BMJ Open

A six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM GPs

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2014-005332
Article Type:	Research
Date Submitted by the Author:	24-Mar-2014
Complete List of Authors:	Baars, Erik; University of Applied Sciences, Care Kooreman, Peter; Tilburg University, Economics
Primary Subject Heading:	Complementary medicine
Secondary Subject Heading:	Health economics
Keywords:	COMPLEMENTARY MEDICINE, PRIMARY CARE, HEALTH ECONOMICS

GEZONDHEIDSZORG

Complementair werkende huisartsen en de kosten van zorg

Een klein aantal Nederlandse huisartsen heeft zich, naast het voltooien van de reguliere huisartsenopleiding, aanvullend geschoold in complementaire behandelwijzen. De zorgkosten van de patiënten van deze complementaire huisartsen die gedekt worden door de basisverzekering zijn substantieel lager dan die van sociaal-economisch vergelijkbare patiënten met een reguliere huisarts, met name in het laatste levensjaar. Voor een goede sturing op kosteneffectiviteit in de zorg is verder onderzoek naar financiële en gezondheidseffecten van complementaire behandelwijzen gewenst.

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Een paar procent van de Nederlandse huisartsen heeft zich, naast het voltooien van de reguliere huisartsenartsenopleiding, aanvullend geschoold in complementaire geneeswijzen. De meest voorkomende aanvullende opleidingen zijn acupunctuur, antroposofische geneeskunde en homeopathie. Kenmerkend voor deze geneeswijzen is de holistische benadering van de mens (in tegenstelling tot een partiële of orgaan-specifieke benadering), terughoudendheid met betrekking tot de inzet van allopathische geneesmiddelen en het gebruik van *health promotion*-therapieën (zoals kunstzinnige therapie) die veelal niet door de basisverzekering gedekt worden. Gezien de toenemende noodzaak om zorguitgaven te verminderen en gezien de resultaten van een recente review over kosteneffecten van complementaire behandelwijzen (Herman *et al*., 2012) en onze eigen studie naar kostenverschillen tussen patiënten van reguliere en van complementaire huisartsen (Kooreman en Baars, 2012), worden in dit artikel opnieuw de zorgkosten van de patiënten van deze twee typen huisartsen vergeleken, maar nu bij een veel grotere groep. Daarbij wordt alleen gekeken naar kosten die door de zorgverzekeraar worden vergoed, met een onderscheid tussen de verplichte basisverzekering en de vrijwillige aanvullende verzekering.

DE AGIS HEALTH DATABASE

Het onderzoek maakt gebruik van geanonimiseerde gegevens uit de Agis Health Database (Smeets *et al.*, 2010), waarin gegevens voor alle verzekerden van Agis zijn vastgelegd. Van elke verzekerde in dit databestand is bekend bij welke huisarts of huisartsenpraktijk hij of zij staat ingeschreven. Door deze informatie te vergelijken met die op de websites van de beroepsverenigingen van antroposofische artsen (www.nvaa.nl), arts-acupuncturisten (www.acupunctuur.com) en arts-homeopaten (www.vhan.nl) kan worden vastgesteld of een verzekerde een complementair werkende huisarts heeft. In het databestand komen 9.323 huisartsen en huisartsenpraktijken voor, waarvan 109 als complementair werkend konden worden geïdentificeerd. Het merendeel van de complementair werkende huisartsen in dit databestand zijn antroposofische huisartsen. Het bestand bevat zorgverzekeringsgegevens van ruim 1,5 miljoen verzekerden gedurende de jaren 2006–2011. Bijna 19.000 verzekerden daarvan, ofwel 1,2 procent, hadden gedurende de hele periode een complementair werkende huisarts. Ruim 10.000 andere verzekerden hadden in sommige jaren een reguliere en in andere jaren een complementair werkende huisarts. Zij zijn geïdentificeerd als overstappers. Gemiddeld was deze laatste groep verzekerden drie jaar bij een reguliere en drie jaar bij een complementair werkende huisarts ingeschreven. Kader 1 laat zien in welk opzicht de analyse verschilt van eerder kostenonderzoek naar complementair werkende huisartsen.

Tabel 1 vermeldt voor drie groepen patiënten in het Agis-bestand achtergrondkarakteristieken en de gemiddelde jaarlijkse zorgkosten: patiënten die uitsluitend bij een reguliere huisarts ingeschreven waren, patiënten die uitsluitend bij een complementair werkende arts ingeschreven waren, en patiënten die een of meer keren zijn overgestapt van het ene naar het andere type huisarts.

Tabel 1 laat allereerst zien dat verzekerden die uitsluitend bij een complementair werkende huisarts waren ingeschreven iets ouder en vaker vrouw zijn, en minder vaak afkomstig uit achterstandswijken. De verzekerden die uitsluitend bij een regulier werkende huisarts waren ingeschreven en de groep overstappers komen grotendeels overeen qua sociaal-economische karakteristieken.

De kosten gedekt door de basisverzekering van patiënten met uitsluitend een complementair werkende huisarts zijn gemiddeld 183 euro per jaar (10,1 procent) lager dan die van patiënten met uitsluitend een reguliere huisarts. Dat komt vooral door lagere kosten voor farmaceutische zorg en ziekenhuiszorg, zoals de uitsplitsing in tabel 1 laat zien. De kosten van overstappers zijn hoger. Dat suggereert dat overstappers meer met (chronische) ziektes te maken hebben; mogelijk is dat een aanleiding voor het maken van de overstap.

In het algemeen worden de meeste kosten gemaakt in het laatste levensjaar. Voor verzekerden die tussen 2007 en 2011 zijn overleden kunnen die kosten worden vastgesteld door te kijken naar het kwartaal van overlijden plus de drie voorgaande kwartalen. Deze zijn 1.451 euro (9,9 procent) lager wanneer de verzekerde een complementair werkende huisarts heeft.

ACHTERGRONDKENMERKEN

De betekenis van de gevonden verschillen is beperkt vanwege de verschillende achtergrondkarakteristieken van de twee groepen verzekerden. Daarom wordt gecorrigeerd voor geobserveerde kenmerken door middel van een regressieanalyse met diverse verklarende variabelen: leeftijd, geslacht, jaardummy's, dummy's voor de viercijferige postcode van de patiënt en een dummyvariabele voor het hebben van een complementair werkende huisarts. De geschatte coëfficiënten voor de laatstgenoemde variabele staan vermeld in tabel 2. De groep overstappers blijft in eerste instantie buiten beschouwing.

De kostenverschillen zijn nu fors groter dan in tabel 1. De kosten gedekt door de basisverzekering zijn gemiddeld 225 euro per jaar (12,4 procent) lager voor patiënten met een complementair werkende huisarts (significant op eenprocentsniveau). Dat komt vooral door lagere kosten voor ziekenhuis- en farmaceutische zorg. Voor verzekerden in de leeftijdscategorie 50–75 jaar bedraagt het verschil eveneens ruim twaalf procent, maar gaat het om hogere absolute bedragen: 356 euro per jaar (significant op eenprocentsniveau).

Tegenover lagere kosten gedekt door de basisverzekering staan hogere kosten gedekt door aanvullende verzekeringen, gemiddeld 33 euro per jaar. Per saldo zijn de door de verzekeraars vergoede kosten ruim lager (−225 + 33 = −192 euro) voor verzekerden met een complementair werkende huisarts.

De kosten gedekt door de basisverzekering in het laatste levensjaar bij patiënten met een complementair werkende huisarts liggen, na correctie voor geobserveerde achtergrondkenmerken, 1.161 euro lager (significant op tienprocentsniveau). Dat verschil wordt volledig veroorzaakt door lagere ziekenhuiskosten (1.250 euro, significant op eenprocentsniveau). Dat gaat niet gepaard met hogere kosten gedekt door aanvullende verzekeringen.

In een regressie waarin de drie groepen verzekerden zijn samengevoegd, is de geschatte coëfficiënt voor het hebben van een complementair werkende arts −128 voor de kosten in de basisverzekering en 32 voor de aanvullende verzekering (beide significant op eenprocentsniveau).

Eerder kostenonderzoek

KADER 1

Eerder kostenonderzoek liet zien dat het verschil in kosten van een patiënt met een complementair werkende huisarts en een vergelijkbare patiënt met reguliere huisarts (zonder onderscheid tussen basis- en aanvullende verzekering) varieert tussen 0 en 30 procent, afhankelijk van het type complementaire huisarts en de leeftijdscategorie van de patiënt (Kooreman en Baars, 2012).

De belangrijkste verschillen tussen het Azivo-bestand en het nu gebruikte Agis-bestand zijn:

- Het Agis-bestand bevat gegevens van tienmaal zo veel verzekerden: ruim 1,5 miljoen versus ruim 150.000. Als gevolg daarvan worden de kostenverschillen in het nieuwe onderzoek geschat met een grotere statistische precisie.
- In tegenstelling tot in het Azivo-bestand wordt in het Agis-bestand onderscheid gemaakt tussen zorgkosten die door de basisverzekering van de Zorgverzekeringwet worden gedekt en kosten die worden gedekt vanuit een eventueel afgesloten vrijwillige aanvullende verzekering.
- Het Azivo-bestand had betrekking op de jaren 2006–2009; het Agis-bestand heeft betrekking op de jaren 2006–2011.
- In het werkgebied van Agis, voornamelijk Amsterdam en Midden-Nederland, bevinden zich verhoudingsgewijs minder complementair werkende huisartsen (ongeveer één procent) dan in het kleinere werkgebied van Azivo, dat bestaat uit Den Haag en omstreken (ongeveer vier procent).
- In het beschikbare Agis-bestand is de postcode-informatie minder gedetailleerd dan in het Azivo-bestand (vier in plaats van zes posities). Als gevolg daarvan kan minder goed worden gecorrigeerd voor de verschillen in achtergrondkarakteristieken van verzekerden.

Kenmerken en kosten in euro's per jaar van drie groepen verzekerden[1]

TABEL 1

	Alleen reguliere huisarts	Alleen complementair werkende huisarts	Overstappers
Leeftijd (jaar)	41,0	41,6	40,1
Vrouw	52,9%	55,2%	56,4%
'Vogelaarwijk'	15,7%	9,3%	17,1%
Aanvullend verzekerd	92,7%	93,4%	92,1%
Basisverzekering			
Totaal	1.821	1.638	1.989
Huisarts	133	128	140
Geneesmiddelen	402	357	474
Ziekenhuis	1.242	1.104	1.328
Paramedisch	44	48	47
Aanvullende verzekering	75	115	100
Aantal verzekerden	1.521.773	18.862	10.769

[1] *Alle verschillen tussen de eerste twee kolommen zijn statistisch significant op het eenprocentsniveau. De kosten van (ambulance)vervoer en verloskunde blijven buiten beschouwing.*

Geschatte kostenverschillen verzekerden bij complementair werkende versus reguliere huisarts, in euro's per jaar[1]

TABEL 2

	Basisverzekering					Aanvullende verzekering
	Totaal	Huisarts	Geneesmiddelen	Ziekenhuis	Paramedisch	
Alle leeftijden	−225***	−3***	−58***	−165***	1	33***
0–24	−80***	−3***	−2	−74***	−2	11***
25–49	−137***	−2**	−50***	−85**	1	32***
50–74	−356***	−1	−126***	−232***	3	52***
75+	−236*	11***	−38	−219**	10	24***
Laatste levensjaar	−1161*	−5	67	−1250**	27	3

[1] *Analyse exclusief overstappers. Standaardfouten geclusterd op het niveau van de verzekerde.*

*/**/*** *Significant op respectievelijk tien-, vijf- en eenprocentsniveau*

GEZONDHEIDSBATEN

De analyse tot nu toe beperkte zich tot kosten. In het databestand is slechts één – maar wel een belangrijke – uitkomstindicator beschikbaar, namelijk sterfte. In de data worden minimale verschillen gevonden tussen sterfte onder patiënten van de twee typen huisartsen. Na correctie voor patiëntkenmerken zijn er lichte aanwijzingen voor lagere sterfte onder patiënten met een complementair werkende huisarts op basis van een lineair kansmodel en een conditioneel logitmodel, maar geen aanwijzingen voor verschillen in sterfte op basis van een *proportional hazard*-model.

MOGELIJK OORZAKEN VAN DE KOSTENVERSCHILLEN

Substitutie van zorg gedekt uit de basisverzekering door aanvullend verzekerde zorg die niet uit collectieve middelen wordt gefinancierd is – zo laten de gepresenteerde resultaten zien – een partiële verklaring voor de lagere kosten gedekt door de basisverzekering bij verzekerden met een complementair werkende huisarts. Een andere mogelijke verklaring zijn niet-waargenomen verschillen tussen de patiënten van de twee typen huisartsen. Zo is het denkbaar dat mensen die zo weinig mogelijk medische ingrepen willen of bewust een gezonde leefstijl nastreven eerder voor een complementair werkende huisarts kiezen. Ander onderzoek laat echter zien dat bij complementair werkende artsen relatief veel patiënten met ernstige en chronische ziektes voorkomen (Melchart *et al.*, 2005). Daarom is het op voorhand onduidelijk wat het effect is van ongeobserveerde patiëntkenmerken op de kostenverschillen. Nog een mogelijke verklaring is dat patiënten met een complementair werkende huisarts onvoldoende zorg krijgen. De resultaten van de sterfteanalyse, evenals ander onderzoek naar klantervaringen met complementaire behandelwijzen, wijzen echter niet in die richting (Melchart *et al.*, 2005). Ten slotte zouden de resultaten het gevolg kunnen zijn van een kwalitatief betere praktijk van complementair werkende huisartsen, als gevolg van een sterkere focus op preventieve en curatieve gezondheidsbevordering, minder overbehandeling en betere communicatie en professionele relaties (Van Dulmen *et al.*, 2010).

CONCLUSIES

In tegenstelling tot landen als Duitsland, Zwitserland en de Verenigde Staten staat de overheid in Nederland overwegend afhoudend tegenover complementaire geneeswijzen. Dit komt onder meer tot uitdrukking in het ontbreken van een systematisch onderzoeksbeleid rond zulke behandelwijzen. De resultaten van dit kostenonderzoek bevatten aanwijzingen dat complementaire geneeswijzen, toegepast onder supervisie van artsen die eerst een reguliere opleiding hebben voltooid, mogelijk een substituut kunnen zijn voor zorg die wordt gedekt door de basisverzekering zonder dat dit de gezondheid schaadt. Meer onderzoek is nodig om duidelijkheid te verkrijgen over het kwantitatieve belang van de diverse mogelijke verklaringen van de kostenverschillen. Vervolgonderzoek vereist de opbouw van een data-infrastructuur waarbij longitudinale informatie over de gezondheidstoestand op het niveau van individuele verzekerden wordt gekoppeld aan zorgkosten. Dit moet duidelijk maken of het opwerpen van drempels tegen het gebruik van complementaire geneeswijzen verstandig beleid is.

De overheid dient dit onderzoeksproces te faciliteren in plaats van af te remmen. Naast de eventuele gezondheidswinst kan dit leiden tot een aanzienlijke besparing op de kosten van collectief gefinancierde zorg.

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Additional file 1

EVEREST Statement: Checklist for health economics paper

	Study section	Additional remarks
Study design		
(1) The research question is stated	Introduction	
(2) The economic importance of the research question is stated	Introduction	
(3) The viewpoint(s) of the analysis are clearly stated and justified	Methods; Discussion	
(4) The rationale for choosing the alternative programmes or interventions compared is stated	Methods	
(5) The alternatives being compared are clearly described	Introduction; Methods	
(6) The form of economic evaluation used is stated	Introduction; Methods	
(7) The choice of form of economic evaluation is justified in relation to the questions addressed	Introduction; Methods; Discussion	
Data collection		
(8) The source(s) of effectiveness estimates used are stated	Methods	
(9) Details of the design and results of effectiveness study are given (if based on single study)	N/A	
(10) Details of the method of synthesis or meta-analysis of estimates are given (if based on an overview of a number of effectiveness studies)	N/A	
(11) The primary outcome measure(s) for the economic evaluation are clearly stated	Methods	
(12) Methods to value health states and other benefits are stated	Introduction; Methods	
(13) Details of the subjects from whom valuations were obtained are given	Methods	
(14) Productivity changes (if included) are reported separately	N/A	
(15) The relevance of productivity changes to the study question is discussed	N/A	
(16) Quantities of resources are reported separately from their unit costs	Methods; Tables 2-4	
(17) Methods for the estimation of quantities and unit costs are described	Methods; Tables 2-4	
(18) Currency and price data are recorded	Methods; Tables 2-4	
(19) Details of currency of price adjustments for	NA	

inflation or currency conversion are given		
(20) Details of any model used are given	Methods-Model overview	
(21) The choice of model used and the key parameters on which it is based are justified	Methods	
Analysis and interpretation of results		
(22) Time horizon of costs and benefits is stated	Methods; Discussion	
(23) The discount rate(s) is stated	N/A	
(24) The choice of rate(s) is justified	N/A	
(25) An explanation is given if costs or benefits are not discounted	N/A	
(26) Details of statistical tests and confidence intervals are given for stochastic data	N/A	
(27) The approach to sensitivity analysis is given	N/A	
(28) The choice of variables for sensitivity analysis is justified	Methods; Tables 2-4	Confidence intervals are given
(29) The ranges over which the variables are varied are stated	Tables 2-4	
(30) Relevant alternatives are compared	Introduction; Methods	
(31) Incremental analysis is reported	Discussion	We describe the extrapolation from the lower costs in the CAM group of patients to the Dutch population
(32) Major outcomes are presented in a disaggregated as well as aggregated form	Tables 2-4	
(33) The answer to the study question is given	Discussion; Conclusion	
(34) Conclusions follow from the data reported	Conclusion	
(35) Conclusions are accompanied by the appropriate caveats	Discussion; Conclusion	

A six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM GPs

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Abstract

Objectives To compare healthcare costs and mortality rates of Dutch patients with a conventional (CON) general practitioner (GP) and patients with a GP who has additionally completed training in complementary and alternative medicine (CAM).

Design Comparative economic evaluation.

Setting Database from the Dutch insurance company Agis.

Participants 1,521,773 patients (98.8%) from a CON practice and 18,862 patients (1.2%) from a CAM practice.

Main outcome measures Annual information on five types of healthcare costs for the years 2006 – 2011: care by GP, hospital care, pharmaceutical care, paramedic care and care covered by supplementary insurance. Healthcare costs in the last year of life. Mortality rates.

Results The mean annual compulsory and supplementary healthcare costs of CON patients are respectively 1,821 Euros (95% CI: 1,813 – 1,828) and 75.3 Euros (95% CI: 75.1 – 75.5). Compulsory healthcare costs of CAM patients are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12,4%) lower and result mainly from lower hospital care costs (165 Euros) (95% CI: 118 – 212; $p < 0.001$) and lower pharmaceutical care costs (58 Euros) (95% CI: 41 – 75; $p < 0.001$), especially in the age categories 25 – 49 years and 50 – 74 years. The costs in the last year of life of patients with CAM GPs are 1,161 euro (95% CI: -138 – 2,461; $p < 0.1$) lower. This difference is entirely due to lower hospital costs (1,250 Euros) (95% CI: 19 – 2,481; $p < 0.05$). The mean annual supplementary costs of CAM patients are 33 Euros (95% CI: 30 – 37; $p < 0.001$) (44%) higher. CAM patients do not have lower or higher mortality rates than CON patients.

Conclusions Dutch patients whose GP additionally completed training in CAM on average have 192 Euros (10.1%) lower annual total compulsory and supplementary healthcare costs and do not live longer or shorter than CON patients.

Strengths and limitations of this study

- The study is based on a large sample size of patients and practices and a relatively long period of six years contributing to more precise estimations, and better representativeness and generalizability of the results.
- The study distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to CAM.
- The study did not compare two treatments (conventional versus CAM) for a specific indication, in a controlled setting with other health related outcome parameters than mortality, prohibiting the possibility to detect causal relationships between interventions and (cost)effects.
- Since the analyses were at the level of the 4-digit postcode and not at the level of the 6-digit postcode, the results might not be optimally controlled for socio-economic status of the patients.
- The study concerns a limited dataset, since the dataset is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most GP practices (64%) were anthroposophic). These facts challenge the generalizability of the results.

Introduction

In most countries of the European Union the annual healthcare costs are rising faster than the economy [1]. Therefore, national healthcare policies are increasingly aiming at controlling and diminishing healthcare expenditures. This also applies to the situation in The Netherlands [2]. In 1972 8% of the Dutch national income (GDP) was used to finance public healthcare. In 2010 already 13% of GDP was used and The Netherlands were worldwide in second place of healthcare expenditures of countries. Without drastic measures, the estimated costs will be over 30% in 2040 [3]. Public spending on healthcare will rise from 61 billion Euros in 2012 to an estimated nearly 80 billion Euros in 2017 [4]. Dutch health economists and policy makers have largely ignored the possible contribution of Complementary and Alternative Medicine (CAM) and Integrative Medicine (IM) to the reduction of healthcare costs as an area of research and interest. The here presented economic study, a six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM general practitioners (GPs), contributes to the development of an evidence-based Dutch policy with regard to the role of CAM and IM in the reduction of healthcare expenditure growth.

The Dutch financing system

The Dutch financing system contains two basic compulsory health insurances, that are for 80% paid for by income taxes: for curative care (Zorgverzekeringswet (ZvW)) and for long-term care (Algemene Wet Bijzondere Ziektekosten (AWBZ)). In addition, people in The Netherlands can buy supplementary insurance. The primary goal of supplementary insurance is to cover costs not covered by basic insurance (for example specific paramedic treatment, complementary therapies) [5]. The second goal of the supplementary insurance is to cover the costs of improvements over the standard level of care paid for by compulsory insurance (e.g., extra costs for a better room and service in case of hospitalisation).

Policies to reduce healthcare expenditure growth

The vast majority of expenditure growth is due to innovations in healthcare. The Cultureel Planbureau (CPB) anticipates that the total costs of curative care will rise from 36 billion Euros this year to 49 billion Euros in 2017. The rising costs of curative care, according to the

CPB is largely due to the 'creeping expansion' of the compulsory health insurance; 'Year after year, new medical techniques and drugs appear on the market that are often better, but also more expensive', especially, since more patients will be treated with the new techniques [3]. Of the total growth of public healthcare expenditure, about a quarter is the result of aging. In 2040 more than 22% of the Dutch population will be older than 65, whereas currently this is 16%. As people grow older, on average the costs of healthcare will increase (on the level of the whole older population).

Which policies can be deployed to control the risk of rising costs? The measures aimed at reducing healthcare expenditures are, without being complete: more efficiency and higher productivity in healthcare (including reducing management layers), more competition between healthcare institutions, fewer hospitals (specialization and concentration), more 'neighbourhood care' by general practitioners (GPs), more remote care (e-health), preventing overtreatment/ less (extra) care, more responsible behaviour of consumers (more self-care), more emphasis on healthy living (prevention), higher co-payments, higher deductibles and already saving for higher health care expenditure in the old days (precautionary savings) [3].

