
Side effects - CM	3.13	9.38	6.25	15.63	28.13	15.63	18.75	16.13
Where available	**0**	**6.25**	**0**	**9.38**	**18.75**	**9.38**	**3.13**	**16.13**
Where available - conv	9.38	21.88	9.38	15.63	28.13	18.75	15.63	25.81
Where available - CM	3.13	15.63	6.25	9.38	31.25	18.75	12.50	22.58
Price	**NA**	**NA**	**0**	**12.50**	**15.63**	**21.88**	**12.50**	**19.35**
Price - conv	NA	NA	9.38	15.63	34.38	43.75	40.63	38.71
Price - CM	NA	NA	9.38	12.50	34.38	34.38	28.13	25.81
Dosage†	**NA**	**NA**	**NA**	**NA**	**0**	**0**	**6.25**	**6.45**
Dosage† - conv	NA	NA	NA	NA	9.38	12.50	6.25	6.45
Dosage† - CM	NA	NA	NA	NA	3.13	3.13	9.38	9.68
Caution	**NA**	**NA**	**NA**	**NA**	**12.50**	**21.88**	**3.13**	**9.68**
Caution - conv	NA	NA	NA	NA	31.25	NA	15.63	NA
Caution - CM	NA	NA	NA	NA	12.50	21.88	9.38	9.68
Warning	**NA**	**NA**	**NA**	**NA**	**NA**	**31.25**	**18.75**	**9.68**
Warning - conv	NA	NA	NA	NA	NA	31.25	18.75	9.68
Warning - CM	NA	NA	NA	NA	NA	NA	NA	NA
Traffic light	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**15.63**	**22.58**
Traffic light - conv	NA	NA	NA	NA	NA	NA	NA	22.58
Traffic light - CM	NA	NA	NA	NA	NA	NA	15.63	NA
Regulation – CM (only)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**15.63**	**16.13**

† Dosage was considered to be a fixed attribute (the levels did not change) – it was included for realism.
‡ Denominator is 31 participants in question 8 due to missing eye-tracking data for participant 124
NA = not applicable – the attribute did not appear in the particular question

Table 4: Summary of main results from eye-tracking regression of attribute non-attendance (ANA)

	(1) Number ANA, fe			(2) Number ANA, re			(3) Number ANA (conv), re			(4) Number ANA (CM), re			(5) Consistency†		
	b	se	p	b	se	p	b	se	p	b	se	p	b	se	p
complexity	0.578***	0.210	0.006	0.578**	0.230	0.012	0.749***	0.247	0.002	0.863***	0.309	0.005			
complexity2	-0.036*	0.019	0.057	-0.036*	0.020	0.081	-0.050**	0.024	0.037	-0.061**	0.027	0.027			
joint	-0.182*	0.097	0.062	-0.182*	0.097	0.060	-0.046	0.132	0.728	-0.013	0.094	0.887			
late appointment				0.481*	0.275	0.080	0.438	0.308	0.155	0.680*	0.412	0.098	0.019	0.011	0.112
forward order				0.005	0.140	0.973	0.154	0.210	0.462	0.029	0.228	0.897	-0.006	0.007	0.412
female				0.104	0.144	0.471	0.017	0.187	0.927	0.234	0.188	0.214	0.003	0.007	0.655
age				0.001	0.037	0.982	-0.022	0.046	0.630	-0.015	0.053	0.775	-0.004**	0.002	0.038
age2				0.000	0.000	0.577	0.001	0.000	0.134	0.000	0.001	0.482	0.000**	0.000	0.017
<uni education				0.218	0.200	0.275	0.431*	0.223	0.053	0.010	0.255	0.970	-0.002	0.010	0.817
student				-0.019	0.156	0.905	0.024	0.187	0.896	-0.125	0.237	0.598	-0.009	0.009	0.346
vit (self-selected)				-0.250	0.176	0.154	-0.183	0.239	0.444	-0.328	0.277	0.236	-0.011	0.008	0.190
vit (prescribed)				0.116	0.171	0.496	-0.189	0.192	0.325	0.456**	0.218	0.036	0.014	0.008	0.104
other CAM				0.027	0.145	0.853	0.088	0.154	0.568	-0.022	0.188	0.906	0.007	0.006	0.312
Constant	-1.348**	0.532	0.012	-1.737**	0.765	0.023	-1.975*	1.055	0.061	-1.970*	1.083	0.069	0.087**	0.041	0.046
Observations‡	255			255			255			255			32		
R^2	.210			.276			.356			.245			.612		

Abbreviations: ANA = attribute non-attendance OR attributes not attended (to); complexity2 = complexity squared; age2 = age squared; uni = university; conv = conventional medicine; CM = complementary medicine; vit (self-selected) = taken a vitamin, mineral or herbal supplement not prescribed by a medical doctor in the past 12 months; vit (prescribed) = taken a vitamin, mineral or herbal supplement prescribed by a medical doctor in the past 12 months; other CAM = used other complementary and alternative medicine products or therapies (here it includes Western herbal medicine; Chinese medicine; CAM practitioners, or indigenous or traditional folk therapies)

†As measured by the mean$(s_{ij}-S)^2$ where s is the proportion of attributes attended to in choice set *j* by individual *i* and S_i = mean (s) for individual *i* [whereby a higher value indicates less consistency and more deviation in terms of attribute non-attendance].

***, **,* indicates significance at the 1%, 5% and 10% levels respectively.

‡ Observations are based on data from 32 participants, however, eye-tracking data is absent for question 8 for one participant (124).

We test for the appropriateness of using a random effects model using a robust Hausman test using a Wald test and cluster-robust standard errors (Wooldrige, 2002) after excluding participant 124 for whom there is missing eye-tracking data for question 8 (the scalar theta cannot be calculated for an unbalanced panel). The null hypothesis assumes that individual effects are random and both fixed and random effect estimators are consistent. The test does not reject the null (p=0.652). We also perform an over-identification test with the null-hypothesis (participant 124 included) that the group means are uncorrelated with the idiosyncratic error term. The test does not reject the null (p=0.911). From this we conclude that the random effects estimator results are appropriate.

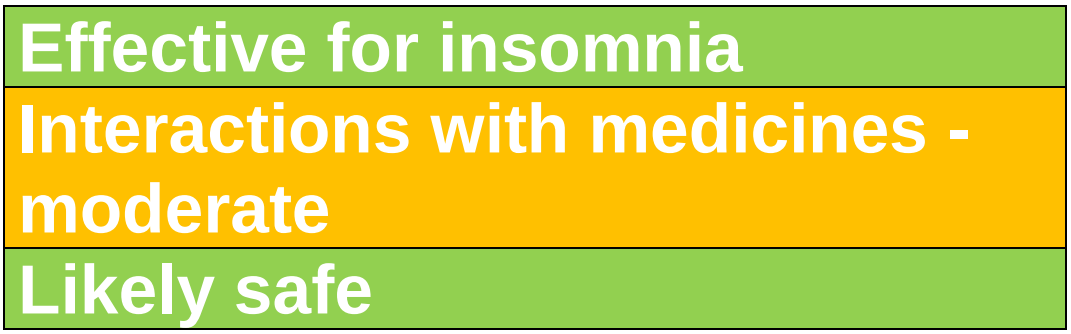
Online Appendix

Figure A1: Wording of the proposed statements to appear on complementary medicines

(1) This product has not been evaluated by Australian Health Authorities for efficacy	(2) This product has been evaluated by Australian Health Authorities for efficacy*
(3) Untested	(4) (No label)

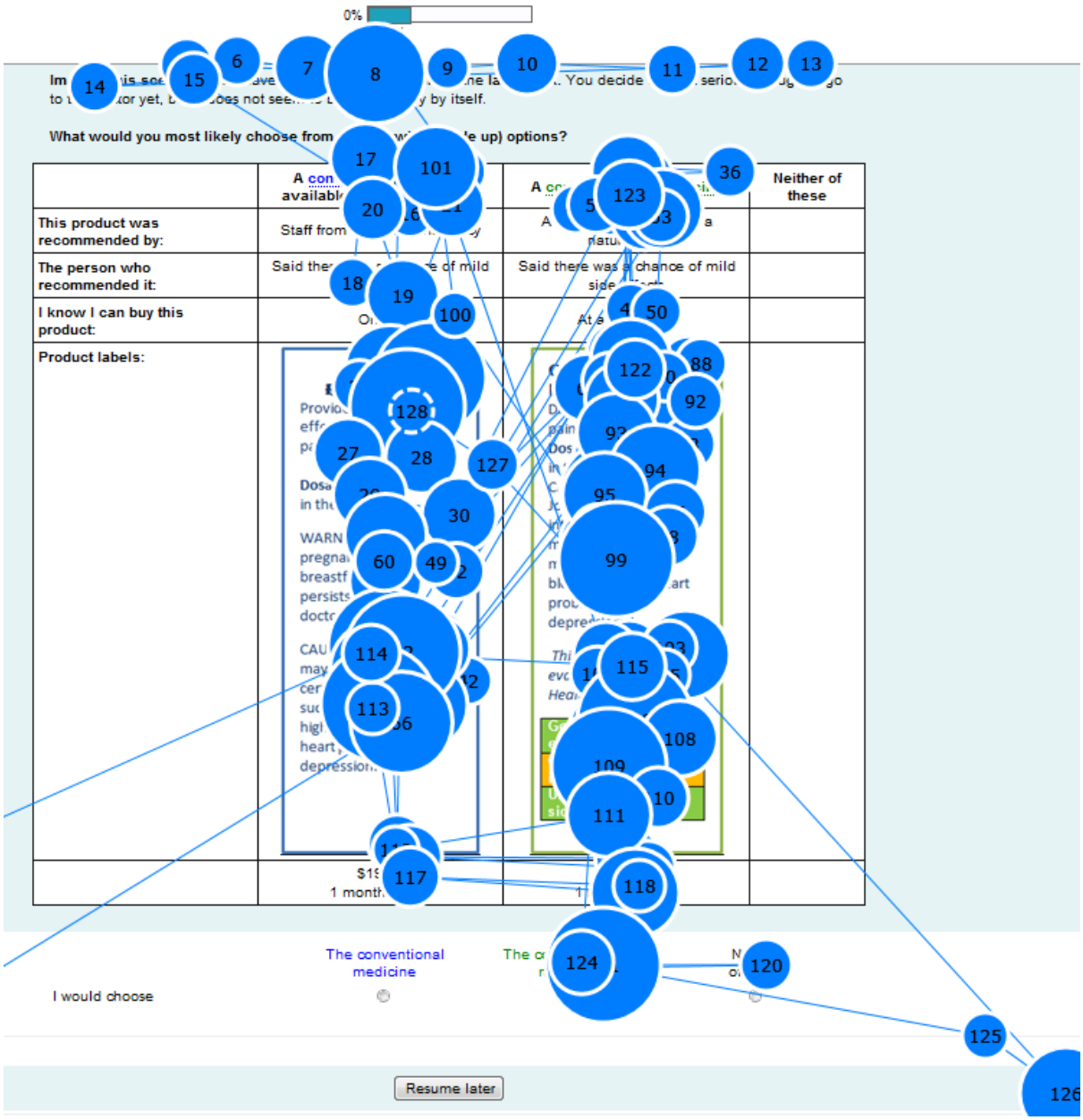
* Although this statement was not suggested in the media, we thought it appropriate to present as a more positive version of the label that was suggested.