In July 2013 the Dutch healthcare minister Schippers reached an agreement with hospitals, medical specialists, mental healthcare providers, general practitioners, health insurers and patients' organizations to reduce the growth rate of healthcare spending: to 1.5% in 2014 and 1% per year from 2015 to 2017. This reduction represents a total additional savings of approximately 1 billion Euros. To achieve the reduced expenditure growth extra measures will be taken that increase the efficiency and improve the quality of care: more care of medical specialists goes to the GP and from the GP to self-care; concentration of complex care; tighter application of medical guidelines and care standards; treatments are given according the standards of the medical profession itself; access to the claims of the compulsory health insurances is tightened; and more transparency about quality and cost of care [6].

The contribution of Complementary and Alternative Medicine

According to the National Center for Complementary and Alternative Medicine (NCCAM), CAM is a group of diverse medical and healthcare systems, practices, and products that are not generally considered part of conventional medicine [7]. The Cochrane Collaboration definition of complementary medicine is that it includes all such practices and ideas that are

outside the domain of conventional medicine in several countries and defined by its users as preventing or treating illness, or promoting health and well-being. These practices complement mainstream medicine by satisfying a demand not met by conventional practices and diversifying the conceptual framework of medicine [8]. "Integrative Medicine is the practice of medicine that reaffirms the importance of the relationship between practitioner and patient, focuses on the whole person, is informed by evidence, and makes use of all appropriate therapeutic approaches, healthcare professionals and disciplines to achieve optimal health and healing." In addition, IM emphasizes the active role of the patient in prevention (lifestyle), well-being and therapy and healing processes, and the use of healing environments [9].

Herman et al. [10] performed a systematic review of economic evaluations on complementary and integrative medicine (CIM). This study identified 338 economic evaluations of CIM, including 114 full evaluations, published between 2001 and 2010. All recent (and likely most cost-relevant) full economic evaluations published from 2001 to 2010 were subjected to several measures of quality. Detailed results of higher-quality studies were reported. The cost-utility analyses found were of similar or better quality to those published across all medicine. Of the 56 comparisons made in the higher-quality studies, 16 (29%) show a health improvement with cost savings for the CIM therapy versus usual (conventional) care. Study quality of the cost-utility analyses (CUAs) of CIM was generally comparable to that seen in CUAs across all medicine according to several measures, and the quality of the cost-saving studies was slightly, but not significantly, lower than those showing cost increases (85% vs 88%, $p = 0.460$).

In The Netherlands, a few percent of the GPs have followed an additional training in CAM. In 2010, we performed a first economic evaluation, comparing the healthcare costs of patients from Dutch conventional (CON) GPs and CAM GPs [11]. A dataset from a Dutch health insurer Azivo was used containing quarterly information on healthcare costs (GP care, hospital care, pharmaceutical care, and paramedic care), dates of birth and death (if applicable), gender and 6-digit postcode of all approximately 150,000 insurees, for the years 2006–2009. Data from 1,913 conventional GPs were compared with data from 79 GPs with additional CAM training in acupuncture (n=25), homeopathy (n=28), and anthroposophic medicine (n=26). Results were that patients whose GP has additionally completed training in CAM training had 0–30% lower healthcare costs and mortality rates, depending on age groups and type of CAM. The lower costs resulted from fewer hospital stays and fewer

prescription drugs. It was concluded that more controlled studies (replication studies, research based on more comprehensive data, cost-effectiveness studies on CAM for specific diagnostic categories) were indicated.

This study

Given the current need to diminish healthcare expenditures in The Netherlands and based on the positive results from both the review of Herman et al. [10] and our own study [11], we decided to perform a replication study comparing the healthcare costs of patients from conventional (CON) GPs and CAM GPs with a larger dataset from a Dutch health insurer, to analyse the robustness of the results of the first study. The research questions of the study were:

1. Is there a statistically significant difference in healthcare costs (care by GP, hospital care, pharmaceutical care, paramedic care, care covered by supplementary insurance, and healthcare costs in the last year of life) of patients from CON GPs and CAM GPs?
2. Is there a statistically significant difference in mortality rates of patients from CON GPs and CAM GPs?

Methods

Comparative economic evaluation

Full economic evaluations compare the costs (resource use) associated with one or more alternative interventions (e.g. intervention X versus comparator Y) with their consequences (outcomes, effects). In this study we were able to measure five types of costs in two categories: (1) care covered by compulsory insurance: care by GP, hospital care, pharmaceutical care, paramedic care, and (2) costs covered by supplementary insurance. Alternative interventions were: conventional GP care compared to care from GPs that know CAM. Outcomes were: differences in healthcare costs and annual mortality rates.

Model overview

Costs were analysed at the patient level using linear and loglinear regression analysis. The cost analysis has been performed for the total sample, as well as separately for the age groups 0–24, 25–49, 50–74, and ≥ 75, given the large average differences in health and healthcare needs across age groups. Effects on mortality rates are analysed using a linear probability model (LPM), a Logit model, and a Cox proportional hazard model (CPH). In all models, the explanatory variables are gender, age (linear, within each age category), dummies for CAM and 'Vogelaarwijk' (city areas with known lower socio-economic status of inhabitants), year dummies, and postal code fixed effects. In the cost regressions and the LPM model, fixed effects at the 2-digit insuree postcode level were controlled for. In the Logit and CPH model 2-digit postcode level fixed effects were included, as estimation with more detailed fixed effects appeared to be numerically infeasible.

Dataset on healthcare costs and demographics

A dataset was analyzed from health insurer Agis, a subsidiary company of Achmea. Achmea has a share in the market of 31% (5.18 million insured) of the Dutch population in 2013; while the share of Agis is 9,2% (1.54 million insured) The dataset contains quarterly information on the healthcare costs of all Agis insures, which was aggregated to annual information for the years 2006 up to 2011. In addition, it contains the date of birth of the insuree, date of death (if applicable), gender, and 4-digit postcode of the insured's residence. For each insuree year combination, information on the costs of five different types of care is available: care by GP, hospital care, pharmaceutical care, paramedic care (like physical therapy), and care covered by supplementary insurance.

General practitioners and patients

The dataset also contains the names and addresses of the general practitioners who have patients who are insured by Agis, which allows us to distinguish between CON GPs and CAM GPs. We defined a general practitioner as anthroposophic CAM GP if his or her name appears in the list of general practitioners with additional training in anthroposophic medicine (AM) as provided by their professional association [14]. CAM GPs with homeopathy (HOM) [15] and CAM GPs with acupuncture [16] are defined similarly.

Patients were regarded CON patients and CAM patients if they were patient of respectively a CON GP or a CAM GP during all of the years they appear in the dataset. Patients that transferred from a CON GP to a CAM GP or vice versa , were regarded to be a member of a third group called 'Switchers' and were excluded from all analyses.

Statistical analyses

Significance of coefficients is tested using Student t tests, with clustering of standard errors at the level of the insured. Calculations were made using StataSE 10.0. Means with 95% confidence intervals and p-values (< 0.1, < 0.05, and < 0.01) are presented.

Ethical approval

Since the study involved no experimental treatment, patients were not recruited. Since patient data were anonymized, no ethical approval was necessary.

Results

GP practices and patients

The dataset contained 9,126 GP practices: 9,016 CON practices and 110 CAM practices. Due to the systematics of the insurance company, one individual GP can appear as different practices, so the actual number of GPs is lower than the number of GP practices. Contrarily, each patient is never counted more than once. The majority of the CAM GPs are anthroposophic GPs (70 AM practices (64%) with 17,257 patients (91%)).

Healthcare costs

The dataset

The dataset contains information of more than 1.5 million insurees during the years 2006-2011 (Table 1). Nearly 19,000 insurees (1.2%) had throughout this whole period a CAM GP. More than 10,000 other insurees had in some years a CON GP and in other years a CAM GP ('Switchers'). On average, the Switchers group had three years a CON GP and three years a

CAM GP. The insurees had a mean age of 41.0 (SD=23.5). 53% are women. These patients live in 4,014 different 4-digit postal codes.

Without controlling for relevant differences between the groups, the comparison demonstrates: higher percentages of females in in the CAM GP and Switchers groups; higher percentages of insurees living in the 'Vogelaarwijk' in the CON and Switchers group; 183 Euros lower and 168 Euros higher total compulsory costs in respectively the CAM and the Switchers group; and 40 Euros and 25 Euros higher supplementary costs in costs in respectively the CAM and the Switchers group.

Since the aim of the study was to compare the costs of patients with a CON GP and a

Table 1. Descriptive statistics of the dataset

	CON GP	CAM GP	Switchers
Age (year)	41.0	41.6	40.1
Female (percentage)	52.9%	55.2%	56.4%
'Vogelaarwijk' (percentage)	15.7%	9.3%	17.1%
Supplementary insured (percentage)	92.7%	93.4%	92.1%
Compulsory insurance costs (Euros)			
Total costs	1,821	1,638	1,989
GP costs	133	128	140
Pharmaceutical costs	402	357	474
Hospital costs	1,242	1,104	1,328
Paramedical costs	44	48	47
Supplementary insurance costs (Euros)	75	115	100
Insurees (n)	1,521,773	18,862	10,769

CAM GP, the data of the Switchers group were left out of the further regression analyses.

Annual total compulsory and supplementary insurance costs

The mean annual total costs of patients treated in CON practices covered by the compulsory insurance were 1,821 Euros (95% CI: 1,813 – 1,828) (Table 1). After correction for observed differences between the groups by means of linear regression analyses, the mean annual total compulsory insurance costs of patients of CAM GP practices are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12.4%) lower. These lower costs are mainly due to lower hospital costs (165 Euros; 95% CI: 118 – 212; $p < 0.001$) and lower pharmaceutical care costs (58 Euros; 95% CI: 41 – 75; $p < 0.001$).

The mean annual total supplementary costs for patients treated in CON practices were 75.3 Euros (95% CI: 75.1 – 75.5). (The mean is calculated over all patients, including those (less than 8%) without supplementary insurance.) For patients treated in CAM practices these costs are 33 Euros (95% CI: 31 – 37; $p < 0.001$) (44%) higher and were highest in the third age group (50 – 74 years) (52 Euros (95% CI: 31 – 37; $p < 0.001$). Taken together, the mean total annual compulsory and supplementary insurance costs are 192 Euros (10.1%) lower for the CAM group of patients.

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (Table 3) provide the same lower costs for the CAM group of patients as found in the linear analyses (Table 2). In addition, higher paramedic costs are found for the CAM group of patients.

Costs per age category and insurance category

Lower total compulsory costs were found in all age categories (Table 2): 80 Euro (95% CI: 21 – 140; $p < 0.01$) in the first group (0-24 years); 137 Euros (95% CI: 54 – 219; $p < 0.01$) in the second group (25 – 49 years); 356 Euros (95% CI: 227 – 485; $p < 0.001$) in the third group (50 – 74 years), and 236 Euros (95% CI: -9 – 481; $p < 0.1$) in the last group (75+ years). Lower pharmaceutical costs were found in the second age group (25 – 49 years) (50 Euros; 95% CI: 23 – 77; $p < 0.001$) and the third age group (50 – 74 years) (126 Euros; 95% CI: 88 – 164; $p < 0.001$). Lower hospital costs were found in all age groups, with the largest

differences in the third age group (50 – 74 years) (232 Euros; 95% CI: 124 – 341; $p < 0.001$) and the last age group (75+ years) (219 Euros; 95% CI: 7 – 431; $p < 0.05$). In addition, the largest difference in total compulsory costs was found in the last year of life (1,161 Euros; 95% CI: -138 – 2461; $p < 0.1$), which is completely the result of lower hospital costs (1,250 Euros; 95% CI: 19 – 2481; $p < 0.05$).

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (Table 3) provide the same lower costs for the separate age groups of CAM patients as found in the linear analyses (Table 2). In addition, now there are also significant lower costs for the CAM group of patients with regard to GP costs in the third age group (50 – 74), lower pharmaceutical costs in the first (0 – 24) and the last age group (75+); and higher paramedic costs in the second (25 – 49) and third (50 – 74) age group (Table 3).

Table 2. Estimated differences in mean annual total compulsory and supplementary insurance costs: CAM patients compared to CON patients (linear regression model)

	Compulsory insurance costs					Supplementary insurance costs
	Total	GP	Pharmaceutical	Hospital	Paramedic	
All ages	-225***	-3***	-58***	-165***	1	33***
0-24	-80***	-3***	-2	-74***	-2	11***
25-49	-137***	-2**	-50***	-85**	1	32***
50-74	-356***	-1	-126***	-232***	3	52***
75+	-236*	11***	-38	-219**	10	24***
Last year of life	-1,161*	5	67	-1,250**	27	3

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Table 3. Estimated differences in mean annual total compulsory and supplementary insurance costs: CAM patients compared to CON patients (loglinear regression model)

	Compulsory insurance costs					Supplementary insurance costs
	Total	GP	Pharmaceutical	Hospital	Paramedic	
All ages	-.114***	-.121***	-.281***	-.185***	.028**	.496***
0-24	-.071***	-.018**	-.169***	-.152***	.017	.344***
25-49	-.088***	-0.14**	-.267***	-.153***	.021*	.433***
50-74	-.173***	-.025***	-.418***	-.220***	.036*	.653***
75+	-.072**	.026*	-.176***	-.124**	.055	.355***
Last year of life	-.146**	.026	-.143	-.287**	.178	.134

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Mortality rates

In the present dataset, the only information available on health outcomes is mortality. During the period 2006-2011 80,543 patients died in the CON group (5.26%) and 973 in the CAM group (5.14%). After controlling for all relevant variables (age, postal codes, etcetera), we find that patients with a CAM GP have significantly lower mortality rates in all LMP analyses (Table 4). However, the differences are very small: total group: 0.004 (95% CI: 0.001 – 0.007; $p < 0.05$); men: 0.004 (95% CI: 0.001 – 0.008; $p < 0.1$); women: 0.007 (95% CI: 0.003 – 0.011; $p < 0.05$). The Logit analyses resulted in a significantly higher mortality rate for the total group at the 10% level (but not at the 5% level). (0.066; 95% CI: -0.143 – 0.011; $p < 0.1$), but no significant differences for men and women separately. The Cox proportional hazard analyses resulted in significant higher mortality rates at the 10% level (but not at the 5% level), both for the total group: 1.059 (95% CI: 0.994 – 1.129; $p < 0.1$), and the group of women: 1.072 (95% CI: 0.987 – 1.165; $p < 0.1$), but no significant difference for men were found.

Based on all results, taking into account the small differences in the LPM analyses, the low p-values ($p < 0.1$) in the Logit and Cox proportional hazard analyses and the contradictory outcomes between the LPM analyses on the one hand and the Logit and Cox

proportional hazard analyses on the other hand, we conclude that there is no difference in mortality rates between the CON and CAM group of patients.

Table 4. Differences in mortality rates: CAM patients compared to CON patients

	Total	Men	Women
LPM with fixed effects	-0.004**	-0.004*	-0.007**
Logit with fixed effects	0.066*	0.081	0.049
Cox proportional hazard	1.059*	1.043	1.072*
*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01			

Conclusions

The comparison of the healthcare costs of insurees of CON GPs and CAM GPs in a database with data of 1,540,635 patients from the Dutch insurance company Agis during the period 2006-2011 demonstrates:

1. On average annual total compulsory and supplementary healthcare costs of patients treated by a CAM GP are 192 Euros (10.1%) lower than the costs of patients treated by conventional GPs as a result of 225 Euros (12.4%) lower compulsory costs and 33 Euros (44%) higher supplementary costs.
2. The lower mean annual total compulsory healthcare costs are mainly due to lower hospital care costs (165 Euros) and lower pharmaceutical care costs (58 Euros).
3. Lower mean annual total compulsory healthcare costs are demonstrated in all age categories, but are highest in the third age group (50 – 74 years) (total costs: 356 Euros; hospital care: 232 Euros; pharmaceutical care: 126 Euros) and in the last year of life (total costs: 1,093 Euros; hospital care: 1,223 Euros).
4. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a CON GP.

Discussion

In this study the mean annual total compulsory costs, supplementary costs, costs during the last year of life and mortality rates of patients with a conventional (CON) GP (n = 1.52

million; 98.8%) and patients with GPs that know complementary and alternative medicine (CAM) (n = 18,862; 1.2%) were compared in a dataset from the Dutch insurance company Agis over a six year period (2006 – 2011) by means of regression analyses. The mean annual compulsory healthcare costs of patients treated by a conventional GP are 1,821 Euros (95% CI: 1,813 – 1,828). On average annual total compulsory healthcare costs of patients treated by a CAM GP are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12.4%) lower than patients treated by conventional GPs. Lower total compulsory costs were found in all age categories. Lower pharmaceutical costs were found in the second age group (25 – 49 years) (50 Euros; 95% CI: 23 – 77; $p < 0.001$) and the third age group (50 – 74 years) (126 Euros; 95% CI: 88 – 164; $p < 0.001$). Lower hospital costs were found in all age groups. The largest difference in total compulsory costs was found in the last year of life (1,161 Euros; 95% CI: -138 – 2461; $p < 0.1$), which is completely the result of lower hospital costs (1,250 Euros; 95% CI: 19 – 2481; $p < 0.05$). The mean annual supplementary insurance costs of patients treated by a conventional GP are 75.3 Euros (95% CI: 75.1 – 75.5). On average annual supplementary healthcare costs of patients treated by a CAM GP are 33 Euros (95% CI: 31 – 37; $p < 0.001$) (44%) higher. The absolute lower compulsory costs for all patients for the six years period (2006 – 2011) for the CAM group is 25,463,700 Euros (or on average 4,243,950 Euros per year) compared to the CON group. The extrapolation of the lower costs in the CAM group of patients to the Dutch population (16.8 million inhabitants), if applicable, would result in 3.78 billion Euros lower annual compulsory costs. The absolute lower compulsory and supplementary costs for all patients for the six years period (2006 -2011) for the CAM group is 21,729,024 Euros (or on average 3,621,504 Euros per year) compared to the CON group. The extrapolation of the lower costs in the CAM group of patients to the Dutch population (16.8 million inhabitants), if applicable, would result in 3.23 billion Euros lower annual compulsory and supplementary costs. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a conventional GP.

The first strength of the study is the large sample size of patients and practices. Approximately 9.2% of the Dutch population (1.54/ 16.8 million), and 29.7% of the insurees of Achmea (1.54/ 5.18 million) were included in the study. Compared to the first pilot study [11] there were 10 times more patients from a CON GP (151,952 versus 1,521,773), three times more patients from a CAM GP (5,922 versus 18,862), 4,5 times more CON GP practices (1,913 versus 9,016) and about 1,5 times more CAM practices (79 versus 110). This large sample size allows a more precise estimate of costs and mortality rate differences and

increases the representativeness of the sample and the generalizability of the results [13]. The second strength is that the results are based on a relatively long period of six years, also contributing to more precise estimations, and better representativeness and generalizability of the results. Thirdly, this study, unlike the first pilot study [11], distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to CAM. The first limitation of the study is that it did not compare two treatments (CON versus CAM) for a specific indication, in a controlled setting with other health related outcome parameters than mortality, prohibiting the possibility to detect causal relationships between interventions and (cost)effects. Missing information includes costs of out-of pocket expenses, morbidity, work absence, objective disease related outcome measures, subjective health and patient satisfaction. A second limitation is, contrary to the first pilot study [11], that we were not able to analyse at the level of the 6-digit postcode but only at the level of the 4-digit postcode. As a result, the results might not be optimally controlled for socio-economic status of the patients. However, a reanalysis of the data of the first pilot study [11] demonstrated very small differences in results between the analyses with the 6-digit postcode and the analyses with the 4-digit postcode. Another limitation of the study concerns the limited dataset, since the dataset is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most GP practices (64%) were anthroposophic). These facts challenge the generalizability of the results.

The current results with regard to differences in healthcare costs confirm the results of our first smaller pilot study [11] with only 153,000 insurees and observations during a four-year period. In addition, the current study with 10 times as many patients and a two-year longer period of observations, enabled to estimate the cost differences more precisely. Whereas in this first study estimation of mean annual total compulsory costs of CAM patients were in the range of 0 – 30% lower than these of patients of CON GPs, the mean cost differences are now estimated to be 12.4% lower (range: 9.3 – 15.4%) for the CAM group. Like in the first study, the lower total compulsory costs are mainly the result from lower hospital and pharmaceutical costs. Lower costs for CAM in this study are also in line with the results of the recent review of Herman et al. [10] on economic evaluation of CAM and CIM, demonstrating that 29% of comparisons made in the 56 higher-quality studies showed a health improvement with cost savings for the CIM therapy versus usual (conventional) care. Since most CAM patients in the current study were treated in an anthroposophic practice, comparison with other economic studies on anthroposophic medicine (AM) is justified.

Kienle et al. [13,15] reviewed the few economic investigations on AM, demonstrating less or equal costs in AM compared to CON treatment, due to reduced hospital admissions and less prescriptions of medications. Hamre et al. [15] found that in patients starting anthroposophic therapies for chronic disease, total healthcare costs did not increase in the first year, and were significantly reduced in the second year by 416 Euros (95% CI: 264 – 960) compared to the pre-study year. This reduction was largely explained by a decrease of inpatient hospitalisation. With regard to differences in mortality rates between CON and CAM patients, the results do not confirm the (weak) evidence of lower mortality rates that were found in the first study [11]. The conclusion is now that CAM patients do not have lower or higher mortality rates than CON patients.

With regard to the healthcare costs differences reported in the Results section, we can hypothesize four types of explanations. First, the differences could be due to selection on unobservables in patients' GP choice. For example, patients who are healthier and more health-conscious or patients with a strong preference to minimize exposure to medical interventions might be more likely to choose a CAM GP. In both cases, costs will be lower due to lower demand for healthcare. A standard approach to control for selection on unobservables in a non-experimental setting is to use Instrumental Variables (IV). A potential instrumental variable in this case is the distance between a patient's home and the various GPs, cq. a change in distance as a result of a move of a patient or practice. We intend to explore this approach in future work. With respect to selection, several studies that compare the health status of patients treated in CAM and in conventional medicine in primary care settings find that patients treated in CAM practices suffer more often from severe and chronic illnesses (e.g., [16, 17]). This suggests that if we could control for severity and chronicity of illnesses (with additional data), the estimated compulsory cost differences might be larger. Second, the results could be due to undertreatment by CAM GPs. In the present dataset, we were only able to analyse mortality and found that patients with a CAM GP tend to have equal mortality rates. However, a number of studies have reported that patients seeking CAM or anthroposophic care have longer lasting and more severe health problems than patients in conventional care. At the same time, these patients report fewer adverse side effects of treatments and higher patient satisfaction (e.g., [16-18]). These findings combined with the results in this study provide some indication that undertreatment by CAM GPs is unlikely. Firmer conclusions require more detailed data on outcomes. Thirdly, the results could be due to better practices of CAM due to a stronger focus on preventive and curative health

promotion, less overtreatment and better communication and professional relationships. For example, a CAM GP might try a low-cost CAM treatment first. As mentioned, the primary professional orientation of CAM doctors is to strengthen the self-healing capacity of the body and the self-management of the patient. This approach is associated with prescribing fewer conventional pharmaceuticals, tests and operations. Nissen et al. [19, p. 14], based on a review of the literature on citizens' attitudes and needs concerning CAM in Europe, concluded that 'many citizens in Europe value the practice of CAM, particularly the CAM provider-patient relationship, and the patient-centred and holistic approach aspired to by many CAM providers.' Van Dulmen [20] concluded in a Dutch study comparing patients visiting conventional general practitioners (GPs) and three types of CAM GPs (homeopathy, acupuncture and naturopathy), that, contrary to expectations, patients do not consult a CAM physician because they are disappointed with mainstream GP care. CAM patients primarily appear to be seeking a physician who takes the time to talk with them and who will treat their complaints from a holistic viewpoint. Ernst and Hung [21] described the published evidence on the expectations of CAM users (in order of prevalence): hope to influence the natural history of the disease; disease prevention and health/ general well-being promotion; fewer side effects; being in control over one's health; symptom relief; boosting the immune system; emotional support; holistic care; improving quality of life; relief of side effects of conventional medicine; positive therapeutic relationship; obtaining information; coping better with illness; supporting the natural healing process; and the availability of treatment. In addition CAM GPs might focus more on the relationship and communication. For example Esch et al. [16] found that AM patients appreciated that their physicians listened to them (80.0% vs. 67.1%, $p < 0.001$), spent more time (76.5% vs. 61.7%, $p < 0.001$), had more interest in their personal situation (74.6% vs. 60.3%, $p < 0.001$), involved them more in decisions about their medical care (67.8% vs. 58.4%, $p = 0.022$), and made it easy to tell the physician about their problems (71.6% vs. 62.9%, $p = 0.023$). AM patients gave significantly better rating as to information and support (in 3 of 4 items $p < 0.05$) and for thoroughness (70.4% vs. 56.5%, $p < 0.001$). AM patients showed significantly higher treatment satisfaction in all of the five items than CON patients. These results are consistent with other studies demonstrating high patient satisfaction with AM [13,14]. For instance, in a Dutch survey (Consumer Quality Index, a national standard to measure healthcare quality from the perspective of healthcare users), 2.099 patients reported very high satisfaction with anthroposophic GP practices (8.4 and 8.3 on a scale: 0-10, 10 indicating the best possible score) [18]. These results are consistent with AM theory, which emphasizes relationship and

communication, as well as shared decision-making [14]. More AM patients expressed a general treatment satisfaction (56.1% vs. 43.4%, $p < 0.001$) and saw their expectations completely fulfilled at follow-up (38.7% vs. 32.6%, $p < 0.001$). AM patients reported significantly fewer adverse side effects (9.3% vs. 15.4%, $p = 0.003$), and more other positive effects from treatment (31.7% vs. 17.1%, $p < 0.001$). Fourthly, the lower costs could be related to the fact that patients interested in CAM might have higher out-of pocket expenses since not all CAM treatments are covered by supplementary insurance Clarifying the role of out-of-pocket expenses is an empirical issue that requires additional data.

The major implication of this study and other economic evaluations of CAM is that there is sufficient evidence now to justify more professional interest in CAM from conventional healthcare professionals and policymakers. We can also conclude that there is sufficient good evidence that CAM can be cost-effective compared to conventional medicine, that the contribution of CAM might result in substantial diminishing of healthcare costs and therefore can provide a contribution to national healthcare policies aiming at controlling and diminishing healthcare expenditures. Therefore more investment in the study of the cost-effectiveness of CAM modalities with their additional health promotion medicines and therapies is indicated. The main unanswered questions in the current study are: where do the cost differences come from (to which indications and which therapies do they pertain to?) and what are the health-related effects of CAM treatment (objective parameters (e.g. lowering of blood pressure), quality of life, patient-reported outcomes, sick-leave, etc.)? Future research should therefore focus on and (1) exploring to what extent selection on unobservables and causal effects explain the lower costs of patients with a CAM GP, (2) exploring in more depth the costs differences between patients of CON GPs and CAM GPs in order to develop adequate, testable hypothesis of cost-effectiveness of specific CAM treatment for specific indications, and to transfer the cost differences related knowledge from CAM to CON GP practices in order to diminish healthcare expenditures in CON practices; (3) designing and executing highly controlled, comparative effectiveness research projects [22] with more health related outcome parameters than mortality rate only; (4) replication studies based on similar, large datasets with other CAM modalities (acupuncture, TCM herbal treatment, etc.) and with other insurance companies to explore and confirm the present results;

Acknowledgements

We would like to thank Agis (Achmea) and especially Dr. Hugo Smeets and Mr. Henk Evers for providing the dataset for the study.

Competing interests

We have read and understood the BMJ Group policy on declaration of interests and declare the following interests:

- Dr. Erik W. Baars receives a part of his salary from the Professorship Anthroposophic Healthcare of the University of Applied Sciences Leiden, The Netherlands. The professorship works closely with those in the AH professional field and works on practical problems using applied research which focuses on three main categories: (1) investigating efficacy and safety, (2) developing and delivering optimal quality, and (3) improving communication about AH.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Contributors

PK was the project lead for the statistical analyses. EB and PK wrote the manuscript. All authors reviewed the manuscript and contributed to manuscript revisions. EB is the guarantor for this study.

Funding

The only financial support for the study was provided by the Stichting Triodos Foundation. These financial resources were only used to cover the costs of Achmea for providing the dataset for the study. The researchers did not receive any funding for salaries or other costs.

Role of the study sponsors

Not applicable.

Statement of independence of researchers from funders

Funders played no part in article selection, analysis, interpretation, or decision to publish.

Data sharing

Details of how to obtain additional data from the study can be obtained from EB (baars.e@hsleiden.nl).

Previous publication

A part of the content of our study results was published in February 2014 as a Dutch article in the Dutch journal Economisch Statistische Berichten for economists in the Netherlands [23].

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BMJ Open

A six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM GPs

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2014-005332.R1
Article Type:	Research
Date Submitted by the Author:	11-Jul-2014
Complete List of Authors:	Baars, Erik; University of Applied Sciences, Care Kooreman, Peter; Tilburg University, Economics
Primary Subject Heading:	Complementary medicine
Secondary Subject Heading:	Health economics
Keywords:	COMPLEMENTARY MEDICINE, PRIMARY CARE, HEALTH ECONOMICS

A six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM GPs

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Abstract

Objectives To compare healthcare costs and mortality rates of Dutch patients with a conventional (CON) general practitioner (GP) and patients with a GP who has additionally completed training in complementary and alternative medicine (CAM).

Design Comparative economic evaluation.

Setting Database from the Dutch insurance company Agis.

Participants 1,521,773 patients (98.8%) from a CON practice and 18,862 patients (1.2%) from a CAM practice.

Main outcome measures Annual information on five types of healthcare costs for the years 2006 – 2011: care by GP, hospital care, pharmaceutical care, paramedic care and care covered by supplementary insurance. Healthcare costs in the last year of life. Mortality rates.

Results The mean annual compulsory and supplementary healthcare costs of CON patients are respectively 1,821 Euros (95% CI: 1,813 – 1,828) and 75.3 Euros (95% CI: 75.1 – 75.5). Compulsory healthcare costs of CAM patients are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12,4%) lower and result mainly from lower hospital care costs (165 Euros) (95% CI: 118 – 212; $p < 0.001$) and lower pharmaceutical care costs (58 Euros) (95% CI: 41 – 75; $p < 0.001$), especially in the age categories 25 – 49 years and 50 – 74 years. The costs in the last year of life of patients with CAM GPs are 1,161 euro (95% CI: -138 – 2,461; $p < 0.1$) lower. This difference is entirely due to lower hospital costs (1,250 Euros) (95% CI: 19 – 2,481; $p < 0.05$). The mean annual supplementary costs of CAM patients are 33 Euros (95% CI: 30 – 37; $p < 0.001$) (44%) higher. CAM patients do not have lower or higher mortality rates than CON patients.

Conclusions Dutch patients whose GP additionally completed training in CAM on average have 192 Euros (10.1%) lower annual total compulsory and supplementary healthcare costs and do not live longer or shorter than CON patients.

Strengths and limitations of this study

- The study is based on a large sample size of patients and practices and a relatively long period of six years contributing to more precise estimations, and better representativeness and generalizability of the results.
- The study distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to CAM.
- The study did not compare two treatment (conventional versus CAM) for a specific indication, in a controlled setting with other health related outcome parameters than mortality, reducing the ability to detect causal relationships between interventions and (cost)effects.
- Since the analyses were at the level of the 4-digit postcode and not at the level of the 6-digit postcode, the results might not be optimally controlled for socio-economic status of the patients.
- The study concerns a limited dataset, since the dataset is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most GP practices (64%) were anthroposophic). These facts challenge the generalizability of the results.

Introduction

In most countries of the European Union the annual healthcare costs are rising faster than the economy [1]. Therefore, national healthcare policies are increasingly aiming at controlling and diminishing healthcare expenditures. This also applies to the situation in The Netherlands [2]. In 1972 8% of the Dutch national income (GDP) was used to finance public healthcare. In 2010 already 13% of GDP was used and The Netherlands were worldwide in second place of healthcare expenditures of countries. Without drastic measures, the estimated costs will be over 30% in 2040 [3]. Public spending on healthcare will rise from 61 billion Euros in 2012 to an estimated nearly 80 billion Euros in 2017 [4]. Dutch health economists and policy makers have largely ignored the possible contribution of Complementary and Alternative Medicine (CAM) and Integrative Medicine (IM) to the reduction of healthcare costs as an area of research and interest. The here presented economic study, a six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM general practitioners (GPs), contributes to the development of an evidence-based Dutch policy with regard to the role of CAM and IM in the reduction of healthcare expenditure growth.

The Dutch financing system

The Dutch financing system contains two basic compulsory health insurances, that are for 80% paid for through income taxes: for curative care (Zorgverzekeringswet (ZvW)) and for long-term care (Algemene Wet Bijzondere Ziektekosten (AWBZ)). The compulsory health insurances cover costs of most of GP, pharmaceutical and hospital care and some paramedic care. In addition, people in The Netherlands can buy supplementary insurance. Supplementary insurance covers costs not covered by basic insurance (for example specific or additional paramedic treatment, complementary therapies) (e.g., costs of CAM treatment is paid for up to 500 Euros/ year) [5]. Many supplementary insurances cover costs of CAM treatments like anthroposophic medicine, acupuncture and homeopathy. Supplementary insurance can also cover costs of improvements over the standard level of care paid for by compulsory insurance (e.g., extra costs for a better room and service in case of hospitalisation).

Policies to reduce healthcare expenditure growth

The vast majority of expenditure growth is due to innovations in healthcare. The Cultureel Planbureau (CPB) anticipates that the total costs of curative care will rise from 36 billion Euros this year to 49 billion Euros in 2017. The rising costs of curative care, according to the CPB is largely due to the 'creeping expansion' of the compulsory health insurance; 'Year after year, new medical techniques and drugs appear on the market that are often better, but also more expensive', especially, since more patients will be treated with the new techniques [3]. Of the total growth of public healthcare expenditure, about a quarter is the result of aging. In 2040 more than 22% of the Dutch population will be older than 65, whereas currently this is 16%. As people grow older, on average the costs of healthcare will increase (on the level of the whole older population).

Which policies can be deployed to control the risk of rising costs? The measures aimed at reducing healthcare expenditures are, without being complete: more efficiency and higher productivity in healthcare (including reducing management layers), more competition between healthcare institutions, fewer hospitals (specialization and concentration), more 'neighbourhood care' by general practitioners (GPs), more remote care (e-health), preventing overtreatment/ less (extra) care, more responsible behaviour of consumers (more self-care), more emphasis on healthy living (prevention), higher co-payments, higher deductibles and already saving for higher healthcare expenditure in the old days (precautionary savings) [3].

In July 2013 the Dutch healthcare minister Schippers reached an agreement with hospitals, medical specialists, mental healthcare providers, general practitioners, health insurers and patients' organizations to reduce the growth rate of healthcare spending: to 1.5% in 2014 and 1% per year from 2015 to 2017. This reduction represents a total additional savings of approximately 1 billion Euros. To achieve the reduced expenditure growth, extra measures will be taken that increase the efficiency and improve the quality of care: more care of medical specialists goes to the GP and from the GP to self-care; concentration of complex care; tighter application of medical guidelines and care standards; treatments are given according the standards of the medical profession itself; access to the claims of the compulsory health insurances is tightened; and more transparency about quality and cost of care [6].

The contribution of Complementary and Alternative Medicine

According to the National Center for Complementary and Alternative Medicine (NCCAM), CAM is a group of diverse medical and healthcare systems, practices, and products that are not generally considered part of conventional medicine [7]. The Cochrane Collaboration definition of complementary medicine is that it includes all such practices and ideas that are outside the domain of conventional medicine in several countries and defined by its users as preventing or treating illness, or promoting health and well-being. These practices complement mainstream medicine by satisfying a demand not met by conventional practices and diversifying the conceptual framework of medicine [8]. "Integrative Medicine is the practice of medicine that reaffirms the importance of the relationship between practitioner and patient, focuses on the whole person, is informed by evidence, and makes use of all appropriate therapeutic approaches, healthcare professionals and disciplines to achieve optimal health and healing." [9] In addition, IM emphasizes the active role of the patient in prevention (lifestyle), well-being and therapy and healing processes, and the use of healing environments [9].

Herman et al. [10] performed a systematic review of economic evaluations on complementary and integrative medicine (CIM). This study identified 338 economic evaluations of CIM, including 114 full evaluations, published between 2001 and 2010. All recent (and likely most cost-relevant) full economic evaluations published from 2001 to 2010 were subjected to several measures of quality. Detailed results of higher-quality studies were reported. The cost-utility analyses found were of similar or better quality to those published across all medicine. Of the 56 comparisons made in the higher-quality studies, 16 (29%) show a health improvement with cost savings for the CIM therapy versus usual (conventional) care. Study quality of the cost-utility analyses (CUAs) of CIM was generally comparable to that seen in CUAs across all medicine according to several measures, and the quality of the cost-saving studies was slightly, but not significantly, lower than those showing cost increases (85% vs 88%, $p = 0.460$).

In The Netherlands, a few percent of the GPs have followed an additional training in CAM. In 2010, we performed an initial economic evaluation, comparing the healthcare costs of patients from Dutch conventional (CON) GPs and CAM GPs [11]. A dataset from a Dutch health insurer Azivo was used containing quarterly information on healthcare costs (GP care, hospital care, pharmaceutical care, and paramedic care), dates of birth and death (if applicable), gender and 6-digit postcode of all approximately 150,000 insurees, for the years 2006–2009. Data from 1,913 conventional GPs were compared with data from 79 GPs with

additional CAM training in acupuncture (n=25), homeopathy (n=28), and anthroposophic medicine (n=26). Results were that patients whose GP has additionally completed training in CAM training had 0–30% lower healthcare costs and mortality rates, depending on age groups and type of CAM. The lower costs resulted from fewer hospital stays and fewer prescription drugs. It was concluded that more controlled studies (replication studies, research based on more comprehensive data, cost-effectiveness studies on CAM for specific diagnostic categories) were indicated.

This study

Given the current need to diminish healthcare expenditures in The Netherlands and based on the positive results from both the review of Herman et al. [10] and our own study [11], we decided to perform a replication study comparing the healthcare costs of patients from conventional (CON) GPs and CAM GPs with a larger dataset from a Dutch health insurer, to analyse the robustness of the results of the first study. The research questions of the study were:

1. Is there a statistically significant difference in healthcare costs (care by GP, hospital care, pharmaceutical care, paramedic care, care covered by supplementary insurance, and healthcare costs in the last year of life) of patients from CON GPs and CAM GPs?
2. Is there a statistically significant difference in mortality rates of patients from CON GPs and CAM GPs?

Methods

Comparative economic evaluation

Full economic evaluations compare the costs (resource use) associated with one or more alternative interventions (e.g., intervention X versus comparator Y) with their consequences (outcomes, effects). In this study we were able to measure five types of costs in two categories: (1) care covered by compulsory insurance: care by GP, hospital care, pharmaceutical care, paramedic care, and (2) costs covered by supplementary insurance.

Alternative interventions were: conventional GP care compared to care from GPs that know CAM. Outcomes were: differences in healthcare costs and annual mortality rates.

Model overview

Costs were analysed at the patient level using linear and loglinear regression analysis. The cost analysis has been performed for the total sample, as well as separately for the age groups 0–24, 25–49, 50–74, and ≥ 75, given the large average differences in health and healthcare needs across age groups. Effects on mortality rates are analysed using a linear probability model (LPM), a Logit model, and a Cox proportional hazard model (CPH). In all models, the explanatory variables are gender, age (linear, within each age category), dummies for CAM and 'Vogelaarwijk' (city areas with known lower socio-economic status of inhabitants), year dummies, and postal code fixed effects. In the cost regressions and the LPM model, fixed effects at the 4-digit insuree postcode level were controlled for. In the Logit and CPH model 2-digit postcode level fixed effects were included, as estimation with more detailed fixed effects appeared to be numerically infeasible.

The regression approach is standard practice in health economics and yields results similar to those of matching procedures (both are unable to correct for unobserved differences between groups of patients). Given the large sample sizes Students' t tests are asymptotically valid by virtue of the central limit theorem, independent of whether the underlying distributions are normal or non-normal. Standard errors are clustered at the level of the insured to control for the statistical dependence of observations pertaining to a given insured person (i.e. observations are independent 'between' individuals but dependent 'within' individuals).

With regard to the six years of data the data set was used as a panel. This means that if an insured person is observed for all six years, six observations of annual costs of this person are used in the analysis (taking into account the 'within'-person correlation by clustering standard errors at the level of the individual). The reported differences can be interpreted as the average of cost differences across years. Any trends are controlled for by the year dummy variables.

Dataset on healthcare costs and demographics

A dataset was analyzed from health insurer Agis, a subsidiary company of Achmea. Achmea has a share in the market of 31% (5.18 million insured) of the Dutch population in 2013; while the share of Agis is 9,2% (1.54 million insured) The dataset contains quarterly information on the healthcare costs of all Agis insurees, which was aggregated to annual information for the years 2006 up to 2011. In addition, it contains the date of birth of the insuree, date of death (if applicable), gender, and 4-digit postcode of the insured's residence. For each insuree year combination, information on the costs of five different types of care is available: care by GP, hospital care, pharmaceutical care, paramedic care (like physical therapy), and care covered by supplementary insurance.

General practitioners and patients

The dataset also contains the names and addresses of the general practitioners who have patients who are insured by Agis, which allows us to distinguish between CON GPs and CAM GPs. We defined a general practitioner as anthroposophic CAM GP if his or her name appears in the list of general practitioners with additional training in anthroposophic medicine (AM) as provided by their professional association [14]. CAM GPs with homeopathy (HOM) [15] and CAM GPs with acupuncture [16] are defined similarly.

Patients were regarded CON patients and CAM patients if they were patient of respectively a CON GP or a CAM GP during all of the years they appear in the dataset. Patients that transferred from a CON GP to a CAM GP or vice versa , were regarded to be a member of a third group called 'Switchers' and were excluded from all analyses.

Statistical analyses

Significance of coefficients is tested using Student t tests, with clustering of standard errors at the level of the insured. Given the large sample sizes available here, asymptotic t-testing for differences in means is appropriate by virtue of the central limit theorem. Calculations were made using StataSE 10.0. Means with 95% confidence intervals and p-values (< 0.1, < 0.05, and < 0.01) are presented.

Ethical approval

Since the study involved no experimental treatment, patients were not recruited. Since patient data were anonymized, no ethical approval was necessary.

Results

GP practices and patients

The dataset contained 9,126 GP practices: 9,016 CON practices and 110 CAM practices. Due to the systematics of the insurance company, one individual GP can appear as different practices, so the actual number of GPs is lower than the number of GP practices. Contrarily, each patient is never counted more than once. The majority of the CAM GPs are anthroposophic GPs (70 AM practices (64%). Other CAM GPs were specialized in acupuncture (15%) and homeopathy (25%). Since some GPs were specialized in more than one CAM modality the total percentage of CAM GPs is larger than 100%. Exact numbers and percentages of CAM GPs vary a little over the years.

Healthcare costs

The dataset

The dataset contains information of more than 1.5 million insurees during the years 2006-2011 (Table 1). Nearly 19,000 insurees (1.2%) had throughout this whole period a CAM GP. More than 10,000 other insurees had in some years a CON GP and in other years a CAM GP ('Switchers'). On average, the Switchers group had three years a CON GP and three years a CAM GP. The insurees had a mean age of 41.0 (SD=23.5). 53% are women. These patients live in 4,014 different 4-digit postal codes.

Without controlling for relevant differences between the groups, the comparison demonstrates: higher percentages of females in in the CAM GP and Switchers groups; higher percentages of insurees living in the 'Vogelaarwijk' in the CON and Switchers group; 183 Euros lower and 168 Euros higher total compulsory costs in respectively the CAM and the Switchers group; and 40 Euros and 25 Euros higher supplementary costs in costs in respectively the CAM and the Switchers group. The percentages of patients with a supplementary insurance were almost the same (CON GPs: 92.7%; CAM GPs: 93.4% and Switchers: 92.1%).

Since the aim of the study was to compare the costs of patients with a CON GP and a CAM GP, the data of the Switchers group were left out of the further regression analyses (Appendix 1).

Table 1. Descriptive statistics of the dataset

	CON GP	CAM GP	Switchers
Insured (n)	1,521,773	18,862	10,769
Age (year)	41.0	41.6	40.1
Female (percentage)	52.9%	55.2%	56.4%
'Vogelaarwijk' (percentage)	15.7%	9.3%	17.1%
Supplementary insured (percentage)	92.7%	93.4%	92.1%
Compulsory insurance costs (Euros)			
Total costs	1,821	1,638	1,989
GP costs	133	128	140
Pharmaceutical costs	402	357	474
Hospital costs	1,242	1,104	1,328
Paramedical costs	44	48	47
Supplementary insurance costs (Euros)	75	115	100

Annual total compulsory and supplementary insurance costs

The mean annual total costs of patients treated in CON practices covered by the compulsory insurance were 1,821 Euros (95% CI: 1,813 – 1,828) (Table 1). After correction for observed differences between the groups by means of linear regression analyses, the mean annual total compulsory insurance costs of patients of CAM GP practices are 225 Euros (95% CI: 169 –

281; p < 0.001) (12.4%) lower. These lower costs are mainly due to lower hospital costs (165 Euros; 95% CI: 118 – 212; p < 0.001) and lower pharmaceutical care costs (58 Euros; 95% CI: 41 – 75; p < 0.001).