Figure A2: The 'traffic-light system' used in the pilot study as an alternative to the statements shown in Figure 1



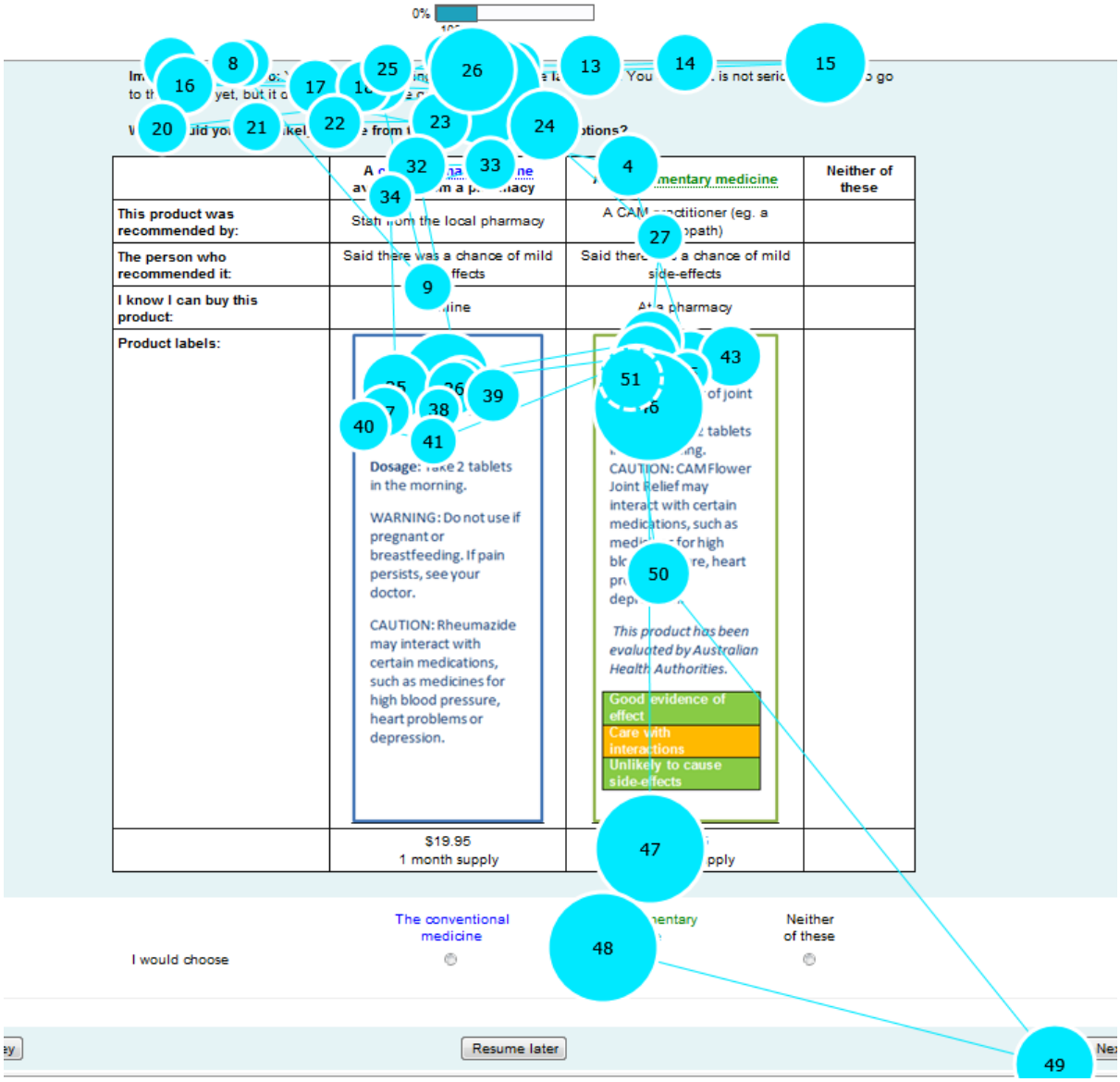
Notes: The traffic light system was designed to describe three main aspects of the CM or conventional medicine product, namely, effectiveness; the potential for interactions with other medicines (CM and conventional); and the potential for side effects. Here, green indicates the most favourable classification; orange indicates that more care needs to be taken; and red indicates caution. It was broadly modelled on food nutrition labels. One of the key motivations of the pilot study was to test the design and comprehension of this logo. Following the pilot, this logo was updated to reflect participant comments.

Figure A3: Example gaze plot for a participant who attended to all attributes within a question



Notes: The Gaze Plot visualization shows the sequence and position of fixations (dots) on a static media. The size of the dots indicates the fixation duration and the numbers in the dots represent the order of the fixations.

Figure A4: Example gaze plot for a participant who did attend to all attributes within a question



Notes: The Gaze Plot visualization shows the sequence and position of fixations (dots) on a static media. The size of the dots indicates the fixation duration and the numbers in the dots represent the order of the fixations.

Table A1: Levels and attributes tested in the survey

Attribute	Level	Conventional medicine	CAM medicine
RECOMMENDED			
This product was recommended by:	0	A pharmacist	A pharmacist
	1	A Naturopath	A Naturopath
	2	Staff from the local pharmacy	Staff from the local pharmacy
	3	A friend or relative or someone I know who has [Scen 1] trouble sleeping OR [Scen 2] with joint pain	A friend or relative or someone I know who has [Scen 1] trouble sleeping OR [Scen 2] with joint pain
SIDE EFFECTS			
The person who recommended it:	0	Said there was a chance of mild side-effects, like a [Scen 1] headache OR [Scen 2] constipation	Said there was a chance of mild side-effects, like a [Scen 1] headache OR [Scen 2] constipation
	1	Didn't mention or know anything about side-effects	Didn't mention or know anything about side-effects
AVAILABLE			
I know I can buy this product:	0		From a naturopath
	1		At a health food shop
	2		At the supermarket
	3	At a pharmacy	At a pharmacy
DOSEAGE (held constant)			
	0	[Scen 1]"1 tablet one hour before bedtime" or [Scen 2] "2 tablets in the morning with food"	[Scen 1]"1 tablet one hour before bedtime" or [Scen 2] "2 tablets in the morning with food"
CAUTION	0	No caution on label	No caution on label
	1	May interact with certain medicines, such as medicines for [Scen 1] high blood pressure, heart disease or depression OR [Scen 2] pain, anxiety or depression.	May interact with certain medicines, such as medicines for [Scen 1] high blood pressure, heart disease or depression OR [Scen 2] pain, anxiety or depression.
WARNING	0	No warning on label	No warning on label
	1	[Scen 1] "Do not use if pregnant or breastfeeding. If pain persists, see you doctor" [Scen 2] "May cause drowsiness. Do not drive or operate heavy machinery if affected".	[Scen 1] "Do not use if pregnant or breastfeeding. If pain persists, see you doctor" [Scen 2] "May cause drowsiness. Do not drive or operate heavy machinery if affected".
TRAFFIC LIGHT	0	No traffic light on label	No traffic light on label
	1	Traffic light on label (compatible with label information)	Traffic light on label (compatible with label information)
REGULATION	0	No label (held constant)	No label
	1		"This product has NOT been evaluated by Australian Health Authorities for efficacy"
	2		"This product HAS been evaluated by Australian Health Authorities for efficacy"
	3		"Untested by Australian health authorities"
PRICE	1	$8.95	$8.95
	2	$14.95	$14.95
	3	$23.70	$23.70
	4	$31.50	$31.50

Table A2: Example of a question (here question 7) from the survey

Imagine this scenario: You have been having **joint pain** for the **last week.** You decide it is not serious enough to go to the doctor yet, but it does not seem to be going away by itself.

What would you most likely choose from the following (made up) options?

	A conventional medicine available from a pharmacy	**An complementary medicine**	**Neither of these**
This product was recommended by:	Staff from the local pharmacy	A CAM practitioner (eg. a naturopath)	
The person who recommended it:	Said there was a chance of mild side-effects	Said there was a chance of mild side-effects	
I know I can buy this product:	Online	At a pharmacy	

Product labels:

RHEUMAZIDE

Provides temporary effective relief of joint pain.

Dosage: Take 2 tablets in the morning.

WARNING: Do not use if pregnant or breastfeeding. If pain persists, see your doctor.

CAUTION: Rheumazide may interact with certain medications, such as medicines for high blood pressure, heart problems or depression.

$ 19.95
1 month supply

CAMFlower Joint Relief Formula

Drug free relief of joint pain.

Dosage: Take 2 tablets in the morning.

CAUTION: CAMFlower Joint Relief may interact with certain medications, such as medicines for high blood pressure, heart problems or depression.