The mean annual total supplementary costs for patients treated in CON practices were 75.3 Euros (95% CI: 75.1 – 75.5). (The mean is calculated over all patients, including those (less than 8%) without supplementary insurance.) For patients treated in CAM practices these costs are 33 Euros (95% CI: 31 – 37; p < 0.001) (44%) higher and were highest in the third age group (50 – 74 years) (52 Euros (95% CI: 31 – 37; p < 0.001). Taken together, the mean total annual compulsory and supplementary insurance costs are 192 Euros (10.1%) lower for the CAM group of patients.

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (Table 3) provide the same lower costs for the CAM group of patients as found in the linear analyses (Table 2). In addition, higher paramedic costs are found for the CAM group of patients.

Costs per age category and insurance category

Lower total compulsory costs were found in all age categories (Table 2): 80 Euro (95% CI: 21 – 140; p < 0.01) in the first group (0-24 years); 137 Euros (95% CI: 54 – 219; p < 0.01) in the second group (25 – 49 years); 356 Euros (95% CI: 227 – 485; p < 0.001) in the third group (50 – 74 years), and 236 Euros (95% CI: -9 – 481; p < 0.1) in the last group (75+ years). Lower pharmaceutical costs were found in the second age group (25 – 49 years) (50 Euros; 95% CI: 23 – 77; p < 0.001) and the third age group (50 – 74 years) (126 Euros; 95% CI: 88 – 164; p < 0.001). Lower hospital costs were found in all age groups, with the largest differences in the third age group (50 – 74 years) (232 Euros; 95% CI: 124 – 341; p < 0.001) and the last age group (75+ years) (219 Euros; 95% CI: 7 – 431; p < 0.05). In addition, the largest difference in total compulsory costs was found in the last year of life (1,161 Euros; 95% CI: -138 – 2461; p < 0.1), which is completely the result of lower hospital costs (1,250 Euros; 95% CI: 19 – 2481; p < 0.05).

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (Appendix 2. Table 4) provide the same lower costs for the separate age groups of CAM patients as found in the linear analyses (Table 2). In addition, now there are

also significant lower costs for the CAM group of patients with regard to GP costs in the third age group (50 – 74), lower pharmaceutical costs in the first (0 – 24) and the last age group (75+); and higher paramedic costs in the second (25 – 49) and third (50 – 74) age group.

Table 2. Estimated differences in mean annual total compulsory and supplementary insurance costs: CAM patients compared to CON patients (linear regression model)

	Compulsory insurance costs					Supplementary insurance costs
	Total	GP	Pharmaceutical	Hospital	Paramedic	
All ages	-225***	-3***	-58***	-165***	1	33***
0-24	-80***	-3***	-2	-74***	-2	11***
25-49	-137***	-2**	-50***	-85**	1	32***
50-74	-356***	-1	-126***	-232***	3	52***
75+	-236*	11***	-38	-219**	10	24***
Last year of life	-1,161*	5	67	-1,250**	27	3

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Mortality rates

In the present dataset, the only information available on health outcomes is mortality. During the period 2006-2011 80,543 patients died in the CON group (5.26%) and 973 in the CAM group (5.14%). After controlling for all relevant variables (age, postal codes, etcetera), we find that patients with a CAM GP have significantly lower mortality rates in all LMP analyses (Table 3). However, the differences are very small: total group: 0.004 (95% CI: 0.001 – 0.007; $p < 0.05$); men: 0.004 (95% CI: 0.001 – 0.008; $p < 0.1$); women: 0.007 (95% CI: 0.003 – 0.011; $p < 0.05$). The Logit analyses resulted in a significantly higher mortality rate for the total group at the 10% level (but not at the 5% level) (0.066; 95% CI: -0.143 – 0.011; $p < 0.1$), but no significant differences for men and women separately. The Cox proportional hazard analyses resulted in significant higher mortality rates at the 10% level (but not at the 5% level), both for the total group: 1.059 (95% CI: 0.994 – 1.129; $p < 0.1$), and the group of women: 1.072 (95% CI: 0.987 – 1.165; $p < 0.1$), but no significant difference for men were found.

Based on all results, taking into account the small differences in the LPM analyses, the high p-values ($p < 0.1$) in the Logit and Cox proportional hazard analyses and the contradictory outcomes between the LPM analyses on the one hand and the Logit and Cox proportional hazard analyses on the other hand, we conclude that there is no difference in mortality rates between the CON and CAM group of patients.

Table 3. Differences in mortality rates: CAM patients compared to CON patients

	Total	Men	Women
LPM with fixed effects	-0.004**	-0.004*	-0.007**
Logit with fixed effects	0.066*	0.081	0.049
Cox proportional hazard	1.059*	1.043	1.072*

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Conclusions

The comparison of the healthcare costs of insurees of CON GPs and CAM GPs in a database with data of 1,540,635 patients from the Dutch insurance company Agis during the period 2006-2011 demonstrates:

1. On average annual total compulsory and supplementary healthcare costs of patients treated by a CAM GP are 192 Euros (10.1%) lower than the costs of patients treated by conventional GPs as a result of 225 Euros (12.4%) lower compulsory costs and 33 Euros (44%) higher supplementary costs.
2. The lower mean annual total compulsory healthcare costs are mainly due to lower hospital care costs (165 Euros) and lower pharmaceutical care costs (58 Euros).
3. Lower mean annual total compulsory healthcare costs are demonstrated in all age categories, but the differences are largest in the third age group (50 – 74 years) (total costs: 356 Euros; hospital care: 232 Euros; pharmaceutical care: 126 Euros) and in the last year of life (total costs: 1,093 Euros; hospital care: 1,223 Euros).
4. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a CON GP.

Discussion

In this study the mean annual total compulsory costs, supplementary costs, costs during the last year of life and mortality rates of patients with a conventional (CON) GP (n = 1.52 million; 98.8%) and patients with GPs that know complementary and alternative medicine (CAM) (n = 18,862; 1.2%) were compared in a dataset from the Dutch insurance company Agis over a six year period (2006 – 2011) by means of regression analyses. The mean annual compulsory healthcare costs of patients treated by a conventional GP are 1,821 Euros (95% CI: 1,813 – 1,828). On average annual total compulsory healthcare costs of patients treated by a CAM GP are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12.4%) lower than patients treated by conventional GPs. Lower total compulsory costs were found in all age categories. Lower pharmaceutical costs were found in the second age group (25 – 49 years) (50 Euros; 95% CI: 23 – 77; $p < 0.001$) and the third age group (50 – 74 years) (126 Euros; 95% CI: 88 – 164; $p < 0.001$). Lower hospital costs were found in all age groups. The largest difference in total compulsory costs was found in the last year of life (1,161 Euros; 95% CI: -138 – 2461; $p < 0.1$), which is completely the result of lower hospital costs (1,250 Euros; 95% CI: 19 – 2481; $p < 0.05$). The mean annual supplementary insurance costs of patients treated by a

conventional GP are 75.3 Euros (95% CI: 75.1 – 75.5). On average annual supplementary healthcare costs of patients treated by a CAM GP are 33 Euros (95% CI: 31 – 37; $p < 0.001$) (44%) higher. The absolute lower compulsory costs for all patients for the six years period (2006 – 2011) for the CAM group is 25,463,700 Euros (or on average 4,243,950 Euros per year) compared to the CON group. The extrapolation of the lower costs in the CAM group of patients to the Dutch population (16.8 million inhabitants), if applicable, would result in 3.78 billion Euros lower annual compulsory costs. The absolute lower compulsory and supplementary costs for all patients for the six years period (2006 -2011) for the CAM group is 21,729,024 Euros (or on average 3,621,504 Euros per year) compared to the CON group. The extrapolation of the lower costs in the CAM group of patients to the Dutch population (16.8 million inhabitants), if applicable, would result in 3.23 billion Euros lower annual compulsory and supplementary costs. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a conventional GP.

The first strength of the study is the large sample size of patients and practices. Approximately 9.2% of the Dutch population (1.54/ 16.8 million), and 29.7% of the insurees of Achmea (1.54/ 5.18 million) were included in the study. Compared to the first pilot study [11] there were 10 times more patients from a CON GP (151,952 versus 1,521,773), three times more patients from a CAM GP (5,922 versus 18,862), 4,5 times more CON GP practices (1,913 versus 9,016) and about 1,5 times more CAM practices (79 versus 110). This large sample size allows a more precise estimate of costs and mortality rate differences and increases the representativeness of the sample and the generalizability of the results [13]. The second strength is that the results are based on a relatively long period of six years, also contributing to more precise estimations, and better representativeness and generalizability of the results. Thirdly, this study, unlike the first pilot study [11], distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to CAM. The first limitation of the study is that it did not compare two treatments (CON versus CAM) for a specific indication, in a controlled setting with other health related outcome parameters than mortality, reducing the ability to detect causal relationships between interventions and (cost)effects. Missing information includes costs of out-of pocket expenses, morbidity, work absence, objective disease related outcome measures, subjective health and patient satisfaction. A second limitation is, contrary to the first pilot study [11], that we were not able to analyse at the level of the 6-digit postcode but only at the level of the 4-digit postcode. As a result, the results might not be optimally

controlled for socio-economic status of the patients. However, a reanalysis of the data of the first pilot study [11] demonstrated very small differences in results between the analyses with the 6-digit postcode and the analyses with the 4-digit postcode. Another limitation of the study concerns the limited dataset, since the dataset is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most GP practices (64%) were anthroposophic). These facts challenge the generalizability of the results.

The current results with regard to differences in healthcare costs confirm the results of our first smaller pilot study [11] with only 153,000 insurees and observations during a four-year period. In addition, the current study with 10 times as many patients and a two-year longer period of observations, enabled to estimate the cost differences more precisely. Whereas in this first study estimation of mean annual total compulsory costs of CAM patients were in the range of 0 – 30% lower than these of patients of CON GPs, the mean cost differences are now estimated to be 12.4% lower (range: 9.3 – 15.4%) for the CAM group. Like in the first study, the lower total compulsory costs are mainly the result from lower hospital and pharmaceutical costs. Lower costs for CAM in this study are also in line with the results of the recent review of Herman et al. [10] on economic evaluation of CAM and CIM, demonstrating that 29% of comparisons made in the 56 higher-quality studies showed a health improvement with cost savings for the CIM therapy versus usual (conventional) care. Since most CAM patients in the current study were treated in an anthroposophic practice, comparison with other economic studies on anthroposophic medicine (AM) is justified. Kienle et al. [13,15] reviewed the few economic investigations on AM, demonstrating less or equal costs in AM compared to CON treatment, due to reduced hospital admissions and less prescriptions of medications. Hamre et al. [15] found that in patients starting anthroposophic therapies for chronic disease, total healthcare costs did not increase in the first year, and were significantly reduced in the second year by 416 Euros (95% CI: 264 – 960) compared to the pre-study year. This reduction was largely explained by a decrease of inpatient hospitalisation. With regard to differences in mortality rates between CON and CAM patients, the results do not confirm the (weak) evidence of lower mortality rates that were found in the first study [11]. The conclusion is now that CAM patients do not have lower or higher mortality rates than CON patients.

With regard to the healthcare costs differences reported in the Results section, we can hypothesize four types of explanations. First, the differences could be due to selection on unobservables in patients' GP choice. For example, patients who are healthier and more

health-conscious or patients with a strong preference to minimize exposure to medical interventions might be more likely to choose a CAM GP. In both cases, costs will be lower due to lower demand for healthcare. A standard approach to control for selection on unobservables in a non-experimental setting is to use Instrumental Variables (IV). A potential instrumental variable in this case is the distance between a patient's home and the various GPs, cq. a change in distance as a result of a move of a patient or practice. We intend to explore this approach in future work. With respect to selection, several studies that compare the health status of patients treated in CAM and in conventional medicine in primary care settings find that patients treated in CAM practices suffer more often from severe and chronic illnesses (e.g., [16, 17]). This suggests that if we could control for severity and chronicity of illnesses (with additional data), the estimated compulsory cost differences might be larger. Second, the results could be due to undertreatment by CAM GPs. In the present dataset, we were only able to analyse mortality and found that patients with a CAM GP tend to have equal mortality rates. However, a number of studies have reported that patients seeking CAM or anthroposophic care have longer lasting and more severe health problems than patients in conventional care. At the same time, these patients report fewer adverse side effects of treatments and higher patient satisfaction (e.g., [16-18]). These findings combined with the results in this study provide some indication that undertreatment by CAM GPs is unlikely. Firmer conclusions require more detailed data on outcomes. Thirdly, the results could be due to better practices of CAM due to a stronger focus on preventive and curative health promotion, less overtreatment and better communication and professional relationships. For example, a CAM GP might try a low-cost CAM treatment first. As mentioned, the primary professional orientation of CAM doctors is to strengthen the self-healing capacity of the body and the self-management of the patient. This approach is associated with prescribing fewer conventional pharmaceuticals, tests and operations. Nissen et al. [19, p. 14], based on a review of the literature on citizens' attitudes and needs concerning CAM in Europe, concluded that 'many citizens in Europe value the practice of CAM, particularly the CAM provider-patient relationship, and the patient-centred and holistic approach aspired to by many CAM providers.' Van Dulmen [20] concluded in a Dutch study comparing patients visiting conventional general practitioners (GPs) and three types of CAM GPs (homeopathy, acupuncture and naturopathy), that, contrary to expectations, patients do not consult a CAM physician because they are disappointed with mainstream GP care. CAM patients primarily appear to be seeking a physician who takes the time to talk with them and who will treat their complaints from a holistic viewpoint. Ernst and Hung [21] described the published evidence

on the expectations of CAM users (in order of prevalence): hope to influence the natural history of the disease; disease prevention and health/ general well-being promotion; fewer side effects; being in control over one's health; symptom relief; boosting the immune system; emotional support; holistic care; improving quality of life; relief of side effects of conventional medicine; positive therapeutic relationship; obtaining information; coping better with illness; supporting the natural healing process; and the availability of treatment. In addition CAM GPs might focus more on the relationship and communication. For example Esch et al. [16] found that AM patients appreciated that their physicians listened to them (80.0% vs. 67.1%, $p < 0.001$), spent more time (76.5% vs. 61.7%, $p < 0.001$), had more interest in their personal situation (74.6% vs. 60.3%, $p < 0.001$), involved them more in decisions about their medical care (67.8% vs. 58.4%, $p = 0.022$), and made it easy to tell the physician about their problems (71.6% vs. 62.9%, $p = 0.023$). AM patients gave significantly better rating as to information and support (in 3 of 4 items $p < 0.05$) and for thoroughness (70.4% vs. 56.5%, $p < 0.001$). AM patients showed significantly higher treatment satisfaction in all of the five items than CON patients. These results are consistent with other studies demonstrating high patient satisfaction with AM [13,14]. For instance, in a Dutch survey (Consumer Quality Index, a national standard to measure healthcare quality from the perspective of healthcare users), 2.099 patients reported very high satisfaction with anthroposophic GP practices (8.4 and 8.3 on a scale: 0-10, 10 indicating the best possible score) [18]. These results are consistent with AM theory, which emphasizes relationship and communication, as well as shared decision-making [14]. More AM patients expressed a general treatment satisfaction (56.1% vs. 43.4%, $p < 0.001$) and saw their expectations completely fulfilled at follow-up (38.7% vs. 32.6%, $p < 0.001$). AM patients reported significantly fewer adverse side effects (9.3% vs. 15.4%, $p = 0.003$), and more other positive effects from treatment (31.7% vs. 17.1%, $p < 0.001$). Fourthly, the lower costs could be related to the fact that patients interested in CAM might have higher out-of-pocket expenses since not all CAM treatments are covered by supplementary insurance. Clarifying the role of out-of-pocket expenses is an empirical issue that requires additional data.

The major implication of this study and other economic evaluations of CAM is that there is sufficient evidence now to justify more professional interest in CAM from conventional healthcare professionals and policymakers. We can also conclude that there is sufficient good evidence that CAM can be cost-effective compared to conventional medicine, that the contribution of CAM might result in substantial diminishing of healthcare costs and

therefore can provide a contribution to national healthcare policies aiming at controlling and diminishing healthcare expenditures. Therefore more investment in the study of the cost-effectiveness of CAM modalities with their additional health promotion medicines and therapies is indicated. The main unanswered questions in the current study are: where do the cost differences come from (to which indications and which therapies do they pertain to?) and what are the health-related effects of CAM treatment (objective parameters (e.g. lowering of blood pressure), quality of life, patient-reported outcomes, sick-leave, etc.)? Future research should therefore focus on and (1) exploring to what extent selection on unobservables and causal effects explain the lower costs of patients with a CAM GP, (2) exploring in more depth the costs differences between patients of CON GPs and CAM GPs in order to develop adequate, testable hypothesis of cost-effectiveness of specific CAM treatment for specific indications, and to transfer the cost differences related knowledge from CAM to CON GP practices in order to diminish healthcare expenditures in CON practices; (3) designing and executing highly controlled, comparative effectiveness research projects [22] with more health related outcome parameters than mortality rate only; (4) replication studies based on similar, large datasets with other CAM modalities (acupuncture, TCM herbal treatment, etc.) and with other insurance companies to explore and confirm the present results;

Acknowledgements

We would like to thank Agis (Achmea) and especially Dr. Hugo Smeets and Mr. Henk Evers for providing the dataset for the study.

Competing interests

We have read and understood the BMJ Group policy on declaration of interests and declare the following interests:

- Dr. Erik W. Baars receives a part of his salary from the Professorship Anthroposophic Healthcare of the University of Applied Sciences Leiden, The Netherlands. The professorship works closely with those in the AH professional field and works on practical problems using applied research which focuses on three main categories: (1) investigating efficacy and safety, (2) developing and delivering optimal quality, and (3) improving communication about AH.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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Contributors

PK was the project lead for the statistical analyses. EB and PK wrote the manuscript. All authors reviewed the manuscript and contributed to manuscript revisions. EB is the guarantor for this study.

Funding

The only financial support for the study was provided by the Stichting Triodos Foundation. These financial resources were only used to cover the costs of Achmea for providing the dataset for the study. The researchers did not receive any funding for salaries or other costs.

Role of the study sponsors

Not applicable.

Statement of independence of researchers from funders

Funders played no part in article selection, analysis, interpretation, or decision to publish.

Data sharing

Details of how to obtain additional data from the study can be obtained from EB (baars.e@hsleiden.nl).

Previous publication

A part of the content of our study results was published in February 2014 as a Dutch article in the Dutch journal Economisch Statistische Berichten for economists in The Netherlands [23].

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A six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM GPs

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Abstract

Objectives To compare healthcare costs and mortality rates of Dutch patients with a conventional (CON) general practitioner (GP) and patients with a GP who has additionally completed training in complementary and alternative medicine (CAM).

Design Comparative economic evaluation.

Setting Database from the Dutch insurance company Agis.

Participants 1,521,773 patients (98.8%) from a CON practice and 18,862 patients (1.2%) from a CAM practice.

Main outcome measures Annual information on five types of healthcare costs for the years 2006 – 2011: care by GP, hospital care, pharmaceutical care, paramedic care and care covered by supplementary insurance. Healthcare costs in the last year of life. Mortality rates.

Results The mean annual compulsory and supplementary healthcare costs of CON patients are respectively 1,821 Euros (95% CI: 1,813 – 1,828) and 75.3 Euros (95% CI: 75.1 – 75.5). Compulsory healthcare costs of CAM patients are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12,4%) lower and result mainly from lower hospital care costs (165 Euros) (95% CI: 118 – 212; $p < 0.001$) and lower pharmaceutical care costs (58 Euros) (95% CI: 41 – 75; $p < 0.001$), especially in the age categories 25 – 49 years and 50 – 74 years. The costs in the last year of life of patients with CAM GPs are 1,161 euro (95% CI: -138 – 2,461; $p < 0.1$) lower. This difference is entirely due to lower hospital costs (1,250 Euros) (95% CI: 19 – 2,481; $p < 0.05$). The mean annual supplementary costs of CAM patients are 33 Euros (95% CI: 30 – 37; $p < 0.001$) (44%) higher. CAM patients do not have lower or higher mortality rates than CON patients.

Conclusions Dutch patients whose GP additionally completed training in CAM on average have 192 Euros (10.1%) lower annual total compulsory and supplementary healthcare costs and do not live longer or shorter than CON patients.

Strengths and limitations of this study

- The study is based on a large sample size of patients and practices and a relatively long period of six years contributing to more precise estimations, and better representativeness and generalizability of the results.
- The study distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to CAM.
- The study did not compare two treatment (conventional versus CAM) for a specific indication, in a controlled setting with other health related outcome parameters than mortality, reducing the ~~prohibiting the possibility~~ ability to detect causal relationships between interventions and (cost)effects.
- Since the analyses were at the level of the 4-digit postcode and not at the level of the 6-digit postcode, the results might not be optimally controlled for socio-economic status of the patients.
- The study concerns a limited dataset, since the dataset is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most GP practices (64%) were anthroposophic). These facts challenge the generalizability of the results.

Introduction

In most countries of the European Union the annual healthcare costs are rising faster than the economy [1]. Therefore, national healthcare policies are increasingly aiming at controlling and diminishing healthcare expenditures. This also applies to the situation in The Netherlands [2]. In 1972 8% of the Dutch national income (GDP) was used to finance public healthcare. In 2010 already 13% of GDP was used and The Netherlands were worldwide in second place of healthcare expenditures of countries. Without drastic measures, the estimated costs will be over 30% in 2040 [3]. Public spending on healthcare will rise from 61 billion Euros in 2012 to an estimated nearly 80 billion Euros in 2017 [4]. Dutch health economists and policy makers have largely ignored the possible contribution of Complementary and Alternative Medicine (CAM) and Integrative Medicine (IM) to the reduction of healthcare costs as an area of research and interest. The here presented economic study, a six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM general practitioners (GPs), contributes to the development of an evidence-based Dutch policy with regard to the role of CAM and IM in the reduction of healthcare expenditure growth.

The Dutch financing system

The Dutch financing system contains two basic compulsory health insurances, that are for 80% paid for through~~by~~ income taxes: for curative care (Zorgverzekeringswet (ZvW)) and for long-term care (Algemene Wet Bijzondere Ziektekosten (AWBZ)). The compulsory health insurances cover costs of most of ~~all~~ GP, pharmaceutical and hospital care and ~~a part~~ some ~~of~~ paramedic care ~~(until a certain amount)~~. In addition, people in The Netherlands can buy supplementary insurance. ~~The primary goal of s~~Supplementary insurance ~~is to~~ covers costs not covered by basic insurance (for example specific or additional paramedic treatment, complementary therapies) (e.g., costs of CAM treatment is paid for up to 500 Euros/ year) [5]. Many supplementary insurances cover costs of CAM treatments like anthroposophic medicine, acupuncture and homeopathy. ~~The second goal of the s~~Supplementary insurance ~~is to cover the~~ can also cover costs of improvements over the standard level of care paid for by compulsory insurance (e.g., extra costs for a better room and service in case of hospitalisation).