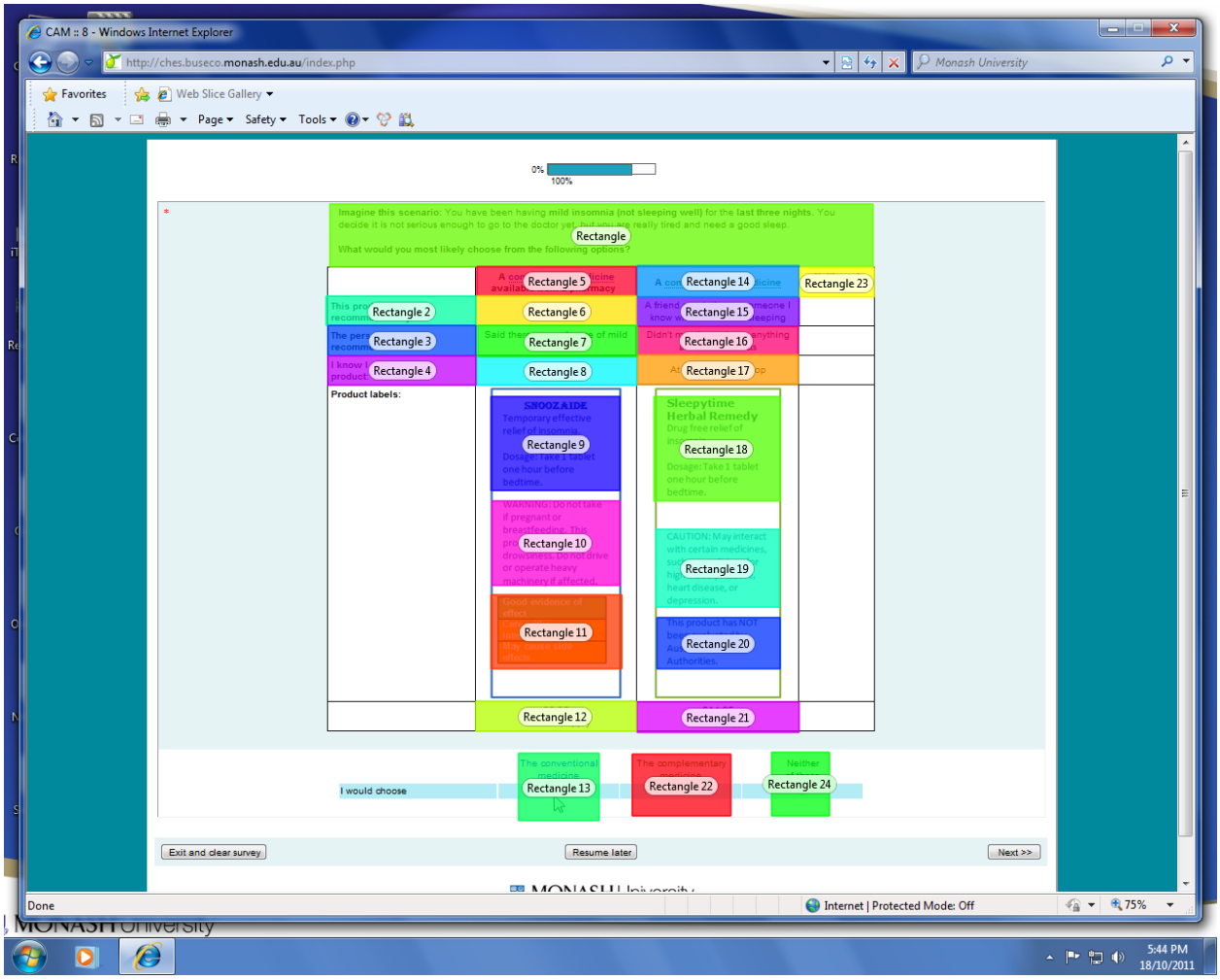
This product has been evaluated by Australian Health Authorities.

Good evidence of effect
Care with interactions
Unlikely to cause side-effects

$ 19.95
1 month supply

I would choose: ○ ○ ○

Figure A5: An example choice set with overlaying Areas of Interest (AOI) used in the eye-tracking software to determine fixation metrics



Notes: AOIs were alternative specific and overlayed on the attributes in such a way that all of the 'cell' was covered but fixations on empty space would not be included.

Specific Declaration Chapter Seven

Declaration by candidate

In the case of Chapter Seven, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
• Contributed to the original concept for the paper • Wrote the first draft and coordinated all suggested changes • Analysed the data • Submitted the paper (corresponding author)	70

The following co-authors contributed to the work. Co-authors who are students at Monash University must also indicate the extent of their contribution in percentage terms:

Name	Nature of contribution
Duncan Mortimer	Contributed to the original concept for the paper; Analysed the data; Edited and reviewed the manuscript

Candidate's Signature		**Date** 06/01/2014

Declaration by co-authors

The undersigned hereby certify that:

(37) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(38) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(39) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(40) there are no other authors of the publication according to these criteria;
(41) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(42) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s)	**Centre for Health Economics, Monash University, Clayton**

[Please note that the location(s) must be institutional in nature, and should be indicated here as a department, centre or institute, with specific campus identification where relevant.]

Signature 1	 Duncan Mortimer	**Date** 06/01/2014

Chapter Seven: The effect of traffic lights and regulatory statements on the choice between complementary and conventional medicines: Results from a discrete choice experiment

Abstract

There are numerous suggestions that complementary medicines are currently 'under-regulated' due to their potential for harm as a direct result from side-effects or interactions; from delaying more effective care; or from the economic cost of purchasing an ineffective or inappropriate treatment. The requirement of additional labelling on complementary medicine products may provide additional information to consumers at the point of purchase. This paper details a unique way of testing the potential effects on consumer behaviour of including either a traffic light logo or regulatory statement on labels. Using a discrete choice experiment, we find that this strategy can affect consumer behaviour, but in unpredictable ways. Predicted changes to market share via simulation if the policy was implemented are presented.

Highlights:

- Additional labelling on complementary medicines has been proposed as a remedy to market failure
- Little is known about the potential effect of such a strategy
- A discrete choice experiment was conducted to elicit consumer preferences
- Both regulatory statement and traffic lights are likely to affect consumer purchasing decisions

Keywords: traffic light; regulatory statements; complementary medicine; discrete choice experiment (DCE); d-efficient design; mixed-multinomial logit

Classification codes: I110

Introduction

The World Health Organization estimates that global spending on complementary or 'traditional' medicines was in excess of US$83 billion in 2008 and growing exponentially (World Health Organization, 2011). Estimates of the prevalence of use vary from country to country reflecting both different uptake rates as well as differences in the definitions used. For example, it is estimated that over 17% of all adults in the US have taken a non-vitamin, non-mineral, natural product (such as fish oil) in the previous year (Barnes et al., 2008); a comparable figure of 10% of Canadians have used herbal preparations (Esmail, 2007). When this definition was extended to include vitamins and minerals (excluding those prescribed by a doctor), more than 50% of Australians (MacLennan et al., 2006) and 65% of South Koreans (Ock et al., 2009) reported use in the previous year.

This popularity is in contrast with the lack of high-level evidence of efficacy for most complementary medicine (CM) (Ernst, 1999) and poses a challenge for health policy makers. On one hand, CM is obviously viewed by many as a legitimate option in their suite of health care choices (Astin, 1998). CM is purchased almost without exception as an out-of-pocket expense and whilst this may be viewed as inequitable (for effective treatments), it is arguably of little concern to tax-payers. On the other hand, there are ongoing safety concerns over CM use, either directly as a result of side effects or interactions with other medicines (Ernst, 2001; Izzo and Ernst, 2009) or as a result of delaying more effective care (Ernst, 1997; Greenlee and Ernst, 2012). Institutional responses to this uncertainty by way of regulation vary between countries (Bodeker and Burford, 2007), however, there have been calls for greater levels of intervention (Avorn, 2000; Bollen and Whicker, 2009; Briggs, 2008; Harvey, 2009; Hunt and Ernst, 2010; Smith, 2012). Where increased regulation is the chosen path, it can be difficult to find the right balance between allowing individual choice, protecting public safety and limiting the chance of economic harm - the opportunity cost to a consumer of purchasing an ineffective or inappropriate product (Ramsay, 2010).

There is a large body of evidence detailing reasons why consumers use CM. Particular health conditions, especially chronic conditions such as arthritis (Fautrel et al., 2002), cardiovascular disease (Yeh et al., 2006), cancer (Girgis et al., 2005) and mental health conditions (Kessler et al., 2001) are strongly linked with CM use. For others, CM is part of a preventive paradigm and products are used to promote 'general health and wellbeing' (Kraft, 2009). Slimming and diet products (Pittler and Ernst, 2004) and 'sports supplements' (Sobal and Marquart, 1994) are used to reduce body weight or improve performance. Prior use or experience with CM will often

inform future use (Williamson et al., 2008). Other less tangible reasons are also relevant. Views on empowerment, control and the degree of self-efficacy are linked with the choice of CM and health care more generally (Lorig and Holman, 2003). Risk preferences (Furnham and Lovett, 2001; Sturm, 2000), beliefs and 'worldview' (Astin, 1998; Bishop et al., 2007; MacLennan et al., 2002) and even personality traits (Honda and Jacobson, 2005; Owens et al., 1999) may also be important.

The choice of CM may be viewed as a two-step process – the decision to use, followed by the process of product selection and purchase. Unlike pharmaceutical or 'conventional' medicines which require a prescription and which are subject to strict supply rules in most high income countries, CM medicines are freely available in supermarkets, health food stores and online. As a consequence, consumers may not have the opportunity to access advice from a qualified health professional before purchase and may instead be led by recommendations from family and friends (Williamson et al., 2008). Increasingly, consumers access information via the internet and are faced with the difficult task of appraising content of variable quality (Sagaram et al., 2002; Williamson et al., 2008). To complicate matters further, CM products are generally not subject to the same regulations as conventional medicines with regard to promotion, and advertising and celebrity endorsement are powerful drivers of use (Ernst and Pittler, 2006). Individual heterogeneity with respect to health literacy (Nutbeam, 2008) and cognitive processing limits are important here (Capon and Davis, 1984) and simplified decision rules or heuristics may be used to make mental short-cuts through the dizzying array of available information (Hibbard and Peters, 2003). These factors, together with the expanding range of CM treatment alternatives, increasing availability, and increasing competition in the market make the choice between competing CMs highly complex. As a consequence, market failure due to imperfect and asymmetric information is highly likely.

When faced with information problems, we might expect any opportunity to provide consumers with additional, reliable and readily understood evidence-based information prior to purchase to be a worthwhile policy intervention. Mandatory labelling is one such way of providing this information – a strategy already implemented in Canada (Boon, 2003; Boon and Kachan, 2007). Australia is now considering changes to CM labelling as part of a range of measures. A report for the Commonwealth (National) Government (Parliamentary Secretary) by an Expert Committee (Expert Committee on Complementary Medicines in the Health System, 2003), provides recommendations for enhancements to the current framework of existing policies and regulations with regard to CMs, including labelling requirements. This had led to some debate as

to the merits of mandatory labelling as well as the specific suggestions for content (Harvey et al., 2008a, b). There is, however, a risk that adding information will simply add complexity and that this additional information may trigger simplifying heuristics rather than evidence-based decision-making (Spinks & Mortimer, under review).

In Australia, the Therapeutic Goods Administration (TGA) is the government body responsible for the regulation of all pharmaceutical medicines as well as CMs. The TGA adopts a risk-based approach to the regulation of medicines (Therapeutic Goods Administration, 2013). Substances deemed to be higher risk, including all prescription medicines, as well as some non-prescription medicines, are required to be assessed for the "Registered" medicines list. This requires evidence of efficacy, usually in the form of randomised, controlled trial evidence, which is rigorously assessed prior to registration. However, substances deemed to be lower risk, including most CMs, need only to apply for inclusion on the "Listed" register. For these products, although the sponsor (manufacturer) is required to hold substantive evidence for any therapeutic claim made, this evidence is not necessarily assessed by the TGA at the time of listing. Indications for use are limited to health maintenance or health enhancement, or for minor health complaints (Expert Committee on Complementary Medicines in the Health System, 2003). Further, the type of evidence required by the TGA is not currently specified.

One option under the new proposal is for CM manufacturers to pay to have their product assessed for efficacy by an independent body. Under such a scheme, the level of evidence, the treatment claims and the consumer product information would all be assessed and awarded a recognisable symbol as a means of providing readily accessible information to consumers if the standard was met[14]. It was also proffered that a disclaimer could be added to all CMs, to make it clear to consumers that the TGA itself had not assessed the product for efficacy. The proposed wording of the disclaimer is: "*This medicine has not been evaluated by Australian Health Authorities for efficacy*"(Harvey, 2009). The reason being that although CM's are generally subject to far less scrutiny from regulatory agencies, there is evidence to suggest that consumers are unaware of this (Boon and Kachan, 2007; MacLennan et al., 2006; Williamson et al., 2008). A less wordy version of this statement has also been proposed – simply the word "*Untested*" (Tippet, 2011). We were also interested as to how a positive endorsement might be perceived: "*This medicine has been evaluated by Australian Health Authorities for efficacy*".

[14] The trademark proposed was similar to the Australian National Heart Foundation "tick of approval", see: http://www.heartfoundation.org.au/HEALTHY-EATING/HEART-FOUNDATION-TICK/Pages/default.aspx Accessed 06/01/2013

There are many parallels with nutritional labelling initiatives designed to provide consumers more readily available information about fat and sugar content (Balcombe et al., 2010). 'Traffic light' logos have been implemented in the United Kingdom (UK) and Europe as one way of conveying a summary of the overall 'healthiness' of food choices (Balcombe et al., 2010; Sacks et al., 2009). In the same way, we propose that a 'traffic light' system might also be considered, alongside the aforementioned regulatory statements, as an alternative way of providing reliable and accessible information to consumers at the point of purchase.

It is difficult to evaluate in advance what effect, if any, the proposed labelling changes may have on consumer choice. This information is important not only to policy makers, but also to CM manufacturers and consumer groups. Ideally, we would want to know the relative effect labelling might have compared with the other factors known to affect the decision to use CM discussed above, for example, price, availability and the source of recommendation. Discrete choice experiments (DCEs) are increasingly used in health care (Lancsar and Louviere, 2008; Viney et al., 2002) and offer a flexible way of collecting such evidence, asking consumers to make hypothetical choices in scenarios as close to real life as possible. The choices (alternatives) can be described by a number of characteristics (attributes) which can be altered in different presentations of the choice (choice sets). Attributes can vary over a number of levels chosen for realism. One survey participant can be asked to choose across a number of choice sets, where the most efficient combination of attributes has been pre-determined using an experimental design. Modelling of the results can then determine the relative effect of different attributes on the likelihood of choosing different alternatives. Here, we use a DCE to evaluate the proposed labelling changes to CM in Australia.

Methods

Identification of attribute and levels: The identification of attributes and levels drew on a larger, multi-disciplinary research project which focused on the use of complementary and alternative medicine (CAM) in people with chronic illness (CAMelot, 2011). Attributes and levels were identified in the first instance by the results of previous qualitative work, as well as a general survey on complementary and alternative medicine (CAM) in people with chronic illness (N=2,915 participants) that included both closed- and open-ended questions regarding motivations for and patterns of CAM use (Manderson et al., 2012a; Manderson et al., 2012b; Spinks et al., 2013). This list was supplemented with a literature review as well as stakeholder consultation. From the resulting 'master list', attributes relating specifically to the use of CAM practitioners (rather than products) were removed as they weren't considered to be relevant to

the more focused question we ask here. A more refined list was then prepared for pilot testing. A number of potential attributes including the 'perceived quality' of the product (in terms of the standard of manufacturing, which may be related to brand) and the level of difficulty to access the product were not included in the final list as they were difficult to describe in terms of attributes, a problem noted by Coast et al. (2012).

We tested our selected attributes in a pilot study of 39 participants, using semi-structured interviews and eye-tracking technology to determine the appropriateness of attributes and levels, as well as to assess the cognitive burden of completing the task[15]. Initial design of the traffic-light logo was informed by nutritional labels as well as input from our study reference group[16]. Results of this pilot are under review elsewhere (Spinks and Mortimer) and were used to further refine the design of the traffic light logo, test comprehensibility of the survey and refine wording. As the pilot study was delivered online and the DCE report on here was a mail-out survey, pilot participants were made aware of this and asked for formatting suggestions. Participants had previously responded to a mail-out survey, so we were aware this format was acceptable. Mail-out surveys were printed in colour with one choice set question per page and telephone support was offered to aid completion. In total, 8 attributes were included in the final DCE, which are shown in Table 1.

These attributes were assumed to be alternative-specific, that is, attributes are allowed to differ across the utility functions specified for the three alternatives. We used a labelled design, that is, we labelled the alternatives as CM or conventional medicine, rather than 'medicine A' & 'medicine B'. We did this to allow estimation of alternative specific parameters including alternative specific constants (ASC's) capturing characteristics of CM and conventional medicine not explicitly described in the choice scenario, such as whether the alternative is perceived to be 'natural' or 'holistic' (Boon and Kachan, 2007).

[15] It was identified from this study that increased complexity (more attributes) made attribute non-attendance (ANA) more likely; however, most participants did not state that they found the task overly burdensome. A recent reference suggests that while ANA is likely to have an effect on willingness–to-pay estimates, it is less likely to affect behavioural prediction of the type we describe here (Lagarde, 2013).

[16] The reference group included representatives from patient advocacy and consumer groups, and biomedical and CAM practitioner organisations including The Australasian Acupuncture and Chinese Medicine Association; the Australian Homeopathic Association; the Australasian Integrative Medicine Association; the Australasian Naturopathic Practitioners Association; the Australian Traditional Medicine Association; General Practice Victoria; Health Issues Centre; National Herbalists Association of Australia; Royal Australian College of General Practitioners. The reference group helped to ensure accountability to research participants. The role of the reference group was to share expertise and provide advice.

Presentation of attributes: Each choice set was framed by one of two health scenarios (quasi-attributes) – either mild joint pain or insomnia. As we were not interested in the effect of the treatment claim (other than making this consistent with the health scenario which precedes the attributes), or the dosage (other than having it appear for realism), these attributes were fixed across alternative and choice sets. Our key attributes of interest are the traffic-light logo, which was allowed to appear on either of the medicines, and the regulatory statement(s), which was constrained to only appear on the CM (as the counterfactual was deemed to be unrealistic). These appear on the label below warnings and cautions. An example choice set is shown in Figure 1.

Attributes were presented in three separate groups. Three attributes (recommendation (recom), side effect (se) and available (avail)) appeared in a table directly above the relevant product label, price appeared directly below the relevant product label as it typically would on retail outlet shelves, and all other attributes were included on the product label itself.

From our pilot study we had some evidence (from a small sample size) that the traffic light and one of the levels of the regulatory statement might negatively affect the probability of choosing CM. Apart from higher price being assumed to negatively affect the choice of both medicines compared with 'something else' and a pharmacist recommendation positively affecting both medicine alternatives, we had no strong a priori assumptions on the direction of attribute effect.

Experimental design: Given the choice to use CM is likely very dependent on the type of health condition being treated, we chose two common mild health complaints for which CM products are available – 'joint pain' and 'insomnia' – to frame each choice set (half of the choices are framed by one health condition, the other half by the other condition). We then asked participants to choose between a hypothetical CM, a hypothetical conventional medicine, or 'something else' given differing levels of attributes.

The full factorial of all attributes would have resulted in $2^4 4^4$ (4096) possible combinations which was unfeasible, therefore we generated a fractional, d-efficient design using Ngene software (ChoiceMetrics, 2011). Orthogonal designs are perhaps the best known and most widely used type of design in DCEs (Louviere et al., 2000), allowing for the effects of attributes to be estimated in linear models without correlation. Unfortunately, the use of non-linear models in estimation and the likely loss of orthogonality in the data generated from an orthogonal design compromise some of the advantages of orthogonal designs (Bliemer et al., 2008). This has given rise to a class of experimental designs known as efficient designs which aim to minimise the

asymptoptic standard errors of the parameter estimates by using prior information about the expected magnitude and sign (Huber and Zwerina, 1996). This type of design is used increasingly in a range of disciplines including health; see for example Sivey et al. (2012); Porteous et al. (2006) and de Bekker-Grob et al. (2012) for a recent review.

Based on the pilot study, we decided that the maximum number of choice sets that a participant could reasonably answer was 12. With 12 choice scenarios per respondent, the specified set of attributes and levels, and a likely response rate of 30% from a sample frame of N=1,786, we traded the size of the design against the number of blocks and required sample size before settling on a (balanced) design of 24 choice scenarios split over two blocks (versions). Participants were randomly assigned to receive one of the two blocks. The health condition being treated (either joint pain or insomnia) was included in the design as a 'quasi-fixed attribute' that varies between but not within choice sets (ChoiceMetrics, 2011). We also imposed two other constraints (detailed in Table 1) to avoid what we considered to be implausible combinations of attribute levels. Prior estimates for 12 parameters were obtained from the pilot study – other attributes were assumed to have a prior estimate of zero.

The utility functions assumed for the design, which we optimized for d-efficiency and a random parameters panel specification (which allows for repeated choice sets to be answered by individuals) using 50 halton draws and effects coding, were[17]:

U(conventional) = b1[-0.6] + b2.[0|0|0.3]*recommend[0,1,2,3] + b3.[0]*SE[0,1] + b4.[0.2]*caution[0,1] + b5.[0]*warning[0,1] + b6.[0]*traffic[0,1] + b7[-0.01]*price[8.95:35.50] + s1[0]*scenario[0,1]

U(CAM) = b8[-0.7] + b9.[0|0|-0.5]*recommend[0,1,2,3]+ b10.[-0.3]*SE[0,1] + b11.[0|0|0]*available[0,1,2,3] + b12.[0.3]*caution[0,1] + b13.[0.3]*warning[0,1] + b14.[n,-0.3, 0.1]*traffic[0,1] + b15.[0|0|n,-0.7,0.3]*regulation[0,1,2,3] + b16[-0.02]*price[8.95:35.50] + s2[0]*scenario[0,1]

This design produces a d-efficiency of 0.63 and required sample size (s-estimate) of 194. Attribute balance is assumed in Ngene (ChoiceMetrics, 2011). The third 'opt-out' or 'status-quo'

[17] Notes: b1 and b8 are the alternative specific constants. Levels of all attributes are given in square brackets following attribute names – see Table 1 for details of attributes and levels. Levels of the price attribute are permitted to take any value between $8.95 and $35.50. For fixed coefficients, priors are given in square brackets following each coefficient name [prior β]. For random coefficients, a distribution is specified of the form [distribution type, mean, standard deviation].

alternative in each choice set was labelled as 'do something else' and it is used as the reference category.