Policies to reduce healthcare expenditure growth

The vast majority of expenditure growth is due to innovations in healthcare. The Cultureel Planbureau (CPB) anticipates that the total costs of curative care will rise from 36 billion Euros this year to 49 billion Euros in 2017. The rising costs of curative care, according to the CPB is largely due to the 'creeping expansion' of the compulsory health insurance; 'Year after year, new medical techniques and drugs appear on the market that are often better, but also more expensive', especially, since more patients will be treated with the new techniques [3]. Of the total growth of public healthcare expenditure, about a quarter is the result of aging. In 2040 more than 22% of the Dutch population will be older than 65, whereas currently this is 16%. As people grow older, on average the costs of healthcare will increase (on the level of the whole older population).

Which policies can be deployed to control the risk of rising costs? The measures aimed at reducing healthcare expenditures are, without being complete: more efficiency and higher productivity in healthcare (including reducing management layers), more competition between healthcare institutions, fewer hospitals (specialization and concentration), more 'neighbourhood care' by general practitioners (GPs), more remote care (e-health), preventing overtreatment/ less (extra) care, more responsible behaviour of consumers (more self-care), more emphasis on healthy living (prevention), higher co-payments, higher deductibles and already saving for higher health-care expenditure in the old days (precautionary savings) [3].

In July 2013 the Dutch healthcare minister Schippers reached an agreement with hospitals, medical specialists, mental healthcare providers, general practitioners, health insurers and patients' organizations to reduce the growth rate of healthcare spending: to 1.5% in 2014 and 1% per year from 2015 to 2017. This reduction represents a total additional savings of approximately 1 billion Euros. To achieve the reduced expenditure growth, extra measures will be taken that increase the efficiency and improve the quality of care: more care of medical specialists goes to the GP and from the GP to self-care; concentration of complex care; tighter application of medical guidelines and care standards; treatments are given according the standards of the medical profession itself; access to the claims of the compulsory health insurances is tightened; and more transparency about quality and cost of care [6].

The contribution of Complementary and Alternative Medicine

According to the National Center for Complementary and Alternative Medicine (NCCAM), CAM is a group of diverse medical and healthcare systems, practices, and products that are not generally considered part of conventional medicine [7]. The Cochrane Collaboration definition of complementary medicine is that it includes all such practices and ideas that are outside the domain of conventional medicine in several countries and defined by its users as preventing or treating illness, or promoting health and well-being. These practices complement mainstream medicine by satisfying a demand not met by conventional practices and diversifying the conceptual framework of medicine [8]. "Integrative Medicine is the practice of medicine that reaffirms the importance of the relationship between practitioner and patient, focuses on the whole person, is informed by evidence, and makes use of all appropriate therapeutic approaches, healthcare professionals and disciplines to achieve optimal health and healing." [9] In addition, IM emphasizes the active role of the patient in prevention (lifestyle), well-being and therapy and healing processes, and the use of healing environments [9].

Herman et al. [10] performed a systematic review of economic evaluations on complementary and integrative medicine (CIM). This study identified 338 economic evaluations of CIM, including 114 full evaluations, published between 2001 and 2010. All recent (and likely most cost-relevant) full economic evaluations published from 2001 to 2010 were subjected to several measures of quality. Detailed results of higher-quality studies were reported. The cost-utility analyses found were of similar or better quality to those published across all medicine. Of the 56 comparisons made in the higher-quality studies, 16 (29%) show a health improvement with cost savings for the CIM therapy versus usual (conventional) care. Study quality of the cost-utility analyses (CUAs) of CIM was generally comparable to that seen in CUAs across all medicine according to several measures, and the quality of the cost-saving studies was slightly, but not significantly, lower than those showing cost increases (85% vs 88%, $p = 0.460$).

In The Netherlands, a few percent of the GPs have followed an additional training in CAM. In 2010, we performed an initial ~~first~~ economic evaluation, comparing the healthcare costs of patients from Dutch conventional (CON) GPs and CAM GPs [11]. A dataset from a Dutch health insurer Azivo was used containing quarterly information on healthcare costs (GP care, hospital care, pharmaceutical care, and paramedic care), dates of birth and death (if applicable), gender and 6-digit postcode of all approximately 150,000 insurees, for the years 2006–2009. Data from 1,913 conventional GPs were compared with data from 79 GPs with

additional CAM training in acupuncture (n=25), homeopathy (n=28), and anthroposophic medicine (n=26). Results were that patients whose GP has additionally completed training in CAM training had 0–30% lower healthcare costs and mortality rates, depending on age groups and type of CAM. The lower costs resulted from fewer hospital stays and fewer prescription drugs. It was concluded that more controlled studies (replication studies, research based on more comprehensive data, cost-effectiveness studies on CAM for specific diagnostic categories) were indicated.

This study

Given the current need to diminish healthcare expenditures in The Netherlands and based on the positive results from both the review of Herman et al. [10] and our own study [11], we decided to perform a replication study comparing the healthcare costs of patients from conventional (CON) GPs and CAM GPs with a larger dataset from a Dutch health insurer, to analyse the robustness of the results of the first study. The research questions of the study were:

1. Is there a statistically significant difference in healthcare costs (care by GP, hospital care, pharmaceutical care, paramedic care, care covered by supplementary insurance, and healthcare costs in the last year of life) of patients from CON GPs and CAM GPs?
2. Is there a statistically significant difference in mortality rates of patients from CON GPs and CAM GPs?

Methods

Comparative economic evaluation

Full economic evaluations compare the costs (resource use) associated with one or more alternative interventions (e.g., intervention X versus comparator Y) with their consequences (outcomes, effects). In this study we were able to measure five types of costs in two categories: (1) care covered by compulsory insurance: care by GP, hospital care, pharmaceutical care, paramedic care, and (2) costs covered by supplementary insurance.

Alternative interventions were: conventional GP care compared to care from GPs that know CAM. Outcomes were: differences in healthcare costs and annual mortality rates.

Model overview

Costs were analysed at the patient level using linear and loglinear regression analysis. The cost analysis has been performed for the total sample, as well as separately for the age groups 0–24, 25–49, 50–74, and ≥ 75, given the large average differences in health and healthcare needs across age groups. Effects on mortality rates are analysed using a linear probability model (LPM), a Logit model, and a Cox proportional hazard model (CPH). In all models, the explanatory variables are gender, age (linear, within each age category), dummies for CAM and 'Vogelaarwijk' (city areas with known lower socio-economic status of inhabitants), year dummies, and postal code fixed effects. In the cost regressions and the LPM model, fixed effects at the 42-digit insuree postcode level were controlled for. In the Logit and CPH model 2-digit postcode level fixed effects were included, as estimation with more detailed fixed effects appeared to be numerically infeasible.

The regression approach is standard practice in health economics and yields results similar to those of matching procedures (both are unable to correct for unobserved differences between groups of patients). Given the large sample sizes Students' t tests are asymptotically valid by virtue of the central limit theorem, independent of whether the underlying distributions are normal or non-normal. Standard errors are clustered at the level of the insured to control for the statistical dependence of observations pertaining to a given insured person (i.e. observations are independent 'between' individuals but dependent 'within' individuals).

With regard to the six years of data the data set was used as a panel. This means that if an insured person is observed for all six years, six observations of annual costs of this person are used in the analysis (taking into account the 'within'-person correlation by clustering standard errors at the level of the individual). The reported differences can be interpreted as the average of cost differences across years. Any trends are controlled for by the year dummy variables.

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Dataset on healthcare costs and demographics

A dataset was analyzed from health insurer Agis, a subsidiary company of Achmea. Achmea has a share in the market of 31% (5.18 million insured) of the Dutch population in 2013; while the share of Agis is 9,2% (1.54 million insured) The dataset contains quarterly information on the healthcare costs of all Agis insurees, which was aggregated to annual information for the years 2006 up to 2011. In addition, it contains the date of birth of the insuree, date of death (if applicable), gender, and 4-digit postcode of the insured's residence. For each insuree year combination, information on the costs of five different types of care is available: care by GP, hospital care, pharmaceutical care, paramedic care (like physical therapy), and care covered by supplementary insurance.

General practitioners and patients

The dataset also contains the names and addresses of the general practitioners who have patients who are insured by Agis, which allows us to distinguish between CON GPs and CAM GPs. We defined a general practitioner as anthroposophic CAM GP if his or her name appears in the list of general practitioners with additional training in anthroposophic medicine (AM) as provided by their professional association [14]. CAM GPs with homeopathy (HOM) [15] and CAM GPs with acupuncture [16] are defined similarly.

Patients were regarded CON patients and CAM patients if they were patient of respectively a CON GP or a CAM GP during all of the years they appear in the dataset. Patients that transferred from a CON GP to a CAM GP or vice versa , were regarded to be a member of a third group called 'Switchers' and were excluded from all analyses.

Statistical analyses

Significance of coefficients is tested using Student t tests, with clustering of standard errors at the level of the insured. Given the large sample sizes available here, asymptotic t-testing for differences in means is appropriate by virtue of the central limit theorem. Calculations were made using StataSE 10.0. Means with 95% confidence intervals and p-values (< 0.1, < 0.05, and < 0.01) are presented.

Ethical approval

Since the study involved no experimental treatment, patients were not recruited. Since patient data were anonymized, no ethical approval was necessary.

Results

GP practices and patients

The dataset contained 9,126 GP practices: 9,016 CON practices and 110 CAM practices. Due to the systematics of the insurance company, one individual GP can appear as different practices, so the actual number of GPs is lower than the number of GP practices. Contrarily, each patient is never counted more than once. The majority of the CAM GPs are anthroposophic GPs (70 AM practices (64%~~) with 17,257 patients (91%)~~). Other CAM GPs were specialized in acupuncture (15%) and homeopathy (25%). Since some GPs were specialized in more than one CAM modality the total percentage of CAM GPs is larger than 100%. Exact numbers and percentages of CAM GPs vary a little over the years.

Healthcare costs

The dataset

The dataset contains information of more than 1.5 million insurees during the years 2006-2011 (Table 1). Nearly 19,000 insurees (1.2%) had throughout this whole period a CAM GP. More than 10,000 other insurees had in some years a CON GP and in other years a CAM GP ('Switchers'). On average, the Switchers group had three years a CON GP and three years a CAM GP. The insurees had a mean age of 41.0 (SD=23.5). 53% are women. These patients live in 4,014 different 4-digit postal codes.

Without controlling for relevant differences between the groups, the comparison demonstrates: higher percentages of females in in the CAM GP and Switchers groups; higher percentages of insurees living in the 'Vogelaarwijk' in the CON and Switchers group; 183 Euros lower and 168 Euros higher total compulsory costs in respectively the CAM and the Switchers group; and 40 Euros and 25 Euros higher supplementary costs in costs in respectively the CAM and the Switchers group. The percentages of patients with a supplementary insurance were almost the same (CON GPs: 92.7%; CAM GPs: 93.4% and Switchers: 92.1%).

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Since the aim of the study was to compare the costs of patients with a CON GP and a CAM GP, the data of the Switchers group were left out of the further regression analyses (Appendix 1).

Table 1. Descriptive statistics of the dataset

	CON GP	CAM GP	Switchers
Insuredes (n)	1,521,773	18,862	10,769
Age (year)	41.0	41.6	40.1
Female (percentage)	52.9%	55.2%	56.4%
'Vogelaarwijk' (percentage)	15.7%	9.3%	17.1%
Supplementary insured (percentage)	92.7%	93.4%	92.1%
Compulsory insurance costs (Euros)			
Total costs	1,821	1,638	1,989
GP costs	133	128	140
Pharmaceutical costs	402	357	474
Hospital costs	1,242	1,104	1,328
Paramedical costs	44	48	47
Supplementary insurance costs (Euros)	75	115	100
~~Insurees (n)~~	~~1,521,773~~	~~18,862~~	~~10,769~~

Annual total compulsory and supplementary insurance costs

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The mean annual total costs of patients treated in CON practices covered by the compulsory insurance were 1,821 Euros (95% CI: 1,813 – 1,828) (Table 1). After correction for observed

differences between the groups by means of linear regression analyses, the mean annual total compulsory insurance costs of patients of CAM GP practices are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12.4%) lower. These lower costs are mainly due to lower hospital costs (165 Euros; 95% CI: 118 – 212; $p < 0.001$) and lower pharmaceutical care costs (58 Euros; 95% CI: 41 – 75; $p < 0.001$).

The mean annual total supplementary costs for patients treated in CON practices were 75.3 Euros (95% CI: 75.1 – 75.5). (The mean is calculated over all patients, including those (less than 8%) without supplementary insurance.) For patients treated in CAM practices these costs are 33 Euros (95% CI: 31 – 37; $p < 0.001$) (44%) higher and were highest in the third age group (50 – 74 years) (52 Euros (95% CI: 31 – 37; $p < 0.001$). Taken together, the mean total annual compulsory and supplementary insurance costs are 192 Euros (10.1%) lower for the CAM group of patients.

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (Table 3) provide the same lower costs for the CAM group of patients as found in the linear analyses (Table 2). In addition, higher paramedic costs are found for the CAM group of patients.

Costs per age category and insurance category

Lower total compulsory costs were found in all age categories (Table 2): 80 Euro (95% CI: 21 – 140; $p < 0.01$) in the first group (0-24 years); 137 Euros (95% CI: 54 – 219; $p < 0.01$) in the second group (25 – 49 years); 356 Euros (95% CI: 227 – 485; $p < 0.001$) in the third group (50 – 74 years), and 236 Euros (95% CI: -9 – 481; $p < 0.1$) in the last group (75+ years). Lower pharmaceutical costs were found in the second age group (25 – 49 years) (50 Euros; 95% CI: 23 – 77; $p < 0.001$) and the third age group (50 – 74 years) (126 Euros; 95% CI: 88 – 164; $p < 0.001$). Lower hospital costs were found in all age groups, with the largest differences in the third age group (50 – 74 years) (232 Euros; 95% CI: 124 – 341; $p < 0.001$) and the last age group (75+ years) (219 Euros; 95% CI: 7 – 431; $p < 0.05$). In addition, the largest difference in total compulsory costs was found in the last year of life (1,161 Euros; 95% CI: -138 – 2461; $p < 0.1$), which is completely the result of lower hospital costs (1,250 Euros; 95% CI: 19 – 2481; $p < 0.05$).

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (~~Table 3~~Appendix 2. Table 4) provide the same lower costs for the separate age groups of CAM patients as found in the linear analyses (Table 2). In addition, now there are also significant lower costs for the CAM group of patients with regard to GP costs in the third age group (50 – 74), lower pharmaceutical costs in the first (0 – 24) and the last age group (75+); and higher paramedic costs in the second (25 – 49) and third (50 – 74) age group ~~(Table 3)~~.

Table 2. Estimated differences in mean annual total compulsory and supplementary insurance costs: CAM patients compared to CON patients (linear regression model)

	Compulsory insurance costs					Supplementary insurance costs
	Total	GP	Pharmaceutical	Hospital	Paramedic	
All ages	-225***	-3***	-58***	-165***	1	33***
0-24	-80***	-3***	-2	-74***	-2	11***
25-49	-137***	-2**	-50***	-85**	1	32***
50-74	-356***	-1	-126***	-232***	3	52***
75+	-236*	11***	-38	-219**	10	24***
Last year of life	-1,161*	5	67	-1,250**	27	3

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

~~Table 3. Estimated differences in mean annual total compulsory and supplementary insurance costs: CAM patients compared to CON patients (loglinear regression model)~~

		~~Compulsory insurance costs~~					~~Supplementary insurance costs~~
		~~Total~~	~~GP~~	~~Pharmaceutical~~	~~Hospital~~	~~Paramedic~~	
~~All ages~~		~~-.114***~~	~~-.121***~~	~~-.281***~~	~~-.185***~~	~~.028**~~	~~.496***~~
	~~*0-24*~~	~~-.071***~~	~~-.018**~~	~~-.169***~~	~~-.152***~~	~~.017~~	~~.344***~~
	~~*25-49*~~	~~-.088***~~	~~-0.14**~~	~~-.267***~~	~~-.153***~~	~~.021*~~	~~.433***~~
	~~*50-74*~~	~~-.173***~~	~~-.025***~~	~~-.418***~~	~~-.220***~~	~~.036*~~	~~.653***~~

	75+	-.072**	.026*	-.176***	-.124**	.055	.355***
Last year of life		-.146**	.026	-.143	-.287**	.178	.134
*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01							

Mortality rates

In the present dataset, the only information available on health outcomes is mortality. During the period 2006-2011 80,543 patients died in the CON group (5.26%) and 973 in the CAM group (5.14%). After controlling for all relevant variables (age, postal codes, etcetera), we find that patients with a CAM GP have significantly lower mortality rates in all LMP analyses (Table 34). However, the differences are very small: total group: 0.004 (95% CI: 0.001 – 0.007; $p < 0.05$); men: 0.004 (95% CI: 0.001 – 0.008; $p < 0.1$); women: 0.007 (95% CI: 0.003 – 0.011; $p < 0.05$). The Logit analyses resulted in a significantly higher mortality rate for the total group at the 10% level (but not at the 5% level) (0.066; 95% CI: -0.143 – 0.011; $p < 0.1$), but no significant differences for men and women separately. The Cox proportional hazard analyses resulted in significant higher mortality rates at the 10% level (but not at the 5% level), both for the total group: 1.059 (95% CI: 0.994 – 1.129; $p < 0.1$), and the group of women: 1.072 (95% CI: 0.987 – 1.165; $p < 0.1$), but no significant difference for men were found.

Based on all results, taking into account the small differences in the LPM analyses, the high low p-values ($p < 0.1$) in the Logit and Cox proportional hazard analyses and the contradictory outcomes between the LPM analyses on the one hand and the Logit and Cox proportional hazard analyses on the other hand, we conclude that there is no difference in mortality rates between the CON and CAM group of patients.

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Table 34. Differences in mortality rates: CAM patients compared to CON patients

	Total	Men	Women
LPM with fixed effects	-0.004**	-0.004*	-0.007**
Logit with fixed effects	0.066*	0.081	0.049
Cox proportional hazard	1.059*	1.043	1.072*

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Conclusions

The comparison of the healthcare costs of insurees of CON GPs and CAM GPs in a database with data of 1,540,635 patients from the Dutch insurance company Agis during the period 2006-2011 demonstrates:

1. On average annual total compulsory and supplementary healthcare costs of patients treated by a CAM GP are 192 Euros (10.1%) lower than the costs of patients treated by conventional GPs as a result of 225 Euros (12.4%) lower compulsory costs and 33 Euros (44%) higher supplementary costs.
2. The lower mean annual total compulsory healthcare costs are mainly due to lower hospital care costs (165 Euros) and lower pharmaceutical care costs (58 Euros).
3. Lower mean annual total compulsory healthcare costs are demonstrated in all age categories, but the differences are largest ~~are highest~~ in the third age group (50 – 74 years) (total costs: 356 Euros; hospital care: 232 Euros; pharmaceutical care: 126 Euros) and in the last year of life (total costs: 1,093 Euros; hospital care: 1,223 Euros).
4. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a CON GP.

Discussion

In this study the mean annual total compulsory costs, supplementary costs, costs during the last year of life and mortality rates of patients with a conventional (CON) GP (n = 1.52

million; 98.8%) and patients with GPs that know complementary and alternative medicine (CAM) (n = 18,862; 1.2%) were compared in a dataset from the Dutch insurance company Agis over a six year period (2006 – 2011) by means of regression analyses. The mean annual compulsory healthcare costs of patients treated by a conventional GP are 1,821 Euros (95% CI: 1,813 – 1,828). On average annual total compulsory healthcare costs of patients treated by a CAM GP are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12.4%) lower than patients treated by conventional GPs. Lower total compulsory costs were found in all age categories. Lower pharmaceutical costs were found in the second age group (25 – 49 years) (50 Euros; 95% CI: 23 – 77; $p < 0.001$) and the third age group (50 – 74 years) (126 Euros; 95% CI: 88 – 164; $p < 0.001$). Lower hospital costs were found in all age groups. The largest difference in total compulsory costs was found in the last year of life (1,161 Euros; 95% CI: -138 – 2461; $p < 0.1$), which is completely the result of lower hospital costs (1,250 Euros; 95% CI: 19 – 2481; $p < 0.05$). The mean annual supplementary insurance costs of patients treated by a conventional GP are 75.3 Euros (95% CI: 75.1 – 75.5). On average annual supplementary healthcare costs of patients treated by a CAM GP are 33 Euros (95% CI: 31 – 37; $p < 0.001$) (44%) higher. The absolute lower compulsory costs for all patients for the six years period (2006 – 2011) for the CAM group is 25,463,700 Euros (or on average 4,243,950 Euros per year) compared to the CON group. The extrapolation of the lower costs in the CAM group of patients to the Dutch population (16.8 million inhabitants), if applicable, would result in 3.78 billion Euros lower annual compulsory costs. The absolute lower compulsory and supplementary costs for all patients for the six years period (2006 -2011) for the CAM group is 21,729,024 Euros (or on average 3,621,504 Euros per year) compared to the CON group. The extrapolation of the lower costs in the CAM group of patients to the Dutch population (16.8 million inhabitants), if applicable, would result in 3.23 billion Euros lower annual compulsory and supplementary costs. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a conventional GP.

The first strength of the study is the large sample size of patients and practices. Approximately 9.2% of the Dutch population (1.54/ 16.8 million), and 29.7% of the insurees of Achmea (1.54/ 5.18 million) were included in the study. Compared to the first pilot study [11] there were 10 times more patients from a CON GP (151,952 versus 1,521,773), three times more patients from a CAM GP (5,922 versus 18,862), 4,5 times more CON GP practices (1,913 versus 9,016) and about 1,5 times more CAM practices (79 versus 110). This large sample size allows a more precise estimate of costs and mortality rate differences and

increases the representativeness of the sample and the generalizability of the results [13]. The second strength is that the results are based on a relatively long period of six years, also contributing to more precise estimations, and better representativeness and generalizability of the results. Thirdly, this study, unlike the first pilot study [11], distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to CAM. The first limitation of the study is that it did not compare two treatments (CON versus CAM) for a specific indication, in a controlled setting with other health related outcome parameters than mortality, reducing ~~prohibiting~~ the ~~possibility~~ ability to detect causal relationships between interventions and (cost)effects. Missing information includes costs of out-of pocket expenses, morbidity, work absence, objective disease related outcome measures, subjective health and patient satisfaction. A second limitation is, contrary to the first pilot study [11], that we were not able to analyse at the level of the 6-digit postcode but only at the level of the 4-digit postcode. As a result, the results might not be optimally controlled for socio-economic status of the patients. However, a reanalysis of the data of the first pilot study [11] demonstrated very small differences in results between the analyses with the 6-digit postcode and the analyses with the 4-digit postcode. Another limitation of the study concerns the limited dataset, since the dataset is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most GP practices (64%) were anthroposophic). These facts challenge the generalizability of the results.