Study sample: As people with chronic conditions are more likely to use CM (Astin, 1998; Spinks and Hollingsworth, 2012) and are more susceptible to CM–drug interactions due to the increased likelihood of taking regular pharmaceuticals, we recruited a sample of people with either type 2 diabetes or cardiovascular disease. Initial recruitment of this sample was via a random selection of registrants on the National Diabetes Services Scheme (NDSS) database in the state of Victoria, Australia or through Heart Support Australia (Manderson et al., 2012b). From this, 2,915 participants were recruited – the majority of which responded to a mail-out survey; results of which subsequently informed selection of our attributes for the present DCE (Spinks et al., 2013). Participants who provided consent to be contacted for further research and provided valid contact details (N=1,786), were approached to answer the present DCE (postal) survey.

Analysis: As we expect individual heterogeneity (including both observed and unobserved effects) to impact on our results, the assumptions of the multinomial logit (MNL) model are considered too restrictive here[18]. Instead we use a variation of the mixed multinomial logit (MMNL) model which is more flexible, allowing for utility to be comprised both a non-stochastic part which is dependent on observed factors, a stochastic part that may be correlated across alternatives and individuals and a second stochastic part which is independently and identically distributed across alternatives and individuals (Brownstone and Train, 1998). In the usual mixed-logit specification, following Train (2009), for consumer *n* who chooses alternative *j* in choice-set *t*, where x_{njt} are attributes of the alternative, their utility (*U*) is described as:

$$U_{njt} = \beta_n' x_{njt} + [\omega_{njt} + \varepsilon_{njt}] \quad (1)$$

where β_n are the random coefficients to be estimated and ε_{njt} is stochastic (iid extreme value - normalised to account for the scale of utility). Here, ω_{njt} is a random term with zero mean which is allowed to vary over individuals and alternatives. The consumer will choose alternative *i* if and only if $U_{ni} > U_{nj} \forall j \neq i$. Only the x_{njt}'s are observed by the researcher, thus the

[18] The MNL assumes independence from irrelevant alternatives (iia) property, which in behavioural terms means that preferences for choice A or B should not be affected by the inclusion of a third option, C. This is a strong assumption which is unlikely to hold in practice in many cases. Further, the MNL model cannot account for correlation of unobserved factors over time or choice-sets (Train, 2009).

unconditional likelihood is the integral of the logit probability $L_{ni}(\beta_n)$ for all possible β_n is the mixed-logit probability:

$$P_{ni} = \int \left(\frac{e^{\beta' x_{nit}}}{\sum_j e^{\beta' x_{njt}}}\right) f(\beta) d\beta \quad (2)$$

In an alternative specification, ω_{njt} takes the structure $\mu_n' z_{njt}$ so that utility is now represented as:

$$U_{njt} = \alpha' x_{njt} + \mu_n' z_{njt} + \varepsilon_{njt} \quad (3)$$

Where α is a vector of fixed coefficients, μ is a vector of random terms and z_{njt} are error components which can be correlated over alternatives. This is known as the error-components (EC) model.

Whilst the MMNL and EC models are considered formally equivalent (Train, 2009), there is a difference in the behavioural interpretation whereby the random terms need not be associated with particular attributes ($x's$).This allows the analyst to specify correlations or 'nests' (analogous to the nested logit) using a series of dummy variables where '1' indicates inclusion in the nest, zero otherwise. Further, use of the EC model does not exclude the possibility of including random parameters for particular attributes.

Here, we exploit the flexibility of this model in a number of ways. Firstly, we can allow for unobserved factors, such as beliefs and risk preferences, as well as observed factors to be correlated across alternatives and choice-sets; we can account for the two different health scenarios to induce correlation; and we can allow for parameters of particular interest – here, the policy intervention of including a traffic light or regulation statement on CM labels – to differ across individuals. We are most concerned here with variation in response to the policy attributes (and, in particular, substitution patterns) and less concerned with variation in the effect of other attributes *per se*, except through the indirect effect that they may have on our key parameters. In such circumstances, the EC model controls for the above sources of variation in a more parsimonious manner than the equivalent RP model (Train, 2009).

The data were 'pooled' across scenarios and separate utility functions were specified for both conventional and complementary medicine in each of the two health scenarios (joint pain and insomnia) as well as one utility function for the 'something else' option in the joint scenario. The 'something else' option in the insomnia option is excluded as only *j-1* ASCs may be specified for

the model to be identified. We estimate the following set of five utility functions concurrently via a multinomial logit (MNL) model and a mixed multinomial logit (MMNL) model using the software Nlogit 5.0 (Econometric Software, 2012) – 500 halton draws are specified as well as five error-components or nests: one each for each of the health scenarios; one each for conventional (CONV) and CM alternatives to account for unobserved factors not related to the health scenarios; and one for the 'something else' option.

Alternative specific constants (ASCs), alternative-specific attribute parameters and gender and age are included. A number of interaction terms between key socio-demographic variables and the policy variables were tested. Two interaction terms between use of CM products in the previous 12 months and the traffic light logo was included in the final specification – the first is between use of vitamin, mineral or herbal supplements not prescribed by a doctor; the second between other CM products (as detailed in Table 2).

The following five utility functions are specified where U(.) denotes the relevant utility function; ASC is the alternative specific constant; α and μ denote fixed and random coefficients on included attributes, individual characteristics or interactions; ω denotes an error component capturing correlation within the relevant nest and ε is an iid extreme value residual. Here, we denote all attributes, individual characteristics and interactions as x and omit subscripts to simplify presentation[19]:

$$U_{CONV\_JOINT} = ASC_{CONV} + \alpha_{CONV\_rec1}x + \alpha_{CONV\_rec2}x + \alpha_{CONV\_rec3}x + \alpha_{CONV\_se}x + \alpha_{CONV\_caut}x + \alpha_{CONV\_warn}x + \mu_{CONV\_traf}x + \alpha_{CONV\_price}x + \alpha_{CONV\_fem}x + \alpha_{CONV\_age}x + \omega_{CONV} + \omega_{JOINT} + \varepsilon_{CONV\_JOINT}$$

$$U_{CM\_JOINT} = ASC_{CM} + \alpha_{CM\_rec1}x + \alpha_{CM\_rec2}x + \alpha_{CM\_rec3}x + \alpha_{CM\_se}x + \alpha_{CM\_avail1}x + \alpha_{CM\_avail2}x + \alpha_{CM\_avail3}x + \alpha_{CM\_caut}x + \alpha_{CM\_warn}x + \mu_{CM\_traf}x + \mu_{regu1}x + \mu_{regu2}x + \mu_{regu3}x + \alpha_{CM\_price}x + \alpha_{VIT*TRAF}x + \alpha_{OTHERCM*TRAF}x + \alpha_{CM\_fem}x + \alpha_{CM\_age}x + \omega_{CM} + \omega_{JOINT} + \varepsilon_{CM\_JOINT}$$

$$U_{SOMETHING\_ELSE} = ASC_{SOMETHING\_ELSE} + \omega_{SOMETHING\_ELSE} + \varepsilon_{SE\_JOINT}$$

$$U_{CONV\_INSOMNIA} = ASC_{CONV} + \alpha_{CONV\_rec1}x + \alpha_{CONV\_rec2}x + \alpha_{CONV\_rec3}x + \alpha_{CONV\_se}x + \alpha_{CONV\_caut}x + \alpha_{CONV\_warn}x + \mu_{CONV\_traf}x + \alpha_{CONV\_price}x + \alpha_{CONV\_fem}x + \alpha_{CONV\_age}x + \omega_{CONV} + \omega_{INSOMNIA} + \varepsilon_{CONV\_INSOMNIA}$$

[19] A full list of variable definitions is provided in a technical appendix to this chapter.

$$U_{CM\_INSOMNIA} = ASC_{CM} + \alpha_{CM\_rec1}x + \alpha_{CM\_rec2}x + \alpha_{CM\_rec3}x + \alpha_{CM\_se}x + \alpha_{CM\_avail1}x + \alpha_{CM\_avail2}x + \alpha_{CM\_avail3}x + \alpha_{CM\_caut}x + \alpha_{CM\_warn}x + \mu_{CM\_traf}x + \mu_{regu1}x + \mu_{regu2}x + \mu_{regu3}x + \alpha_{CM\_price}x + \alpha_{VIT*TRAF}x + \alpha_{OTHERCM*TRAF}x + \alpha_{CM\_fem}x + \alpha_{CM\_age}x + \omega_{CM} + \omega_{INSOMNIA} + \varepsilon_{CM\_INSOMNIA}$$

Results

Sample characteristics: An overall response rate of 30% (544/1,786) was achieved. After accounting for missing data, a final sample of 521 is used in this analysis. Missing choice data occurred equally in each block resulting in 50.8% of observations from block 1 & 49.2% from block 2 thereby eliminating any requirement to weight responses to account for unbalance. A summary of participant characteristics is shown in Table 2.

By definition this population all had at least one chronic illness, thus the mean age of 66 years (s.d. 9.72, min 27, max 90) was expected. Roughly half the sample (48%) was female; 29% were employed; 73% were born in Australia and 95% spoke English at home.

Model results: We present the results of the MMNL/EC model alongside the basic MNL for comparison in Table 3. Here, coefficients can only be interpreted in terms of their sign, significance and effect relative to other attributes, rather than their absolute magnitude (marginal effect) due to differences in scale[20]. In the discussion that follows, we focus on results from our main MMNL/EC model, hereafter referred to as the MMNL model.

Policy attributes: Appearance of the traffic light logo, interestingly, has opposite effects when included on the label of conventional medicine compared with CM. As seen in Table 3, when the traffic light was absent, utility for the conventional medicine was enhanced (compared with the base category of the logo being present), although there was heterogeneity in this result as shown by the significant standard deviations of both of the random parameters. In terms of the regulatory statements (where 'Untested' was the base category), the statement '*This product HAS been evaluated by Australian Health Authorities for efficacy*' was most utility-enhancing, followed by the status quo of '*No label*'. '*This product HAS NOT been evaluated by Australian Health Authorities for efficacy*' had an effect similar to '*Untested*'; the difference being insignificant. '*This product has been*

[20] As utility has no natural unit and only differences in utilities can be estimated, the scale of utility is defined as the variance, which is normalised to allow estimation. As normalisation of variance across different data sets or using different models can affect parameter interpretation, coefficients cannot be directly compared.

evaluated for efficacy….' was the only regulatory statement with an estimated standard deviation that reached statistical significance. By way of comparison, '*This product has been evaluated*' was the most utility enhancing of the proposed interventions, followed by the appearance of the traffic light on the CM.