The current results with regard to differences in healthcare costs confirm the results of our first smaller pilot study [11] with only 153,000 insurees and observations during a four-year period. In addition, the current study with 10 times as many patients and a two-year longer period of observations, enabled to estimate the cost differences more precisely. Whereas in this first study estimation of mean annual total compulsory costs of CAM patients were in the range of 0 – 30% lower than these of patients of CON GPs, the mean cost differences are now estimated to be 12.4% lower (range: 9.3 – 15.4%) for the CAM group. Like in the first study, the lower total compulsory costs are mainly the result from lower hospital and pharmaceutical costs. Lower costs for CAM in this study are also in line with the results of the recent review of Herman et al. [10] on economic evaluation of CAM and CIM, demonstrating that 29% of comparisons made in the 56 higher-quality studies showed a health improvement with cost savings for the CIM therapy versus usual (conventional) care. Since most CAM patients in the current study were treated in an anthroposophic practice,

comparison with other economic studies on anthroposophic medicine (AM) is justified. Kienle et al. [13,15] reviewed the few economic investigations on AM, demonstrating less or equal costs in AM compared to CON treatment, due to reduced hospital admissions and less prescriptions of medications. Hamre et al. [15] found that in patients starting anthroposophic therapies for chronic disease, total healthcare costs did not increase in the first year, and were significantly reduced in the second year by 416 Euros (95% CI: 264 – 960) compared to the pre-study year. This reduction was largely explained by a decrease of inpatient hospitalisation. With regard to differences in mortality rates between CON and CAM patients, the results do not confirm the (weak) evidence of lower mortality rates that were found in the first study [11]. The conclusion is now that CAM patients do not have lower or higher mortality rates than CON patients.

With regard to the healthcare costs differences reported in the Results section, we can hypothesize four types of explanations. First, the differences could be due to selection on unobservables in patients' GP choice. For example, patients who are healthier and more health-conscious or patients with a strong preference to minimize exposure to medical interventions might be more likely to choose a CAM GP. In both cases, costs will be lower due to lower demand for healthcare. A standard approach to control for selection on unobservables in a non-experimental setting is to use Instrumental Variables (IV). A potential instrumental variable in this case is the distance between a patient's home and the various GPs, cq. a change in distance as a result of a move of a patient or practice. We intend to explore this approach in future work. With respect to selection, several studies that compare the health status of patients treated in CAM and in conventional medicine in primary care settings find that patients treated in CAM practices suffer more often from severe and chronic illnesses (e.g., [16, 17]). This suggests that if we could control for severity and chronicity of illnesses (with additional data), the estimated compulsory cost differences might be larger. Second, the results could be due to undertreatment by CAM GPs. In the present dataset, we were only able to analyse mortality and found that patients with a CAM GP tend to have equal mortality rates. However, a number of studies have reported that patients seeking CAM or anthroposophic care have longer lasting and more severe health problems than patients in conventional care. At the same time, these patients report fewer adverse side effects of treatments and higher patient satisfaction (e.g., [16-18]). These findings combined with the results in this study provide some indication that undertreatment by CAM GPs is unlikely. Firmer conclusions require more detailed data on outcomes. Thirdly, the results could be due

to better practices of CAM due to a stronger focus on preventive and curative health promotion, less overtreatment and better communication and professional relationships. For example, a CAM GP might try a low-cost CAM treatment first. As mentioned, the primary professional orientation of CAM doctors is to strengthen the self-healing capacity of the body and the self-management of the patient. This approach is associated with prescribing fewer conventional pharmaceuticals, tests and operations. Nissen et al. [19, p. 14], based on a review of the literature on citizens' attitudes and needs concerning CAM in Europe, concluded that 'many citizens in Europe value the practice of CAM, particularly the CAM provider-patient relationship, and the patient-centred and holistic approach aspired to by many CAM providers.' Van Dulmen [20] concluded in a Dutch study comparing patients visiting conventional general practitioners (GPs) and three types of CAM GPs (homeopathy, acupuncture and naturopathy), that, contrary to expectations, patients do not consult a CAM physician because they are disappointed with mainstream GP care. CAM patients primarily appear to be seeking a physician who takes the time to talk with them and who will treat their complaints from a holistic viewpoint. Ernst and Hung [21] described the published evidence on the expectations of CAM users (in order of prevalence): hope to influence the natural history of the disease; disease prevention and health/ general well-being promotion; fewer side effects; being in control over one's health; symptom relief; boosting the immune system; emotional support; holistic care; improving quality of life; relief of side effects of conventional medicine; positive therapeutic relationship; obtaining information; coping better with illness; supporting the natural healing process; and the availability of treatment. In addition CAM GPs might focus more on the relationship and communication. For example Esch et al. [16] found that AM patients appreciated that their physicians listened to them (80.0% vs. 67.1%, $p < 0.001$), spent more time (76.5% vs. 61.7%, $p < 0.001$), had more interest in their personal situation (74.6% vs. 60.3%, $p < 0.001$), involved them more in decisions about their medical care (67.8% vs. 58.4%, $p = 0.022$), and made it easy to tell the physician about their problems (71.6% vs. 62.9%, $p = 0.023$). AM patients gave significantly better rating as to information and support (in 3 of 4 items $p < 0.05$) and for thoroughness (70.4% vs. 56.5%, $p < 0.001$). AM patients showed significantly higher treatment satisfaction in all of the five items than CON patients. These results are consistent with other studies demonstrating high patient satisfaction with AM [13,14]. For instance, in a Dutch survey (Consumer Quality Index, a national standard to measure healthcare quality from the perspective of healthcare users), 2.099 patients reported very high satisfaction with anthroposophic GP practices (8.4 and 8.3 on a scale: 0-10, 10 indicating the best possible

score) [18]. These results are consistent with AM theory, which emphasizes relationship and communication, as well as shared decision-making [14]. More AM patients expressed a general treatment satisfaction (56.1% vs. 43.4%, $p < 0.001$) and saw their expectations completely fulfilled at follow-up (38.7% vs. 32.6%, $p < 0.001$). AM patients reported significantly fewer adverse side effects (9.3% vs. 15.4%, $p = 0.003$), and more other positive effects from treatment (31.7% vs. 17.1%, $p < 0.001$). Fourthly, the lower costs could be related to the fact that patients interested in CAM might have higher out-of-pocket expenses since not all CAM treatments are covered by supplementary insurance. Clarifying the role of out-of-pocket expenses is an empirical issue that requires additional data.

The major implication of this study and other economic evaluations of CAM is that there is sufficient evidence now to justify more professional interest in CAM from conventional healthcare professionals and policymakers. We can also conclude that there is sufficient good evidence that CAM can be cost-effective compared to conventional medicine, that the contribution of CAM might result in substantial diminishing of healthcare costs and therefore can provide a contribution to national healthcare policies aiming at controlling and diminishing healthcare expenditures. Therefore more investment in the study of the cost-effectiveness of CAM modalities with their additional health promotion medicines and therapies is indicated. The main unanswered questions in the current study are: where do the cost differences come from (to which indications and which therapies do they pertain to?) and what are the health-related effects of CAM treatment (objective parameters (e.g. lowering of blood pressure), quality of life, patient-reported outcomes, sick-leave, etc.)? Future research should therefore focus on and (1) exploring to what extent selection on unobservables and causal effects explain the lower costs of patients with a CAM GP, (2) exploring in more depth the costs differences between patients of CON GPs and CAM GPs in order to develop adequate, testable hypothesis of cost-effectiveness of specific CAM treatment for specific indications, and to transfer the cost differences related knowledge from CAM to CON GP practices in order to diminish healthcare expenditures in CON practices; (3) designing and executing highly controlled, comparative effectiveness research projects [22] with more health related outcome parameters than mortality rate only; (4) replication studies based on similar, large datasets with other CAM modalities (acupuncture, TCM herbal treatment, etc.) and with other insurance companies to explore and confirm the present results;

Acknowledgements

We would like to thank Agis (Achmea) and especially Dr. Hugo Smeets and Mr. Henk Evers for providing the dataset for the study.

Competing interests

We have read and understood the BMJ Group policy on declaration of interests and declare the following interests:

- Dr. Erik W. Baars receives a part of his salary from the Professorship Anthroposophic Healthcare of the University of Applied Sciences Leiden, The Netherlands. The professorship works closely with those in the AH professional field and works on practical problems using applied research which focuses on three main categories: (1) investigating efficacy and safety, (2) developing and delivering optimal quality, and (3) improving communication about AH.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Contributors

PK was the project lead for the statistical analyses. EB and PK wrote the manuscript. All authors reviewed the manuscript and contributed to manuscript revisions. EB is the guarantor for this study.

Funding

The only financial support for the study was provided by the Stichting Triodos Foundation. These financial resources were only used to cover the costs of Achmea for providing the dataset for the study. The researchers did not receive any funding for salaries or other costs.

Role of the study sponsors

Not applicable.

Statement of independence of researchers from funders

Funders played no part in article selection, analysis, interpretation, or decision to publish.

Data sharing

Details of how to obtain additional data from the study can be obtained from EB (baars.e@hsleiden.nl).

Previous publication

A part of the content of our study results was published in February 2014 as a Dutch article in the Dutch journal Economisch Statistische Berichten for economists in The Netherlands [23].

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Appendix 1

The Switcher group

From the total group of 10,769 Switchers, during the period 2006-2011, 6,224 patients switched one time; 2,992 patients switched two times (= back to their first type of GP); 1,282 patients switched three times; 241 patients switched four times and 30 patients switched five times. From the Switchers group that started with a CAM GP, 69.3% ends up with a CON GP. From the Switchers group that started with a CON GP, 70.5% ends up with a CAM GP. As a result the total percentages of CAM patients and CON patients hardly change.

When we analyze the changes in compulsory costs after switching in the subgroup that switched only one time, the total compulsory costs after switching are higher, independent of the direction of the switch. Switching from a CON to a CAM GP results in 337 Euros higher costs ($p < 0.001$), switching from a CAM to a CON GP results in 372 Euros higher costs ($p < 0.001$). After correction for observed differences between the groups by means of linear regression analyses, switching from a CON to a CAM GP results in 34 Euros lower costs (not significant: $p = 0.83$) and switching from a CAM to a CON GP results in 360 Euros higher costs ($p < 0.079$).

When we analyze the changes in supplementary costs after switching in the subgroup that switched only one time, we see that switching from a CON to a CAM GP results in 23 Euros higher costs ($p < 0.001$), and that switching from a CAM to a CON GP results in 1 Euro lower costs (not significant: $p = 0.78$). After correction for observed differences between the groups by means of linear regression analyses, switching from a CON to a CAM GP results in 1 Euro higher costs (not significant: $p = 0.816$) and switching from a CAM to a CON GP results in 2 Euros higher costs (not significant: $p = 0.803$).

Since we are mainly interested in the differences in costs between patients that have a CAM GP and patient that have a CON GP for the whole period of six years (2006-2011), the Switcher group is left out of the following analyses.

Appendix 2

Table 43. Estimated differences in mean annual total compulsory and supplementary insurance costs: CAM patients compared to CON patients (loglinear regression model)

	Compulsory insurance costs					Supplementary insurance costs
	Total	GP	Pharmaceutical	Hospital	Paramedic	
All ages	-.114***	-.121***	-.281***	-.185***	.028**	.496***
0-24	-.071***	-.018**	-.169***	-.152***	.017	.344***
25-49	-.088***	-0.14**	-.267***	-.153***	.021*	.433***
50-74	-.173***	-.025***	-.418***	-.220***	.036*	.653***
75+	-.072**	.026*	-.176***	-.124**	.055	.355***
Last year of life	-.146**	.026	-.143	-.287**	.178	.134

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Appendix 1

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When we analyze the changes in supplementary costs after switching in the subgroup that switched only one time, we see that switching from a CON to a CAM GP results in 23 Euros higher costs ($p < 0.001$), and that switching from a CAM to a CON GP results in 1 Euro lower costs (not significant: $p = 0.78$). After correction for observed differences between the groups by means of linear regression analyses, switching from a CON to a CAM GP results in 1 Euro higher costs (not significant: $p = 0.816$) and switching from a CAM to a CON GP results in 2 Euros higher costs (not significant: $p = 0.803$).

Since we are mainly interested in the differences in costs between patients that have a CAM GP and patient that have a CON GP for the whole period of six years (2006-2011), the Switcher group is left out of the following analyses.

Appendix 2

Table 4. Estimated differences in mean annual total compulsory and supplementary insurance costs: CAM patients compared to CON patients (loglinear regression model)

	Compulsory insurance costs					Supplementary insurance costs
	Total	GP	Pharmaceutical	Hospital	Paramedic	
All ages	-.114***	-.121***	-.281***	-.185***	.028**	.496***
0-24	-.071***	-.018**	-.169***	-.152***	.017	.344***
25-49	-.088***	-0.14**	-.267***	-.153***	.021*	.433***
50-74	-.173***	-.025***	-.418***	-.220***	.036*	.653***
75+	-.072**	.026*	-.176***	-.124**	.055	.355***
Last year of life	-.146**	.026	-.143	-.287**	.178	.134

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Additional file 1

EVEREST Statement: Checklist for health economics paper

	Study section	Additional remarks
Study design		
(1) The research question is stated	Introduction	
(2) The economic importance of the research question is stated	Introduction	
(3) The viewpoint(s) of the analysis are clearly stated and justified	Methods; Discussion	
(4) The rationale for choosing the alternative programmes or interventions compared is stated	Methods	
(5) The alternatives being compared are clearly described	Introduction; Methods	
(6) The form of economic evaluation used is stated	Introduction; Methods	
(7) The choice of form of economic evaluation is justified in relation to the questions addressed	Introduction; Methods; Discussion	
Data collection		
(8) The source(s) of effectiveness estimates used are stated	Methods	
(9) Details of the design and results of effectiveness study are given (if based on single study)	N/A	
(10) Details of the method of synthesis or meta-analysis of estimates are given (if based on an overview of a number of effectiveness studies)	N/A	
(11) The primary outcome measure(s) for the economic evaluation are clearly stated	Methods	
(12) Methods to value health states and other benefits are stated	Introduction; Methods	
(13) Details of the subjects from whom valuations were obtained are given	Methods	
(14) Productivity changes (if included) are reported separately	N/A	
(15) The relevance of productivity changes to the study question is discussed	N/A	
(16) Quantities of resources are reported separately from their unit costs	Methods; Tables 2-4	
(17) Methods for the estimation of quantities and unit costs are described	Methods; Tables 2-4	
(18) Currency and price data are recorded	Methods; Tables 2-4	
(19) Details of currency of price adjustments for	NA	

inflation or currency conversion are given		
(20) Details of any model used are given	Methods-Model overview	
(21) The choice of model used and the key parameters on which it is based are justified	Methods	
Analysis and interpretation of results		
(22) Time horizon of costs and benefits is stated	Methods; Discussion	
(23) The discount rate(s) is stated	N/A	
(24) The choice of rate(s) is justified	N/A	
(25) An explanation is given if costs or benefits are not discounted	N/A	
(26) Details of statistical tests and confidence intervals are given for stochastic data	N/A	
(27) The approach to sensitivity analysis is given	N/A	
(28) The choice of variables for sensitivity analysis is justified	Methods; Tables 2-4	Confidence intervals are given
(29) The ranges over which the variables are varied are stated	Tables 2-4	
(30) Relevant alternatives are compared	Introduction; Methods	
(31) Incremental analysis is reported	Discussion	We describe the extrapolation from the lower costs in the CAM group of patients to the Dutch population
(32) Major outcomes are presented in a disaggregated as well as aggregated form	Tables 2-4	
(33) The answer to the study question is given	Discussion; Conclusion	
(34) Conclusions follow from the data reported	Conclusion	
(35) Conclusions are accompanied by the appropriate caveats	Discussion; Conclusion	

BMJ Open

A six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM GPs

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2014-005332.R2
Article Type:	Research
Date Submitted by the Author:	06-Aug-2014
Complete List of Authors:	Baars, Erik; University of Applied Sciences, Care Kooreman, Peter; Tilburg University, Economics
Primary Subject Heading:	Complementary medicine
Secondary Subject Heading:	Health economics
Keywords:	COMPLEMENTARY MEDICINE, PRIMARY CARE, HEALTH ECONOMICS

A six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM GPs

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Abstract

Objectives To compare healthcare costs and mortality rates of Dutch patients with a conventional (CON) general practitioner (GP) and patients with a GP who has additionally completed training in complementary and alternative medicine (CAM).

Design Comparative economic evaluation.

Setting Database from the Dutch insurance company Agis.

Participants 1,521,773 patients (98.8%) from a CON practice and 18,862 patients (1.2%) from a CAM practice.

Main outcome measures Annual information on five types of healthcare costs for the years 2006 – 2011: care by GP, hospital care, pharmaceutical care, paramedic care and care covered by supplementary insurance. Healthcare costs in the last year of life. Mortality rates.

Results The mean annual compulsory and supplementary healthcare costs of CON patients are respectively 1,821 Euros (95% CI: 1,813 – 1,828) and 75.3 Euros (95% CI: 75.1 – 75.5). Compulsory healthcare costs of CAM patients are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12,4%) lower and result mainly from lower hospital care costs (165 Euros) (95% CI: 118 – 212; $p < 0.001$) and lower pharmaceutical care costs (58 Euros) (95% CI: 41 – 75; $p < 0.001$), especially in the age categories 25 – 49 years and 50 – 74 years. The costs in the last year of life of patients with CAM GPs are 1,161 euro (95% CI: -138 – 2,461; $p < 0.1$) lower. This difference is entirely due to lower hospital costs (1,250 Euros) (95% CI: 19 – 2,481; $p < 0.05$). The mean annual supplementary costs of CAM patients are 33 Euros (95% CI: 30 – 37; $p < 0.001$) (44%) higher. CAM patients do not have lower or higher mortality rates than CON patients.

Conclusions Dutch patients whose GP additionally completed training in CAM on average have 192 Euros (10.1%) lower annual total compulsory and supplementary healthcare costs and do not live longer or shorter than CON patients.

Strengths and limitations of this study

- The study is based on a large sample size of patients and practices and a relatively long period of six years contributing to more precise estimations, and better representativeness and generalizability of the results.
- The study distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to CAM.
- The study did not compare two treatments (conventional versus CAM) for a specific indication, in a controlled setting with other health related outcome parameters than mortality, reducing the ability to detect causal relationships between interventions and (cost)effects.
- Since the analyses were at the level of the 4-digit postcode and not at the level of the 6-digit postcode, the results might not be optimally controlled for socio-economic status of the patients.
- The study concerns a limited dataset, since the dataset is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most GP practices (64%) were anthroposophic). These facts challenge the generalizability of the results.

Introduction

In most countries of the European Union the annual healthcare costs are rising faster than the economy [1]. Therefore, national healthcare policies are increasingly aiming at controlling and diminishing healthcare expenditures. This also applies to the situation in The Netherlands [2]. In 1972 8% of the Dutch national income (GDP) was used to finance public healthcare. In 2010 already 13% of GDP was used and The Netherlands were worldwide in second place of healthcare expenditures of countries. Without drastic measures, the estimated costs will be over 30% in 2040 [3]. Public spending on healthcare will rise from 61 billion Euros in 2012 to an estimated nearly 80 billion Euros in 2017 [4]. Dutch health economists and policy makers have largely ignored the possible contribution of Complementary and Alternative Medicine (CAM) and Integrative Medicine (IM) to the reduction of healthcare costs as an area of research and interest. The here presented economic study, a six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM general practitioners (GPs), contributes to the development of an evidence-based Dutch policy with regard to the role of CAM and IM in the reduction of healthcare expenditure growth.

The Dutch financing system

The Dutch financing system contains two basic compulsory health insurances, that are for 80% paid for through income taxes: for curative care (Zorgverzekeringswet (ZvW)) and for long-term care (Algemene Wet Bijzondere Ziektekosten (AWBZ)). The compulsory health insurances cover costs of most of GP, pharmaceutical and hospital care and some paramedic care. In addition, people in The Netherlands can buy supplementary insurance. Supplementary insurance covers costs not covered by basic insurance (for example specific or additional paramedic treatment, complementary therapies) (e.g., costs of CAM treatment is paid for up to 500 Euros/ year) [5]. Many supplementary insurances cover costs of CAM treatments like anthroposophic medicine, acupuncture and homeopathy. Supplementary insurance can also cover costs of improvements over the standard level of care paid for by compulsory insurance (e.g., extra costs for a better room and service in case of hospitalisation).

Policies to reduce healthcare expenditure growth

The vast majority of expenditure growth is due to innovations in healthcare. The Cultureel Planbureau (CPB) anticipates that the total costs of curative care will rise from 36 billion Euros this year to 49 billion Euros in 2017. The rising costs of curative care, according to the CPB is largely due to the 'creeping expansion' of the compulsory health insurance; 'Year after year, new medical techniques and drugs appear on the market that are often better, but also more expensive', especially, since more patients will be treated with the new techniques [3]. Of the total growth of public healthcare expenditure, about a quarter is the result of aging. In 2040 more than 22% of the Dutch population will be older than 65, whereas currently this is 16%. As people grow older, on average the costs of healthcare will increase (on the level of the whole older population).

Which policies can be deployed to control the risk of rising costs? The measures aimed at reducing healthcare expenditures are, without being complete: more efficiency and higher productivity in healthcare (including reducing management layers), more competition between healthcare institutions, fewer hospitals (specialization and concentration), more 'neighbourhood care' by general practitioners (GPs), more remote care (e-health), preventing overtreatment/ less (extra) care, more responsible behaviour of consumers (more self-care), more emphasis on healthy living (prevention), higher co-payments, higher deductibles and already saving for higher healthcare expenditure in the old days (precautionary savings) [3].

In July 2013 the Dutch healthcare minister Schippers reached an agreement with hospitals, medical specialists, mental healthcare providers, general practitioners, health insurers and patients' organizations to reduce the growth rate of healthcare spending: to 1.5% in 2014 and 1% per year from 2015 to 2017. This reduction represents a total additional savings of approximately 1 billion Euros. To achieve the reduced expenditure growth, extra measures will be taken that increase the efficiency and improve the quality of care: more care of medical specialists goes to the GP and from the GP to self-care; concentration of complex care; tighter application of medical guidelines and care standards; treatments are given according the standards of the medical profession itself; access to the claims of the compulsory health insurances is tightened; and more transparency about quality and cost of care [6].

The contribution of Complementary and Alternative Medicine

According to the National Center for Complementary and Alternative Medicine (NCCAM), CAM is a group of diverse medical and healthcare systems, practices, and products that are not generally considered part of conventional medicine [7]. The Cochrane Collaboration definition of complementary medicine is that it includes all such practices and ideas that are outside the domain of conventional medicine in several countries and defined by its users as preventing or treating illness, or promoting health and well-being. These practices complement mainstream medicine by satisfying a demand not met by conventional practices and diversifying the conceptual framework of medicine [8]. "Integrative Medicine is the practice of medicine that reaffirms the importance of the relationship between practitioner and patient, focuses on the whole person, is informed by evidence, and makes use of all appropriate therapeutic approaches, healthcare professionals and disciplines to achieve optimal health and healing." [9] In addition, IM emphasizes the active role of the patient in prevention (lifestyle), well-being and therapy and healing processes, and the use of healing environments [9].