Other attributes: For conventional medicine, a recommendation from a pharmacist was utility enhancing (compared with the base category of recommendation from a friend or family member) whereas a recommendation from a naturopath decreased utility. The source of recommendation had no significant impact on utility from CM. In general, the appearance of cautions, warnings and the provision of information on the label about possible side-effects show mixed results. Being told that mild side effects may arise was utility enhancing (although only significant for CM in the MMNL); whereas no caution or warning on the labels generally had a positive effect (with the exception of the warning on the conventional medicine in the MMNL which had the opposite sign). The availability of CM products from a naturopath or health food shop was associated with lower utility than from a pharmacy (base category); however, availability from a supermarket had no significant impact on CM utility. Price was negative and significant for both products as expected.

Socio-demographic variables and interaction effects: Older age and being female was associated with a lower probability of choosing either the conventional or CM product compared with doing 'something else', although this was only significant for being female in relation to conventional medicine use in the MMNL. The interaction term between having used a vitamin, mineral or herbal product in the previous 12 months (not prescribed by a medical doctor) and the effect of the traffic light was statistically significant, that is, for people who had previously used these products, the presence of the traffic light provided disutility. However, the interaction between other CM products (described in Table 2) showed no effect in the MMNL.

Model fit: Results of the MMNL/EC model compared with the basic MNL show that model fit is greatly improved using the more flexible specification. Four of the five estimated standard deviations of the error-components n were statistically significant. Other more parsimonius nesting structures were trialled, however, results were substantially unchanged and the model presented showed the better fit.

Predictions of market share if the policy attributes were implemented: Using the simulation feature in Nlogit 5.0 and following the method by Train (2009), pg. 29, we simulated the likely effect of policy changes on respondents' choice of CM, conventional or something else (all else being equal).

Four separate policy scenarios were run whereby the traffic light and each proposed regulatory statement appear in turn on the label of the CM, but not on the conventional medicine. Results evaluated against a 'no label' option and are reported in Table 4.

The magnitude of these changes do not appear large; the largest predicted change being a 3.64% gain in market share for CM joint pain products with implementation of the traffic light. However, it is interesting to note the expected relative substitution patterns if each of the interventions were implemented. Such information will be pivotal in the refinement of policy proposals and will assist CM manufacturers to prepare for policy implementation.

Discussion

This paper uses the flexibility provided by DCE design and analysis to provide policy relevant information on the likely effect of adding traffic light logos or regulatory statements to the labels of CMs. Our results suggest that, depending upon the form and wording of regulatory statements and decision aids, policy intervention may produce either an increase or a decrease in CM utilisation.

As mentioned previously, the regulatory agency in Australia (the TGA) currently takes a risk-based approach to the regulation of CMs. Even if clinical trials of sufficient quality were to become available in the future, rigorous assessment of the type required for conventional (pharmaceutical) medicines would require a substantial increase in the resources required by this agency. Simply requiring manufacturers to include a negatively-worded statement about the regulatory status of the product could be a low-cost exercise from the perspective of the regulator. However, it is clear from our results that consumers prefer positively worded-statements to negative ones and that inclusion of negative statements can be expected to decrease CM market share.). Thus, if the intention of including negatively-worded statements is to decrease the likelihood of making poor quality decisions (as opposed to simply decreasing utilisation), it is not clear how such an effect would act in isolation and not 'spill-over' to decrease potentially good consumer choices. Such a strategy is unlikely to be popular with manufacturers and most consumers.

Conversely, one can envisage a situation where positively-worded statements might act as a 'carrot rather than a stick', where the potential for increased market share may encourage manufacturers to voluntarily enter an endorsement scheme charging a fee-for-assessment, perhaps from the current regulator or even a suitably qualified independent assessor. Here, poor consumer choices would be reduced in line with the height of the hurdle that must be cleared in

order to receive the assessor's 'tick' or endorsement. The success of such a strategy would be greatly influenced by consumer recognition of the 'tick' or 'endorsement' and would likely require a supporting consumer education campaign to be successful, especially in the short-run.

We included the traffic light option here as a potential alternative to the regulatory statements. This is already being used to provide nutritional advice on foods (Balcombe et al., 2010; Sacks et al., 2009) and it provides additional information to consumers at the point of purchase compared with the regulatory statements. The results from this attribute were interesting, inducing positive utility responses when appearing on CMs and negative effects for conventional medicines (albeit with a great deal of heterogeneity around both results). It is difficult to interpret the likely causes(s) of this result. It may be that consumers have strongly-formed prior expectations of the relative risk and effectiveness of both modalities, which may have been re-iterated or even contradicted by the information provided on these logos. The logos themselves, as presented here, are already very complex and convey a number of messages. It must be remembered that this population all have a chronic illness and are more likely than the general population to be taking one or more prescription medications which have the potential to interact with CMs or over-the counter conventional medicines. Thus, the appearance on the traffic light of, for example, the statement '*May interact with other medicines*' could be interpreted very differently by different consumers, perhaps leading to some of the reported heterogeneity. We are not suggesting that the stylised logos we presented here are suitable for implementation in their current form – this intervention would require further refinement and stakeholder input for development. Repeating a DCE similar to the one presented here, testing different interventions in different populations, would then provide additional information to policy makers.

In terms of the effect of other attributes presented here, perhaps the most interesting and relevant to this discussion is mixed effect of the appearance of information about side-effects, cautions and warnings. On average, consumers found being told there was a 'chance of mild side-effects' utility enhancing compared with 'the person who recommended it….not mentioning or knowing anything about side effects'. Indeed, it can be envisioned that some consumers value additional information about risk, even if the message is negative, as it may suggest that the product has been well evaluated and that the potential treatment benefits outweigh the risk of mild side-effects. Again, this population is likely to be using prescription medication for their chronic illness and as such, may be well-practised in making this type of trade-off. Similar conclusions may be reached for the coefficients on the appearance of cautions and warnings on the labels.

There are a number of limitations to this analysis. Whilst we were most interested on the effect these policy interventions may have on a population with chronic illness, further research would be required to model the effect of the proposed policy changes on ostensibly healthy populations. Further, only two health scenarios were used here to frame choice sets and we cannot assume that the types of products used to treat these conditions are representative of the market as a whole. In particular, the information communicated via the traffic light logos was condition-specific such that results may not be generalizable to conditions and products characterised by different risk/benefit trade-offs. Lastly, it is unclear if the exclusion of the brand of CM as an attribute (which may convey manufactured quality) and the level of difficulty to access the product may have influence results and if so, in which direction. Where the excluded attributes are correlated with included attributes (such as cardiovascular risk), parameter estimates are likely to be biased (Witt et al., 2009).

Conclusions

It does appear from the results presented here that mandatory labelling of CMs may provide policy makers with the opportunity to affect consumer purchasing decisions, conditional on other factors known to be related to this decision. A number of key messages can be drawn from this discussion. Firstly, the consumers included in this analysis preferred positively-worded statements to negative ones when communicating the regulatory status of CMs. Depending on the intended effect of such a policy, an opt-in assessment scheme which provides a positive endorsement may well be preferred to the 'deterrent' effect of negatively worded statements by manufacturers and consumers. Secondly, alternative labelling options that have previously been trialled in packaged foods may also be effective. Here, the appearance of the traffic light logo, whilst arguably providing some 'negative' information to consumers, was on average utility enhancing. This finding, combined with mixed results for the appearance of information on side-effects, cautions and warnings may suggest that consumers value additional information provided on labels.

As more work on the development of different labelling strategies for CMs occurs, we suggest it would be prudent to use the framework adopted here, evaluating the impact of different interventions in different populations, to assess the likely effects on consumer behaviour before roll-out.

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Table 1: Attributes and levels used in the DCE

Attribute (abbreviation)	Level	Conventional medicine (CONV)	Complementary medicine (CM)
Information tabulated above the label			
This product was recommended by:	0	A pharmacist	A pharmacist
(rec)	1	A Naturopath	A Naturopath
	2	Staff from the local pharmacy	Staff from the local pharmacy
Base	3	A friend or relative or someone I know who has [Scen 1] trouble sleeping OR [Scen 2] with joint pain	A friend or relative or someone I know who has [Scen 1] trouble sleeping OR [Scen 2] with joint pain
The person who recommended it:	0	Said there was a chance of mild side-effects, like a [Scen 1] headache OR [Scen 2] constipation	Said there was a chance of mild side-effects, like a [Scen 1] headache OR [Scen 2] constipation
(se)			
Base	1	Didn't mention or know anything about side-effects	Didn't mention or know anything about side-effects
I know I can buy this product:	0		From a naturopath
(avail)	1		At a health food shop
	2		At the supermarket
Base	3	At a pharmacy	At a pharmacy
Information included on the product label			
Treatment claim (held constant)	0	Temporary effective relief of [Scen 1] insomnia or [Scen 2] joint pain.	Drug free relief of [Scen 1] insomnia or [Scen 2] joint pain.
Dosage (held constant)	0	[Scen 1]"1 tablet one hour before bedtime" or [Scen 2] "2 tablets in the morning with food"	[Scen 1]"1 tablet one hour before bedtime" or [Scen 2] "2 tablets in the morning with food"
Caution(caut)	0	No caution on label	No caution on label
Base	1	May interact with certain medicines, such as medicines for [Scen 1] high blood pressure, heart disease or depression OR [Scen 2] pain, anxiety or depression.	May interact with certain medicines, such as medicines for [Scen 1] high blood pressure, heart disease or depression OR [Scen 2] pain, anxiety or depression.
Warning (warn)	0	No warning on label	No warning on label
Base	1	[Scen 1] "Do not use if pregnant or breastfeeding. If pain persists, see you doctor" [Scen 2] "May cause drowsiness. Do not drive or operate heavy machinery if affected".	[Scen 1] "Do not use if pregnant or breastfeeding. If pain persists, see you doctor" [Scen 2] "May cause drowsiness. Do not drive or operate heavy machinery if affected".
Traffic light (traf)	0	No traffic light on label	No traffic light on label
Base	1	Traffic light on label (compatible with label information)	Traffic light on label (compatible with label information)
Regulation (regu)	0	No label (held constant)	No label
	1		"This product has NOT been evaluated by Australian Health Authorities for efficacy"
	2		"This product HAS been evaluated by Australian Health Authorities for efficacy"
Base	3		"Untested by Australian health authorities"
Price (price)	1	Between $8.95 & $35.50	Between $8.95 & $35.50