Herman et al. [10] performed a systematic review of economic evaluations on complementary and integrative medicine (CIM). This study identified 338 economic evaluations of CIM, including 114 full evaluations, published between 2001 and 2010. All recent (and likely most cost-relevant) full economic evaluations published from 2001 to 2010 were subjected to several measures of quality. Detailed results of higher-quality studies were reported. The cost-utility analyses found were of similar or better quality to those published across all medicine. Of the 56 comparisons made in the higher-quality studies, 16 (29%) show a health improvement with cost savings for the CIM therapy versus usual (conventional) care. Study quality of the cost-utility analyses (CUAs) of CIM was generally comparable to that seen in CUAs across all medicine according to several measures, and the quality of the cost-saving studies was slightly, but not significantly, lower than those showing cost increases (85% vs 88%, $p = 0.460$).

In The Netherlands, a few percent of the GPs have followed an additional training in CAM. In 2010, we performed an initial economic evaluation, comparing the healthcare costs of patients from Dutch conventional (CON) GPs and CAM GPs [11]. A dataset from a Dutch health insurer Azivo was used containing quarterly information on healthcare costs (GP care, hospital care, pharmaceutical care, and paramedic care), dates of birth and death (if

applicable), gender and 6-digit postcode of all approximately 150,000 insurees, for the years 2006–2009. Data from 1,913 conventional GPs were compared with data from 79 GPs with additional CAM training in acupuncture (n=25), homeopathy (n=28), and anthroposophic medicine (n=26). Results were that patients whose GP has additionally completed training in CAM training had 0–30% lower healthcare costs and mortality rates, depending on age groups and type of CAM. The lower costs resulted from fewer hospital stays and fewer prescription drugs. It was concluded that more controlled studies (replication studies, research based on more comprehensive data, cost-effectiveness studies on CAM for specific diagnostic categories) were indicated.

This study

Given the current need to diminish healthcare expenditures in The Netherlands and based on the positive results from both the review of Herman et al. [10] and our own study [11], we decided to perform a replication study comparing the healthcare costs of patients from conventional (CON) GPs and CAM GPs with a larger dataset from a Dutch health insurer, to analyse the robustness of the results of the first study. The research questions of the study were:

1. Is there a statistically significant difference in healthcare costs (care by GP, hospital care, pharmaceutical care, paramedic care, care covered by supplementary insurance, and healthcare costs in the last year of life) of patients from CON GPs and CAM GPs?
2. Is there a statistically significant difference in mortality rates of patients from CON GPs and CAM GPs?

Methods

Comparative economic evaluation

Full economic evaluations compare the costs (resource use) associated with one or more alternative interventions (e.g., intervention X versus comparator Y) with their consequences (outcomes, effects). In this study we were able to measure five types of costs in two categories: (1) care covered by compulsory insurance: care by GP, hospital care,

pharmaceutical care, paramedic care, and (2) costs covered by supplementary insurance. Alternative interventions were: conventional GP care compared to care from GPs that know CAM. Outcomes were: differences in healthcare costs and annual mortality rates.

Model overview

Costs were analysed at the patient level using linear and loglinear regression analysis. The cost analysis has been performed for the total sample, as well as separately for the age groups 0–24, 25–49, 50–74, and ≥ 75, given the large average differences in health and healthcare needs across age groups. Effects on mortality rates are analysed using a linear probability model (LPM), a Logit model, and a Cox proportional hazard model (CPH). In all models, the explanatory variables are gender, age (linear, within each age category), dummies for CAM and 'Vogelaarwijk' (city areas with known lower socio-economic status of inhabitants), year dummies, and postal code fixed effects. In the cost regressions and the LPM model, fixed effects at the 4-digit insuree postcode level were controlled for. In the Logit and CPH model 2-digit postcode level fixed effects were included, as estimation with more detailed fixed effects appeared to be numerically infeasible.

The regression approach is standard practice in health economics and yields results similar to those of matching procedures (both are unable to correct for unobserved differences between groups of patients). Given the large sample sizes Student's t tests are asymptotically valid by virtue of the central limit theorem, independent of whether the underlying distributions are normal or non-normal. Standard errors are clustered at the level of the insured to control for the statistical dependence of observations pertaining to a given insured person (i.e. observations are independent 'between' individuals but dependent 'within' individuals).

With regard to the six years of data the data set was used as a panel. This means that if an insured person is observed for all six years, six observations of annual costs of this person are used in the analysis (taking into account the 'within'-person correlation by clustering standard errors at the level of the individual). The reported differences can be interpreted as the average of cost differences across years. Any trends are controlled for by the year dummy variables.

Dataset on healthcare costs and demographics

A dataset was analyzed from health insurer Agis, a subsidiary company of Achmea. Achmea has a share in the market of 31% (5.18 million insured) of the Dutch population in 2013; while the share of Agis is 9,2% (1.54 million insured). The dataset contains quarterly information on the healthcare costs of all Agis insurees, which was aggregated to annual information for the years 2006 up to 2011. In addition, it contains the date of birth of the insuree, date of death (if applicable), gender, and 4-digit postcode of the insured's residence. For each insuree year combination, information on the costs of five different types of care is available: care by GP, hospital care, pharmaceutical care, paramedic care (like physical therapy), and care covered by supplementary insurance.

General practitioners and patients

The dataset also contains the names and addresses of the general practitioners who have patients who are insured by Agis, which allows us to distinguish between CON GPs and CAM GPs. We defined a general practitioner as anthroposophic CAM GP if his or her name appears in the list of general practitioners with additional training in anthroposophic medicine (AM) as provided by their professional association [14]. CAM GPs with homeopathy (HOM) [15] and CAM GPs with acupuncture [16] are defined similarly.

Patients were regarded CON patients and CAM patients if they were patient of respectively a CON GP or a CAM GP during all of the years they appear in the dataset. Patients that transferred from a CON GP to a CAM GP or vice versa , were regarded to be a member of a third group called 'Switchers'.

Statistical analyses

Significance of coefficients is tested using Student's t tests, with clustering of standard errors at the level of the insured. Given the large sample sizes available here, asymptotic t-testing for differences in means is appropriate by virtue of the central limit theorem. Calculations were made using StataSE 10.0. Means with 95% confidence intervals and p-values (< 0.1, < 0.05, and < 0.01) are presented.

Ethical approval

Since the study involved no experimental treatment, patients were not recruited. Since patient data were anonymized, no ethical approval was necessary.

Results

GP practices and patients

The dataset contained 9,126 GP practices: 9,016 CON practices and 110 CAM practices. Due to the systematics of the insurance company, one individual GP can appear as different practices, so the actual number of GPs is lower than the number of GP practices. Contrarily, each patient is never counted more than once. The majority of the CAM GPs are anthroposophic GPs (70 AM practices (64%)). Other CAM GPs were specialized in acupuncture (15%) and homeopathy (25%). Since some GPs were specialized in more than one CAM modality the total percentage of CAM GPs is larger than 100%. Exact numbers and percentages of CAM GPs vary a little over the years.

Healthcare costs

The dataset

The dataset contains information of more than 1.5 million insurees during the years 2006-2011 (Table 1). Nearly 19,000 insurees (1.2%) had throughout this whole period a CAM GP. More than 10,000 other insurees had in some years a CON GP and in other years a CAM GP ('Switchers'). On average, the Switchers group had three years a CON GP and three years a CAM GP. The insurees had a mean age of 41.0 (SD=23.5). 53% are women. These patients live in 4,014 different 4-digit postal codes.

Without controlling for relevant differences between the groups, the comparison demonstrates: higher percentages of females in in the CAM GP and Switchers groups; higher percentages of insurees living in the 'Vogelaarwijk' in the CON and Switchers group; 183 Euros lower and 168 Euros higher total compulsory costs in respectively the CAM and the Switchers group; and 40 Euros and 25 Euros higher supplementary costs in costs in respectively the CAM and the Switchers group. The percentages of patients with a

supplementary insurance were almost the same (CON GPs: 92.7%; CAM GPs: 93.4% and Switchers: 92.1%).

Since the aim of the study was to compare the costs of patients with a CON GP and a CAM GP, the data of the Switchers group were left out of the main regression analyses on annual total compulsory and supplementary costs. The results of the analyses on the Switchers group are separately presented in Appendix 1.

Table 1. Descriptive statistics of the dataset

	CON GP	CAM GP	Switchers
Insured (n)	1,521,773	18,862	10,769
Age (year)	41.0	41.6	40.1
Female (percentage)	52.9%	55.2%	56.4%
'Vogelaarwijk' (percentage)	15.7%	9.3%	17.1%
Supplementary insured (percentage)	92.7%	93.4%	92.1%
Compulsory insurance costs (Euros)			
Total costs	1,821	1,638	1,989
GP costs	133	128	140
Pharmaceutical costs	402	357	474
Hospital costs	1,242	1,104	1,328
Paramedical costs	44	48	47
Supplementary insurance costs (Euros)	75	115	100

Annual total compulsory and supplementary insurance costs

The mean annual total costs of patients treated in CON practices covered by the compulsory insurance were 1,821 Euros (95% CI: 1,813 – 1,828) (Table 1). After correction for observed differences between the groups by means of linear regression analyses, the mean annual total compulsory insurance costs of patients of CAM GP practices are 225 Euros (95% CI: 169 –

281; p < 0.001) (12.4%) lower. These lower costs are mainly due to lower hospital costs (165 Euros; 95% CI: 118 – 212; p < 0.001) and lower pharmaceutical care costs (58 Euros; 95% CI: 41 – 75; p < 0.001).

The mean annual total supplementary costs for patients treated in CON practices were 75.3 Euros (95% CI: 75.1 – 75.5) (the mean is calculated over all patients, including those (less than 8%) without supplementary insurance). For patients treated in CAM practices these costs are 33 Euros (95% CI: 31 – 37; p < 0.001) (44%) higher and were highest in the third age group (50 – 74 years) (52 Euros (95% CI: 31 – 37; p < 0.001)). Taken together, the mean total annual compulsory and supplementary insurance costs are 192 Euros (10.1%) lower for the CAM group of patients.

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (Appendix 2) provide the same lower costs for the CAM group of patients as found in the linear analyses (Table 2). In addition, higher paramedic costs are found for the CAM group of patients.

Costs per age category and insurance category

Lower total compulsory costs were found in all age categories (Table 2): 80 Euro (95% CI: 21 – 140; p < 0.01) in the first group (0-24 years); 137 Euros (95% CI: 54 – 219; p < 0.01) in the second group (25 – 49 years); 356 Euros (95% CI: 227 – 485; p < 0.001) in the third group (50 – 74 years), and 236 Euros (95% CI: -9 – 481; p < 0.1) in the last group (75+ years). Lower pharmaceutical costs were found in the second age group (25 – 49 years) (50 Euros; 95% CI: 23 – 77; p < 0.001) and the third age group (50 – 74 years) (126 Euros; 95% CI: 88 – 164; p < 0.001). Lower hospital costs were found in all age groups, with the largest differences in the third age group (50 – 74 years) (232 Euros; 95% CI: 124 – 341; p < 0.001) and the last age group (75+ years) (219 Euros; 95% CI: 7 – 431; p < 0.05). In addition, the largest difference in total compulsory costs was found in the last year of life (1,161 Euros; 95% CI: -138 – 2,461; p < 0.1), which is completely the result of lower hospital costs (1,250 Euros; 95% CI: 19 – 2,481; p < 0.05).

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (Appendix 2) provide the same lower costs for the separate age groups of CAM patients as found in the linear analyses (Table 2). In addition, now there are also

significant lower costs for the CAM group of patients with regard to GP costs in the third age group (50 – 74), lower pharmaceutical costs in the first (0 – 24) and the last age group (75+); and higher paramedic costs in the second (25 – 49) and third (50 – 74) age group.

Table 2. Estimated differences in mean annual total compulsory and supplementary insurance costs: CAM patients compared to CON patients (linear regression model)

	Compulsory insurance costs					Supplementary insurance costs
	Total	GP	Pharmaceutical	Hospital	Paramedic	
All ages	-225***	-3***	-58***	-165***	1	33***
0-24	-80***	-3***	-2	-74***	-2	11***
25-49	-137***	-2**	-50***	-85**	1	32***
50-74	-356***	-1	-126***	-232***	3	52***
75+	-236*	11***	-38	-219**	10	24***
Last year of life	-1,161*	5	67	-1,250**	27	3

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Mortality rates

In the present dataset, the only information available on health outcomes is mortality. During the period 2006 – 2011 80,543 patients died in the CON group (5.26%) and 973 in the CAM group (5.14%). After controlling for all relevant variables (age, postal codes, etcetera), we find that patients with a CAM GP have significantly lower mortality rates in all LMP analyses (Table 3). However, the differences are very small: total group: 0.004 (95% CI: 0.001 – 0.007; $p < 0.05$); men: 0.004 (95% CI: 0.001 – 0.008; $p < 0.1$); women: 0.007 (95% CI: 0.003 – 0.011; $p < 0.05$). The Logit analyses resulted in a significantly higher mortality rate for the total group at the 10% level (but not at the 5% level) (0.066; 95% CI: -0.143 – 0.011; $p < 0.1$), but no significant differences for men and women separately. The Cox proportional hazard analyses resulted in significant higher mortality rates at the 10% level (but not at the 5% level), both for the total group: 1.059 (95% CI: 0.994 – 1.129; $p < 0.1$), and

the group of women: 1.072 (95% CI: 0.987 – 1.165; $p < 0.1$), but no significant difference for men was found.

Based on all results, taking into account the small differences in the LPM analyses, the high p-values ($p < 0.1$) in the Logit and Cox proportional hazard analyses and the contradictory outcomes between the LPM analyses on the one hand and the Logit and Cox proportional hazard analyses on the other hand, we conclude that there is no difference in mortality rates between the CON and CAM group of patients.

Table 3. Differences in mortality rates: CAM patients compared to CON patients

	Total	Men	Women
LPM with fixed effects	-0.004**	-0.004*	-0.007**
Logit with fixed effects	0.066*	0.081	0.049
Cox proportional hazard	1.059*	1.043	1.072*

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Conclusions

The comparison of the healthcare costs of insurees of CON GPs and CAM GPs in a database with data of 1,540,635 patients from the Dutch insurance company Agis during the period 2006-2011 demonstrates:

1. On average annual total compulsory and supplementary healthcare costs of patients treated by a CAM GP are 192 Euros (10.1%) lower than the costs of patients treated by conventional GPs as a result of 225 Euros (12.4%) lower compulsory costs and 33 Euros (44%) higher supplementary costs.
2. The lower mean annual total compulsory healthcare costs are mainly due to lower hospital care costs (165 Euros) and lower pharmaceutical care costs (58 Euros).
3. Lower mean annual total compulsory healthcare costs are demonstrated in all age categories, but the differences are largest in the third age group (50 – 74 years) (total costs: 356 Euros; hospital care: 232 Euros; pharmaceutical care: 126 Euros) and in the last year of life (total costs: 1,093 Euros; hospital care: 1,223 Euros).

4. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a CON GP.

Discussion

In this study the mean annual total compulsory costs, supplementary costs, costs during the last year of life and mortality rates of patients with a conventional (CON) GP (n = 1.52 million; 98.8%) and patients with GPs that know complementary and alternative medicine (CAM) (n = 18,862; 1.2%) were compared in a dataset from the Dutch insurance company Agis over a six year period (2006 – 2011) by means of regression analyses. The mean annual compulsory healthcare costs of patients treated by a conventional GP are 1,821 Euros (95% CI: 1,813 – 1,828). On average annual total compulsory healthcare costs of patients treated by a CAM GP are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12.4%) lower than patients treated by conventional GPs. Lower total compulsory costs were found in all age categories. Lower pharmaceutical costs were found in the second age group (25 – 49 years) (50 Euros; 95% CI: 23 – 77; $p < 0.001$) and the third age group (50 – 74 years) (126 Euros; 95% CI: 88 – 164; $p < 0.001$). Lower hospital costs were found in all age groups. The largest difference in total compulsory costs was found in the last year of life (1,161 Euros; 95% CI: -138 – 2461; $p < 0.1$), which is completely the result of lower hospital costs (1,250 Euros; 95% CI: 19 – 2481; $p < 0.05$). The mean annual supplementary insurance costs of patients treated by a conventional GP are 75.3 Euros (95% CI: 75.1 – 75.5). On average annual supplementary healthcare costs of patients treated by a CAM GP are 33 Euros (95% CI: 31 – 37; $p < 0.001$) (44%) higher. The absolute lower compulsory costs for all patients for the six years period (2006 – 2011) for the CAM group is 25,463,700 Euros (or on average 4,243,950 Euros per year) compared to the CON group. The extrapolation of the lower costs in the CAM group of patients to the Dutch population (16.8 million inhabitants), if applicable, would result in 3.78 billion Euros lower annual compulsory costs. The absolute lower compulsory and supplementary costs for all patients for the six years period (2006 -2011) for the CAM group is 21,729,024 Euros (or on average 3,621,504 Euros per year) compared to the CON group. The extrapolation of the lower costs in the CAM group of patients to the Dutch population (16.8 million inhabitants), if applicable, would result in 3.23 billion Euros lower annual compulsory and supplementary costs. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a conventional GP.

The first strength of the study is the large sample size of patients and practices. Approximately 9.2% of the Dutch population (1.54/ 16.8 million), and 29.7% of the insurees of Achmea (1.54/ 5.18 million) were included in the study. Compared to the first pilot study [11] there were 10 times more patients from a CON GP (151,952 versus 1,521,773), three times more patients from a CAM GP (5,922 versus 18,862), 4,5 times more CON GP practices (1,913 versus 9,016) and about 1,5 times more CAM practices (79 versus 110). This large sample size allows a more precise estimate of costs and mortality rate differences and increases the representativeness of the sample and the generalizability of the results [13]. The second strength is that the results are based on a relatively long period of six years, also contributing to more precise estimations, and better representativeness and generalizability of the results. Thirdly, this study, unlike the first pilot study [11], distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to CAM. The first limitation of the study is that it did not compare two treatments (CON versus CAM) for a specific indication, in a controlled setting with other health related outcome parameters than mortality, reducing the ability to detect causal relationships between interventions and (cost)effects. Missing information includes costs of out-of pocket expenses, morbidity, work absence, objective disease related outcome measures, subjective health and patient satisfaction. A second limitation is, contrary to the first pilot study [11], that we were not able to analyse at the level of the 6-digit postcode but only at the level of the 4-digit postcode. As a result, the results might not be optimally controlled for socio-economic status of the patients. However, a reanalysis of the data of the first pilot study [11] demonstrated very small differences in results between the analyses with the 6-digit postcode and the analyses with the 4-digit postcode. Another limitation of the study concerns the limited dataset, since the dataset is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most GP practices (64%) were anthroposophic). These facts challenge the generalizability of the results.

The current results with regard to differences in healthcare costs confirm the results of our first smaller pilot study [11] with only 153,000 insurees and observations during a four-year period. In addition, the current study with 10 times as many patients and a two-year longer period of observations, enabled to estimate the cost differences more precisely. Whereas in this first study estimation of mean annual total compulsory costs of CAM patients were in the range of 0 – 30% lower than these of patients of CON GPs, the mean cost differences are now estimated to be 12.4% lower (range: 9.3 – 15.4%) for the CAM group.

Like in the first study, the lower total compulsory costs are mainly the result from lower hospital and pharmaceutical costs. Lower costs for CAM in this study are also in line with the results of the recent review of Herman et al. [10] on economic evaluation of CAM and CIM, demonstrating that 29% of comparisons made in the 56 higher-quality studies showed a health improvement with cost savings for the CIM therapy versus usual (conventional) care. Since most CAM patients in the current study were treated in an anthroposophic practice, comparison with other economic studies on anthroposophic medicine (AM) is justified. Kienle et al. [13,15] reviewed the few economic investigations on AM, demonstrating less or equal costs in AM compared to CON treatment, due to reduced hospital admissions and less prescriptions of medications. Hamre et al. [15] found that in patients starting anthroposophic therapies for chronic disease, total healthcare costs did not increase in the first year, and were significantly reduced in the second year by 416 Euros (95% CI: 264 – 960) compared to the pre-study year. This reduction was largely explained by a decrease of inpatient hospitalisation. With regard to differences in mortality rates between CON and CAM patients, the results do not confirm the (weak) evidence of lower mortality rates that were found in the first study [11]. The conclusion is now that CAM patients do not have lower or higher mortality rates than CON patients.