Abbreviations: scen scenario;

Constraints: If CM_traffic=1, CM_reg = 0,2; If CM_traffic=1, CM_caution=1

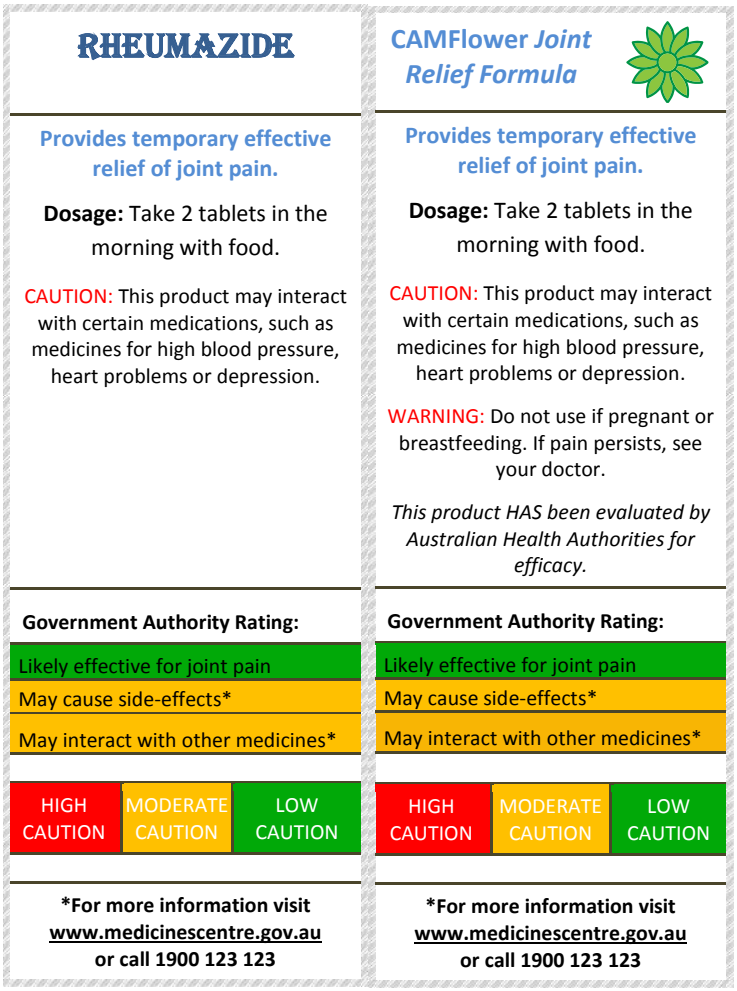
Figure 1: An example choice set from the DCE

Q2. Imagine this scenario: You have been having **joint pain** for the **last three weeks**. You decide it is not serious enough to go to the doctor as yet, but it does not seem to be going away by itself.

What would you choose from the following options?

Information	An oral **conventional** medicine available without prescription	An oral **complementary** medicine available without prescription
This product was recommended by:	**A pharmacist**	**Staff from the local pharmacy**
The person who recommended it:	**Didn't mention or know anything about side-effects**	**Didn't mention or know anything about side-effects**
I know I can buy this product:	**At a pharmacy**	**At a pharmacy**

Product labels:



I would choose:

(please tick)

☐ **the conventional medicine**

☐ **the complementary medicine**

☐ **something else**

Table 2: Summary of participant characteristics

	Observations	mean	s.d.
Age (range 27-90 years)	511	66.03	9.72
Female	516	0.48	0.50
Used CM product type 1 in previous 12 months [a]	509	0.53	0.50
Used CM product type 2 in previous 12 months [b]	514	0.33	0.47
Used CAM practitioner in previous 12 months [c]	494	0.14	0.34
Education above high school	511	0.57	0.50
Household income (gross) >= $AUD100,000 p.a.	468	0.07	0.26
Currently employed	512	0.29	0.45
Born in Australia	521	0.73	0.44
Speaks English as the main language at home	521	0.95	0.22
Total	**521**		

Abbreviations: s.d. standard deviation; $AUD Australian dollars (2012 prices); p.a. per annum; CAM complementary and alternative medicine

[a] A vitamin, mineral or herbal product not prescribed by a medical doctor

[b] Includes: Western herbal medicine (herbal teas, tinctures, etc.); Chinese or Oriental medicine; homeopathy; indigenous, traditional or folk therapies; aromatherapy

[c] Includes: acupuncturist; Chinese or Oriental medicine practitioner; naturopath; Western herbalist; homeopath; chiropractor; osteopath; massage therapist or similar; myotherapist; hypnotherapist; spiritual healer; music, art or colour therapist; energy healer

Table 3: Results from the MNL and MMNL with EC models

	MNL Coefficient	S.E.	MMNL Coefficient	S.E.
Specified as random parameters in MMNL				
no traffic light - conventional	0.073**	0.034	0.121*	0.066
no traffic light - CM	-0.550***	0.105	-0.423**	0.174
regulation statement - none	0.203***	0.069	0.213*	0.110
regulation statement - 'This product has not been evaluated…'	-0.138	0.104	-0.250*	0.151
regulation statement - 'This product has been evaluated…for efficacy' (base - 'Untested')	0.296***	0.080	0.535***	0.130
Non-random parameters				
conventional				
ASC conventional	1.253***	0.267	1.770	1.142
recommended - by a pharmacist	0.397***	0.059	0.856***	0.101
recommended - by a naturopath	-0.186***	0.057	-0.384***	0.101
recommended - by staff from a pharmacy (base - a friend/relative….with similar health condition'	0.051	0.054	0.072	0.099
side effects - chance of mild side effects (base - didn't mention or know anything about side-effects)	0.097***	0.034	0.087	0.054
caution - no caution on label	0.186***	0.037	0.359***	0.058
warning - no warning on label	-0.132***	0.038	-0.169**	0.067
price	-0.030***	0.004	-0.060***	0.008
female	-0.474***	0.062	-0.676**	0.316
age	-0.011***	0.003	-0.010	0.017
CM				
ASC CM	1.015***	0.325	1.061	1.278
recommended - by a pharmacist	0.064	0.076	0.141	0.107
recommended - by a naturopath	0.029	0.123	-0.071	0.192
recommended - by staff from a pharmacy (base - a friend/relative….with similar health condition'	-0.014	0.090	-0.158	0.157
side effects - chance of mild side effects (base - didn't mention or know anything about side-effects)	0.107**	0.051	0.211**	0.085
available - from a naturopath	-0.186	0.118	-0.466***	0.172
available - at a health food shop	-0.218**	0.099	-0.288**	0.139
available - at the supermarket (base - available at pharmacy)	-0.048	0.093	0.091	0.142

Table 3: continued

caution - no caution on label	0.300***	0.076	0.346***	0.105
warning - no warning on label	0.213***	0.081	0.231*	0.138
price	-0.055***	0.007	-0.082***	0.011
female	-0.181**	0.074	-0.163	0.339
age	-0.010**	0.004	-0.016	0.019
interaction: use of vitamin*no traffic light	0.334***	0.073	0.219*	0.118
interaction: use of other CM product*no traffic light	0.232***	0.076	-0.023	0.117
Something else				
ASC Something else	-0.036	0.060	-0.149	0.169
Standard deviations of random parameters				
SD no traffic light - conventional			1.229***	0.151
SD no traffic light - CM			0.618**	0.308
SD regulation statement - none			0.782	0.482
SD regulation statement - 'This product has not been evaluated…'			0.115	0.932
SD regulation statement - 'This product has been evaluated…'			1.033***	0.355
Standard deviations of error components				
joint pain' scenario			1.225***	0.257
insomnia' scenario			1.439***	0.227
conventional (joint + insomnia)			0.398	0.247
CM (joint + insomnia)			1.561***	0.109
something else			4.128***	0.219
Model fit				
Respondents	521		521	
Log likelihood	-5716.540		-3846.986	
AIC	1.950		1.319	
McFadden Pseudo R-squared[a]	0.459		0.636	

Abbreviations: MNL multinomial logit; MMNL mixed multinomial logit; S.E. standard error; CM complementary medicine

[a] McFadden Pseudo R-squared using a zero-parameters base model

Table 4: Predicted changes to market share across the alternatives if each policy intervention was implemented (all else being equal)

	Traffic light	This product has not been evaluated	This product has been evaluated	Untested
Joint pain scenario				
Conventional	-2.43%	1.33%	-0.99%	1.88%
CM	3.64%	-2.02%	1.55%	-2.80%
something else	-1.21%	0.69%	-0.56%	0.92%
Insomnia scenario				
Conventional	-2.20%	1.13%	-0.84%	1.59%
CM	3.55%	-1.81%	1.39%	-2.51%
something else	-1.35%	0.68%	-0.55%	0.91%

Abbreviations: CM complementary medicine

NOTE: Each policy intervention only appears on the complementary medicine product and is evaluated against the status quo of 'no label

Technical Appendix: Definition of variable labels used in the utility functions

	Variable labels
Specified as random parameters in MMNL	
no traffic light - conventional	CONV_traf
no traffic light - CM	CM_traf
regulation statement - none	regu1
regulation statement – 'This product has not been evaluated…'	regu2
regulation statement – 'This product has been evaluated…for efficacy'	regu3
(base - 'Untested')	
Non-random parameters	
conventional	
ASC conventional	ASC_{CONV}
recommended - by a pharmacist	CONV_rec1
recommended - by a naturopath	CONV_rec2
recommended - by staff from a pharmacy	CONV_rec3
(base - a friend/relative….with similar health condition)	
side effects - chance of mild side effects	CONV_se
(base - didn't mention or know anything about side-effects)	
caution - no caution on label	CONV_caut
warning - no warning on label	CONV_warn
price	CONV_price
female	CONV_fem
age	CONV_age
CM	
ASC CM	ASC_{CM}
recommended - by a pharmacist	CM_rec1
recommended - by a naturopath	CM_rec2
recommended - by staff from a pharmacy	CM_rec3
(base - a friend/relative….with similar health condition'	
side effects - chance of mild side effects	CM_se
(base - didn't mention or know anything about side-effects)	
available - from a naturopath	CM_avail1
available - at a health food shop	CM_avail2
available - at the supermarket	CM_avail3
(base - available at pharmacy)	
caution - no caution on label	CM_caut
warning - no warning on label	CM_warn
price	CM_price
female	CM_fem
age	CM_age
interaction: use of vitamin*no traffic light	VIT*TRAF
interaction: use of other CM product*no traffic light	OTHERCM*TRAF
Something else	
ASC Something else	$ASC_{SOMETHING\_ELSE}$
Standard deviations of error components	
joint pain scenario	ω_{JOINT}
insomnia scenario	$\omega_{INSOMNIA}$
conventional (joint + insomnia)	ω_{CONV}
CM (joint + insomnia)	ω_{CM}
something else	$\omega_{SOMETHING\_ELSE}$

Conclusions

This thesis forms the health economics component of a large, inter-disciplinary project which focuses on complementary and alternative medicine (CAM) use in people with type 2 diabetes and cardiovascular disease in Australia. The health economics component recognises that there are important issues still to be addressed by policy makers with regard to the regulation, financing, and inclusion in primary care of CAM. To conclude this thesis, a summary of the key findings is presented. A discussion on the policy implications, limitations and directions for further research follows before the concluding remarks.

i. Summary of findings

An initial, and important, contribution of this thesis is to characterise the prevalence and utilisation of CAM use in the general population and relate this to prevalence in the sub-group of people living with chronic illness. It was found that the prevalence of any CAM use in the previous 12 months in the general population was around 40%, which is considered to be an underestimate. Whilst a proportion of the general population use CAM (either products or practitioners) as their only form of health care (an alternative rather than complement), this percentage was relatively low - around 12%. A larger percentage (about 26%) used CAM as a complement to some type of conventional care. Differences emerged between different types of CAM use. For example, different explanatory factors were associated with CAM practitioner use compared with product use, suggesting heterogeneity in consumer preferences. For this reason, CAM use is disaggregated in subsequent chapters. Chronic illness, particularly mental health conditions, were found to be predictive of both CAM practitioner and product use. In contrast, healthy behaviours such as being a healthy weight, exercising and not smoking were more likely to be associated with CAM users compared with non-users, perhaps suggesting two different 'types' of CAM user – a more healthy, motivated CAM user and one who is likely to have one or more chronic illnesses.

Use in the general population can then be contrasted with use by people with chronic illness. Using purposefully collected data it was identified that the prevalence of CAM use, both practitioner and product, was higher in people with type 2 diabetes and cardiovascular disease.

Whereas 11% of the general population reported CAM practitioner use in the previous 12 months, the corresponding figure was 23% in the chronic illness population; and whereas around 23% of the general population had used a CAM product, around 40% of the chronic disease group reported use. Despite these differences, key drivers of use (such as being female, more educated and having private health insurance) are common to both populations. Other key findings include that CAM utilisation is almost predominately complementary in the chronic disease population studied; that there is a significant and persistent association between lower quality of life (QoL) and CAM use; and there is a positive and significant relationship between CAM use and previous attendance at self-management courses. Both of these findings are limited as they are based on cross-sectional analysis and the use of longitudinal data would be more meaningful to examine causal pathways and whether associations between CAM and QoL persist over time.

Whilst the key focus of this thesis was on type 2 diabetes and cardiovascular disease, there have been a number of previous reports of associations between a higher likelihood of CAM use and mental health conditions in large samples. The hypothesis that CAM practitioners may provide a hypothetical pathway to engage some of those requiring treatment into appropriate care is then tested in Chapter Three. This is an area of significant policy relevance given the underlying morbidity and mortality associated with undiagnosed and untreated mental health conditions in the community.

Similar to previous findings, the effect of having a mental health condition is found to be positive and significant for CAM use. The main strength of this analysis, however, is that this effect can be directly compared with that of other primary care providers. Here, it is found that those with mental health conditions are most likely to see a GP, followed by a CAM practitioner or physiotherapist and then a pharmacist (for advice) or a counsellor. The effect of mental health in this case appears to differ from the effect of other chronic illness; the latter exhibiting more selective positive associations with certain health care practitioners but not others. This may suggest that people target care for other chronic illness in a different way to mental health conditions. Whilst in theory CAM practitioners may provide a possible first contact point with the primary health care system for those with a mental health condition, as it stands, this is unlikely to be a particularly successful strategy from a population perspective given the low rates of substitution. Further, there remains a comparatively larger proportion of the population who are not likely to access any type of primary health care provider and it is this latter group that provides the biggest challenge to policy makers and practitioners.

Turning to the consequences of CAM use by people with chronic illness, the small but consistent negative correlation found in Chapter Five between CAM use and QoL is of great interest. This relationship is even stronger when greater CAM use intensity is compared with lower intensity. These results are surprising given the potential for survey responder bias. It was hypothesised that CAM use would have a positive association with QoL similar to other lifestyle factors, such as not smoking, exercising, or attending a group exercise programme. It is plausible that the negative association between CAM and QoL may work in either direction. Low QoL may be seen as a driver of CAM use, perhaps suggesting that CAM is utilised to mitigate against side effects of conventional treatment or as a 'last resort'. Alternatively, inappropriate or ineffective CAM use may lead to a decrease in QoL. If the latter is true, it supports the notion of additional consumer support by way of regulation or the provision of (trustworthy) information upon which to base an informed decision.

The final two chapters of the thesis explore the potential effect of proposed changes to the labelling of CMs in Australia. Using a combination of qualitative methods, eye-tracking and DCE survey design it was found that although the additional labelling information was intended to make evidence-based decision-making easier for consumers, it may have the perverse effect of triggering simplifying heuristics. Evidence was also found, consistent with previous studies, that consumers have strong *a priori* views that may dominate decision-making and mean they are less influenced by the presentation of new information such as traffic lights and regulatory statements. Thus, the provision of additional information in the form that it is currently suggested may not have the desired influence on decision-making for an important subgroup of consumers.

The average effect of these proposed changes were then tested in a population with type 2 diabetes and cardiovascular disease. Results were interesting - the appearance of the traffic light logo had opposite effects when placed on the labels of CMs or conventional medicines (a positive effect for CMs; negative effect for conventional medicines). This may suggest that prior expectations of risk or the relative efficacy of the products have a strong effect on the interpretation of this logo. In terms of the regulation statements, consumers were more likely to be positively influenced by statements couched in positive terms. Depending on the policy aim of the labelling approach, such effects may or may not be desirable.

ii. Policy implications

There are perhaps three main policy 'levers' available to government in terms of potential interventions in the CAM 'market' – regulation, clinical governance and control of subsidies. A discussion focused on the first is perhaps the most relevant in terms of the findings of this thesis, however a number of policy suggestions fall under the headings of the latter two. One possible interpretation of the high prevalence of CAM use by people with chronic illness and the negative correlation with QoL suggest that this group may be most at risk of using ineffective or inappropriate treatments. Here, a distinction needs to be made between product (CM) and practitioner issues. Potential policy options warranting further investigation include:

For complementary medicines

- Supporting the provision of additional information about the effectiveness, potential side effects and interactions of CMs. The potential effect of additional labelling was explored in detail in Chapters Six and Seven. From this, it may be concluded that this strategy may have the potential to change consumer behaviour, although not necessarily in the expected direction. Thus, although this does seem like a worthwhile avenue to pursue, further research is required to confirm the generalisability of results and to test further refinements of regulatory statements and decision aids;
- Changes in labelling could also be linked to the establishment of a new 'endorsement' scheme for CMs. This could potentially operate on a fee-for-assessment service by either the government regulator or deputised agency and lead to the development of a recognisable 'tick of approval' (or similar) for consumers;
- Provision of information may be encouraged in other ways. For example, people with chronic conditions who use CAM are more likely to attend a self-management course than those who do not use CAM. Given that these courses are usually conducted by health care professionals, the opportunity to educate about safe CAM use using this avenue is worthy of further consideration;
- Other policy options are available, but not dealt with in any detail in this thesis. These include tightening the restrictions on advertising claims made by manufacturers as well as improving the process by which CMs are listed by the government regulator, the Therapeutic Goods Administration (TGA).

For CAM practitioners:

- As shown in Chapter Three, a policy of supporting CAM practitioners to act as an additional, formally recognised, referral pathway for people at risk of mental health illness and who are not seeking conventional care is unlikely to be successful on a population level. A relatively small number of people were found to be using CAM as a substitute – complementary use was more evident. It is hoped that such a referral system is already occurring. However, in terms of clinical governance, it may be prudent for the government to support dialogue about what type of CAM practitioners may be treating what type of mental health conditions; the appropriateness of this from a practitioner competency point of view; and whether a revised definition of 'primary care' may be more reflective of consumer preferences and behaviour.
- Private health insurance (PHI) in Australia is associated with increased CAM use as found in Chapters Two, Three and Four in both the general population and chronic illness group. As the government subsidises PHI, they also indirectly subsidise some types of CAM for some people. This arrangement is currently the subject of government scrutiny. A number of issues here are important. Given that poor health is more common in lower socio-economic groups, the selective subsidy of CAM may induce further health inequalities (if treatments are effective). If treatments are ineffective, it is hard to explain why tax revenue is being spent in this way. Further, given that the premise of insurance is to cover people for unexpected, catastrophic occurrences, it may be argued that CAM practitioners (as well as other health practitioners covered by the ancillary insurance arrangements) should not be included at all. Removal of this subsidy is unlikely to be popular with CAM practitioners.

iii. Limitations and potential for further research

The focus on chronic illness is both a strength and limitation of this thesis. The main reasons for focussing on chronic illness, particularly type 2 diabetes and cardiovascular disease, were because of the importance if these conditions in terms of morbidity and mortality in the population; the opportunity for CAM to be considered as an additional treatment option which may provide to be cost-effective in some instances compared with conventional options; the greater risk of harm from use of ineffective or inappropriate CAM treatments by this group; and the implications of these three factors in the organisation and delivery of health care services. However, the focus

on this group has entailed a loss of generalisibility for some of the findings, particularly in relation to the policy option of additional labelling on CMs. Of course, this presents a further research opportunity as the DCE methods and framework here could be adapted to test the potential effect of the same or alternative labelling options in the general population.

Data limitations are also evident in this thesis. Most notably, no longitudinal data containing information on CAM use over time in the general population was found. The use of longitudinal data alongside panel data methods may allow the direction of effect between CAM use and health outcomes (causation) to be determined. Further, inconsistencies and omissions of key variables describing CAM use in the National Health Survey meant that data could not be pooled to form a time-series. It is hoped this is changed in future iterations of this survey.

iv. Concluding remarks

The publications arsing form this thesis will be useful to researchers from a variety of disciplinary backgrounds, to policy makers and to health practitioners from a CAM and non-CAM background. Through these avenues, CAM use may be optimised for consumers. Whilst there has been a great deal of literature detailing CAM use from other perspectives, there is very little to date from a health economics point of view. CAM is a somewhat unique area of health policy, exhibiting attributes which have both parallels and deviations from mainstream health services. Given the prevalence of use and increasing expenditure in populations, this is an exciting and important area for further work in health economics.

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