With regard to the healthcare costs differences reported in the Results section, we can hypothesize four types of explanations. First, the differences could be due to selection on unobservables in patients' GP choice. For example, patients who are healthier and more health-conscious or patients with a strong preference to minimize exposure to medical interventions might be more likely to choose a CAM GP. In both cases, costs will be lower due to lower demand for healthcare. A standard approach to control for selection on unobservables in a non-experimental setting is to use Instrumental Variables (IV). A potential instrumental variable in this case is the distance between a patient's home and the various GPs, cq. a change in distance as a result of a move of a patient or practice. We intend to explore this approach in future work. With respect to selection, several studies that compare the health status of patients treated in CAM and in conventional medicine in primary care settings find that patients treated in CAM practices suffer more often from severe and chronic illnesses (e.g., [16, 17]). This suggests that if we could control for severity and chronicity of illnesses (with additional data), the estimated compulsory cost differences might be larger. Second, the results could be due to undertreatment by CAM GPs. In the present dataset, we were only able to analyse mortality and found that patients with a CAM GP tend to have

equal mortality rates. However, a number of studies have reported that patients seeking CAM or anthroposophic care have longer lasting and more severe health problems than patients in conventional care. At the same time, these patients report fewer adverse side effects of treatments and higher patient satisfaction (e.g., [16-18]). These findings combined with the results in this study provide some indication that undertreatment by CAM GPs is unlikely. Firmer conclusions require more detailed data on outcomes. Thirdly, the results could be due to better practices of CAM due to a stronger focus on preventive and curative health promotion, less overtreatment and better communication and professional relationships. For example, a CAM GP might try a low-cost CAM treatment first. As mentioned, the primary professional orientation of CAM doctors is to strengthen the self-healing capacity of the body and the self-management of the patient. This approach is associated with prescribing fewer conventional pharmaceuticals, tests and operations. Nissen et al. [19, p. 14], based on a review of the literature on citizens' attitudes and needs concerning CAM in Europe, concluded that 'many citizens in Europe value the practice of CAM, particularly the CAM provider-patient relationship, and the patient-centred and holistic approach aspired to by many CAM providers.' Van Dulmen [20] concluded in a Dutch study comparing patients visiting conventional general practitioners (GPs) and three types of CAM GPs (homeopathy, acupuncture and naturopathy), that, contrary to expectations, patients do not consult a CAM physician because they are disappointed with mainstream GP care. CAM patients primarily appear to be seeking a physician who takes the time to talk with them and who will treat their complaints from a holistic viewpoint. Ernst and Hung [21] described the published evidence on the expectations of CAM users (in order of prevalence): hope to influence the natural history of the disease; disease prevention and health/ general well-being promotion; fewer side effects; being in control over one's health; symptom relief; boosting the immune system; emotional support; holistic care; improving quality of life; relief of side effects of conventional medicine; positive therapeutic relationship; obtaining information; coping better with illness; supporting the natural healing process; and the availability of treatment. In addition CAM GPs might focus more on the relationship and communication. For example Esch et al. [16] found that AM patients appreciated that their physicians listened to them (80.0% vs. 67.1%, $p < 0.001$), spent more time (76.5% vs. 61.7%, $p < 0.001$), had more interest in their personal situation (74.6% vs. 60.3%, $p < 0.001$), involved them more in decisions about their medical care (67.8% vs. 58.4%, $p = 0.022$), and made it easy to tell the physician about their problems (71.6% vs. 62.9%, $p = 0.023$). AM patients gave significantly better rating as to information and support (in 3 of 4 items, $p < 0.05$) and for thoroughness

(70.4% vs. 56.5%, $p < 0.001$). AM patients showed significantly higher treatment satisfaction in all of the five items than CON patients. These results are consistent with other studies demonstrating high patient satisfaction with AM [13,14]. For instance, in a Dutch survey (Consumer Quality Index, a national standard to measure healthcare quality from the perspective of healthcare users), 2,099 patients reported very high satisfaction with anthroposophic GP practices (8.4 on a scale: 0-10, 10 indicating the best possible score) [18]. These results are consistent with AM theory, which emphasizes relationship and communication, as well as shared decision-making [14]. More AM patients expressed a general treatment satisfaction (56.1% vs. 43.4%, $p < 0.001$) and saw their expectations completely fulfilled at follow-up (38.7% vs. 32.6%, $p < 0.001$). AM patients reported significantly fewer adverse side effects (9.3% vs. 15.4%, $p = 0.003$), and more other positive effects from treatment (31.7% vs. 17.1%, $p < 0.001$). Fourthly, the lower costs could be related to the fact that patients interested in CAM might have higher out-of-pocket expenses since not all CAM treatments are covered by supplementary insurance. Clarifying the role of out-of-pocket expenses is an empirical issue that requires additional data.

The major implication of this study and other economic evaluations of CAM is that there is sufficient evidence now to justify more professional interest in CAM from conventional healthcare professionals and policymakers. We can also conclude that there is sufficient good evidence that CAM can be cost-effective compared to conventional medicine, that the contribution of CAM might result in substantial diminishing of healthcare costs and therefore can provide a contribution to national healthcare policies aiming at controlling and diminishing healthcare expenditures. Therefore more investment in the study of the cost-effectiveness of CAM modalities with their additional health promotion medicines and therapies is indicated. The main unanswered questions in the current study are: where do the cost differences come from (to which indications and which therapies do they pertain to?) and what are the health-related effects of CAM treatment (objective parameters (e.g., lowering of blood pressure), quality of life, patient-reported outcomes, sick-leave, etcetera)? Future research should therefore focus on (1) exploring to what extent selection on unobservables and causal effects explain the lower costs of patients with a CAM GP; (2) exploring in more depth the costs differences between patients of CON GPs and CAM GPs in order to develop adequate, testable hypothesis of cost-effectiveness of specific CAM treatments for specific indications, and to transfer the cost differences related knowledge from CAM to CON GP practices in order to diminish healthcare expenditures in CON practices; (3) designing and

executing highly controlled, comparative effectiveness research projects [22] with more health related outcome parameters than mortality rate only; and (4) replication studies based on similar, large datasets with other CAM modalities (acupuncture, TCM herbal treatment, etcetera) and with other insurance companies to explore and confirm the present results.

Acknowledgements

We would like to thank Agis (Achmea) and especially Dr. Hugo Smeets and Mr. Henk Evers for providing the dataset for the study.

Funding

The only financial support for the study was provided by the Stichting Triodos Foundation. These financial resources were only used to cover the costs of Achmea for providing the dataset for the study. The researchers did not receive any funding for salaries or other costs.

Contributors

PK was the project lead for the statistical analyses. EB and PK wrote the manuscript. All authors reviewed the manuscript and contributed to manuscript revisions. EB is the guarantor for this study.

Competing interests

We have read and understood the BMJ Group policy on declaration of interests and declare the following interests:

- Dr. Erik W. Baars receives a part of his salary from the Professorship Anthroposophic Healthcare of the University of Applied Sciences Leiden, The Netherlands. The professorship works closely with those in the AH professional field and works on practical problems using applied research which focuses on three main categories: (1) investigating efficacy and safety, (2) developing and delivering optimal quality, and (3) improving communication about AH.

Data sharing

- No additional data available

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Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Role of the study sponsors

Not applicable.

Statement of independence of researchers from funders

Funders played no part in article selection, analysis, interpretation, or decision to publish.

Previous publication

A part of the content of our study results was published in February 2014 as a Dutch article in the Dutch journal Economisch Statistische Berichten for economists in The Netherlands [23].

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A six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM GPs

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Formatted: English (U.K.)

Abstract

Objectives To compare healthcare costs and mortality rates of Dutch patients with a conventional (CON) general practitioner (GP) and patients with a GP who has additionally completed training in complementary and alternative medicine (CAM).

Design Comparative economic evaluation.

Setting Database from the Dutch insurance company Agis.

Participants 1,521,773 patients (98.8%) from a CON practice and 18,862 patients (1.2%) from a CAM practice.

Main outcome measures Annual information on five types of healthcare costs for the years 2006 – 2011: care by GP, hospital care, pharmaceutical care, paramedic care and care covered by supplementary insurance. Healthcare costs in the last year of life. Mortality rates.

Results The mean annual compulsory and supplementary healthcare costs of CON patients are respectively 1,821 Euros (95% CI: 1,813 – 1,828) and 75.3 Euros (95% CI: 75.1 – 75.5). Compulsory healthcare costs of CAM patients are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12,4%) lower and result mainly from lower hospital care costs (165 Euros) (95% CI: 118 – 212; $p < 0.001$) and lower pharmaceutical care costs (58 Euros) (95% CI: 41 – 75; $p < 0.001$), especially in the age categories 25 – 49 years and 50 – 74 years. The costs in the last year of life of patients with CAM GPs are 1,161 euro (95% CI: -138 – 2,461; $p < 0.1$) lower. This difference is entirely due to lower hospital costs (1,250 Euros) (95% CI: 19 – 2,481; $p < 0.05$). The mean annual supplementary costs of CAM patients are 33 Euros (95% CI: 30 – 37; $p < 0.001$) (44%) higher. CAM patients do not have lower or higher mortality rates than CON patients.

Conclusions Dutch patients whose GP additionally completed training in CAM on average have 192 Euros (10.1%) lower annual total compulsory and supplementary healthcare costs and do not live longer or shorter than CON patients.

Strengths and limitations of this study

- The study is based on a large sample size of patients and practices and a relatively long period of six years contributing to more precise estimations, and better representativeness and generalizability of the results.
- The study distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to CAM.
- The study did not compare two treatments (conventional versus CAM) for a specific indication, in a controlled setting with other health related outcome parameters than mortality, reducing the ability to detect causal relationships between interventions and (cost)effects.
- Since the analyses were at the level of the 4-digit postcode and not at the level of the 6-digit postcode, the results might not be optimally controlled for socio-economic status of the patients.
- The study concerns a limited dataset, since the dataset is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most GP practices (64%) were anthroposophic). These facts challenge the generalizability of the results.

Introduction

In most countries of the European Union the annual healthcare costs are rising faster than the economy [1]. Therefore, national healthcare policies are increasingly aiming at controlling and diminishing healthcare expenditures. This also applies to the situation in The Netherlands [2]. In 1972 8% of the Dutch national income (GDP) was used to finance public healthcare. In 2010 already 13% of GDP was used and The Netherlands were worldwide in second place of healthcare expenditures of countries. Without drastic measures, the estimated costs will be over 30% in 2040 [3]. Public spending on healthcare will rise from 61 billion Euros in 2012 to an estimated nearly 80 billion Euros in 2017 [4]. Dutch health economists and policy makers have largely ignored the possible contribution of Complementary and Alternative Medicine (CAM) and Integrative Medicine (IM) to the reduction of healthcare costs as an area of research and interest. The here presented economic study, a six-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM general practitioners (GPs), contributes to the development of an evidence-based Dutch policy with regard to the role of CAM and IM in the reduction of healthcare expenditure growth.

The Dutch financing system

The Dutch financing system contains two basic compulsory health insurances, that are for 80% paid for through income taxes: for curative care (Zorgverzekeringswet (ZvW)) and for long-term care (Algemene Wet Bijzondere Ziektekosten (AWBZ)). The compulsory health insurances cover costs of most of GP, pharmaceutical and hospital care and some paramedic care. In addition, people in The Netherlands can buy supplementary insurance. Supplementary insurance covers costs not covered by basic insurance (for example specific or additional paramedic treatment, complementary therapies) (e.g., costs of CAM treatment is paid for up to 500 Euros/ year) [5]. Many supplementary insurances cover costs of CAM treatments like anthroposophic medicine, acupuncture and homeopathy. Supplementary insurance can also cover costs of improvements over the standard level of care paid for by compulsory insurance (e.g., extra costs for a better room and service in case of hospitalisation).

Policies to reduce healthcare expenditure growth

The vast majority of expenditure growth is due to innovations in healthcare. The Cultureel Planbureau (CPB) anticipates that the total costs of curative care will rise from 36 billion Euros this year to 49 billion Euros in 2017. The rising costs of curative care, according to the CPB is largely due to the 'creeping expansion' of the compulsory health insurance; 'Year after year, new medical techniques and drugs appear on the market that are often better, but also more expensive', especially, since more patients will be treated with the new techniques [3]. Of the total growth of public healthcare expenditure, about a quarter is the result of aging. In 2040 more than 22% of the Dutch population will be older than 65, whereas currently this is 16%. As people grow older, on average the costs of healthcare will increase (on the level of the whole older population).

Which policies can be deployed to control the risk of rising costs? The measures aimed at reducing healthcare expenditures are, without being complete: more efficiency and higher productivity in healthcare (including reducing management layers), more competition between healthcare institutions, fewer hospitals (specialization and concentration), more 'neighbourhood care' by general practitioners (GPs), more remote care (e-health), preventing overtreatment/ less (extra) care, more responsible behaviour of consumers (more self-care), more emphasis on healthy living (prevention), higher co-payments, higher deductibles and already saving for higher healthcare expenditure in the old days (precautionary savings) [3].

In July 2013 the Dutch healthcare minister Schippers reached an agreement with hospitals, medical specialists, mental healthcare providers, general practitioners, health insurers and patients' organizations to reduce the growth rate of healthcare spending: to 1.5% in 2014 and 1% per year from 2015 to 2017. This reduction represents a total additional savings of approximately 1 billion Euros. To achieve the reduced expenditure growth, extra measures will be taken that increase the efficiency and improve the quality of care: more care of medical specialists goes to the GP and from the GP to self-care; concentration of complex care; tighter application of medical guidelines and care standards; treatments are given according the standards of the medical profession itself; access to the claims of the compulsory health insurances is tightened; and more transparency about quality and cost of care [6].

The contribution of Complementary and Alternative Medicine

According to the National Center for Complementary and Alternative Medicine (NCCAM), CAM is a group of diverse medical and healthcare systems, practices, and products that are not generally considered part of conventional medicine [7]. The Cochrane Collaboration definition of complementary medicine is that it includes all such practices and ideas that are outside the domain of conventional medicine in several countries and defined by its users as preventing or treating illness, or promoting health and well-being. These practices complement mainstream medicine by satisfying a demand not met by conventional practices and diversifying the conceptual framework of medicine [8]. "Integrative Medicine is the practice of medicine that reaffirms the importance of the relationship between practitioner and patient, focuses on the whole person, is informed by evidence, and makes use of all appropriate therapeutic approaches, healthcare professionals and disciplines to achieve optimal health and healing." [9] In addition, IM emphasizes the active role of the patient in prevention (lifestyle), well-being and therapy and healing processes, and the use of healing environments [9].

Herman et al. [10] performed a systematic review of economic evaluations on complementary and integrative medicine (CIM). This study identified 338 economic evaluations of CIM, including 114 full evaluations, published between 2001 and 2010. All recent (and likely most cost-relevant) full economic evaluations published from 2001 to 2010 were subjected to several measures of quality. Detailed results of higher-quality studies were reported. The cost-utility analyses found were of similar or better quality to those published across all medicine. Of the 56 comparisons made in the higher-quality studies, 16 (29%) show a health improvement with cost savings for the CIM therapy versus usual (conventional) care. Study quality of the cost-utility analyses (CUAs) of CIM was generally comparable to that seen in CUAs across all medicine according to several measures, and the quality of the cost-saving studies was slightly, but not significantly, lower than those showing cost increases (85% vs 88%, $p = 0.460$).

In The Netherlands, a few percent of the GPs have followed an additional training in CAM. In 2010, we performed an initial economic evaluation, comparing the healthcare costs of patients from Dutch conventional (CON) GPs and CAM GPs [11]. A dataset from a Dutch health insurer Azivo was used containing quarterly information on healthcare costs (GP care, hospital care, pharmaceutical care, and paramedic care), dates of birth and death (if

applicable), gender and 6-digit postcode of all approximately 150,000 insurees, for the years 2006–2009. Data from 1,913 conventional GPs were compared with data from 79 GPs with additional CAM training in acupuncture (n=25), homeopathy (n=28), and anthroposophic medicine (n=26). Results were that patients whose GP has additionally completed training in CAM training had 0–30% lower healthcare costs and mortality rates, depending on age groups and type of CAM. The lower costs resulted from fewer hospital stays and fewer prescription drugs. It was concluded that more controlled studies (replication studies, research based on more comprehensive data, cost-effectiveness studies on CAM for specific diagnostic categories) were indicated.

This study

Given the current need to diminish healthcare expenditures in The Netherlands and based on the positive results from both the review of Herman et al. [10] and our own study [11], we decided to perform a replication study comparing the healthcare costs of patients from conventional (CON) GPs and CAM GPs with a larger dataset from a Dutch health insurer, to analyse the robustness of the results of the first study. The research questions of the study were:

1. Is there a statistically significant difference in healthcare costs (care by GP, hospital care, pharmaceutical care, paramedic care, care covered by supplementary insurance, and healthcare costs in the last year of life) of patients from CON GPs and CAM GPs?
2. Is there a statistically significant difference in mortality rates of patients from CON GPs and CAM GPs?

Methods

Comparative economic evaluation

Full economic evaluations compare the costs (resource use) associated with one or more alternative interventions (e.g., intervention X versus comparator Y) with their consequences (outcomes, effects). In this study we were able to measure five types of costs in two categories: (1) care covered by compulsory insurance: care by GP, hospital care,

pharmaceutical care, paramedic care, and (2) costs covered by supplementary insurance. Alternative interventions were: conventional GP care compared to care from GPs that know CAM. Outcomes were: differences in healthcare costs and annual mortality rates.

Model overview

Costs were analysed at the patient level using linear and loglinear regression analysis. The cost analysis has been performed for the total sample, as well as separately for the age groups 0–24, 25–49, 50–74, and ≥ 75, given the large average differences in health and healthcare needs across age groups. Effects on mortality rates are analysed using a linear probability model (LPM), a Logit model, and a Cox proportional hazard model (CPH). In all models, the explanatory variables are gender, age (linear, within each age category), dummies for CAM and 'Vogelaarwijk' (city areas with known lower socio-economic status of inhabitants), year dummies, and postal code fixed effects. In the cost regressions and the LPM model, fixed effects at the 4-digit insuree postcode level were controlled for. In the Logit and CPH model 2-digit postcode level fixed effects were included, as estimation with more detailed fixed effects appeared to be numerically infeasible.

The regression approach is standard practice in health economics and yields results similar to those of matching procedures (both are unable to correct for unobserved differences between groups of patients). Given the large sample sizes Student's t tests are asymptotically valid by virtue of the central limit theorem, independent of whether the underlying distributions are normal or non-normal. Standard errors are clustered at the level of the insured to control for the statistical dependence of observations pertaining to a given insured person (i.e. observations are independent 'between' individuals but dependent 'within' individuals).

With regard to the six years of data the data set was used as a panel. This means that if an insured person is observed for all six years, six observations of annual costs of this person are used in the analysis (taking into account the 'within'-person correlation by clustering standard errors at the level of the individual). The reported differences can be interpreted as the average of cost differences across years. Any trends are controlled for by the year dummy variables.

Dataset on healthcare costs and demographics

A dataset was analyzed from health insurer Agis, a subsidiary company of Achmea. Achmea has a share in the market of 31% (5.18 million insured) of the Dutch population in 2013; while the share of Agis is 9,2% (1.54 million insured). The dataset contains quarterly information on the healthcare costs of all Agis insurees, which was aggregated to annual information for the years 2006 up to 2011. In addition, it contains the date of birth of the insuree, date of death (if applicable), gender, and 4-digit postcode of the insured's residence. For each insuree year combination, information on the costs of five different types of care is available: care by GP, hospital care, pharmaceutical care, paramedic care (like physical therapy), and care covered by supplementary insurance.

General practitioners and patients

The dataset also contains the names and addresses of the general practitioners who have patients who are insured by Agis, which allows us to distinguish between CON GPs and CAM GPs. We defined a general practitioner as anthroposophic CAM GP if his or her name appears in the list of general practitioners with additional training in anthroposophic medicine (AM) as provided by their professional association [14]. CAM GPs with homeopathy (HOM) [15] and CAM GPs with acupuncture [16] are defined similarly.

Patients were regarded CON patients and CAM patients if they were patient of respectively a CON GP or a CAM GP during all of the years they appear in the dataset. Patients that transferred from a CON GP to a CAM GP or vice versa , were regarded to be a member of a third group called 'Switchers' ~~and were excluded from all analyses~~.

Statistical analyses

Significance of coefficients is tested using Student's t tests, with clustering of standard errors at the level of the insured. Given the large sample sizes available here, asymptotic t-testing for differences in means is appropriate by virtue of the central limit theorem. Calculations were made using StataSE 10.0. Means with 95% confidence intervals and p-values (< 0.1, < 0.05, and < 0.01) are presented.

Ethical approval

Since the study involved no experimental treatment, patients were not recruited. Since patient data were anonymized, no ethical approval was necessary.

Results

GP practices and patients

The dataset contained 9,126 GP practices: 9,016 CON practices and 110 CAM practices. Due to the systematics of the insurance company, one individual GP can appear as different practices, so the actual number of GPs is lower than the number of GP practices. Contrarily, each patient is never counted more than once. The majority of the CAM GPs are anthroposophic GPs (70 AM practices (64%)). Other CAM GPs were specialized in acupuncture (15%) and homeopathy (25%). Since some GPs were specialized in more than one CAM modality the total percentage of CAM GPs is larger than 100%. Exact numbers and percentages of CAM GPs vary a little over the years.

Healthcare costs

The dataset

The dataset contains information of more than 1.5 million insurees during the years 2006-2011 (Table 1). Nearly 19,000 insurees (1.2%) had throughout this whole period a CAM GP. More than 10,000 other insurees had in some years a CON GP and in other years a CAM GP ('Switchers'). On average, the Switchers group had three years a CON GP and three years a CAM GP. The insurees had a mean age of 41.0 (SD=23.5). 53% are women. These patients live in 4,014 different 4-digit postal codes.

Without controlling for relevant differences between the groups, the comparison demonstrates: higher percentages of females in in the CAM GP and Switchers groups; higher percentages of insurees living in the 'Vogelaarwijk' in the CON and Switchers group; 183 Euros lower and 168 Euros higher total compulsory costs in respectively the CAM and the Switchers group; and 40 Euros and 25 Euros higher supplementary costs in costs in respectively the CAM and the Switchers group. The percentages of patients with a

supplementary insurance were almost the same (CON GPs: 92.7%; CAM GPs: 93.4% and Switchers: 92.1%).

Since the aim of the study was to compare the costs of patients with a CON GP and a CAM GP, the data of the Switchers group were left out of the ~~further~~ main regression analyses on annual total compulsory and supplementary costs. The results of the analyses on the Switchers group are separately presented ~~(~~in Appendix 1~~)~~.

Table 1. Descriptive statistics of the dataset

	CON GP	CAM GP	Switchers
Insured (n)	1,521,773	18,862	10,769
Age (year)	41.0	41.6	40.1
Female (percentage)	52.9%	55.2%	56.4%
'Vogelaarwijk' (percentage)	15.7%	9.3%	17.1%
Supplementary insured (percentage)	92.7%	93.4%	92.1%
Compulsory insurance costs (Euros)			
Total costs	1,821	1,638	1,989
GP costs	133	128	140
Pharmaceutical costs	402	357	474
Hospital costs	1,242	1,104	1,328
Paramedical costs	44	48	47
Supplementary insurance costs (Euros)	75	115	100

Annual total compulsory and supplementary insurance costs

The mean annual total costs of patients treated in CON practices covered by the compulsory insurance were 1,821 Euros (95% CI: 1,813 – 1,828) (Table 1). After correction for observed differences between the groups by means of linear regression analyses, the mean annual total compulsory insurance costs of patients of CAM GP practices are 225 Euros (95% CI: 169 –

281; p < 0.001) (12.4%) lower. These lower costs are mainly due to lower hospital costs (165 Euros; 95% CI: 118 – 212; p < 0.001) and lower pharmaceutical care costs (58 Euros; 95% CI: 41 – 75; p < 0.001).

The mean annual total supplementary costs for patients treated in CON practices were 75.3 Euros (95% CI: 75.1 – 75.5). (The mean is calculated over all patients, including those (less than 8%) without supplementary insurance.). For patients treated in CAM practices these costs are 33 Euros (95% CI: 31 – 37; p < 0.001) (44%) higher and were highest in the third age group (50 – 74 years) (52 Euros (95% CI: 31 – 37; p < 0.001)). Taken together, the mean total annual compulsory and supplementary insurance costs are 192 Euros (10.1%) lower for the CAM group of patients.

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (Appendix Table 3 2) provide the same lower costs for the CAM group of patients as found in the linear analyses (Table 2). In addition, higher paramedic costs are found for the CAM group of patients.

Costs per age category and insurance category

Lower total compulsory costs were found in all age categories (Table 2): 80 Euro (95% CI: 21 – 140; p < 0.01) in the first group (0-24 years); 137 Euros (95% CI: 54 – 219; p < 0.01) in the second group (25 – 49 years); 356 Euros (95% CI: 227 – 485; p < 0.001) in the third group (50 – 74 years), and 236 Euros (95% CI: -9 – 481; p < 0.1) in the last group (75+ years). Lower pharmaceutical costs were found in the second age group (25 – 49 years) (50 Euros; 95% CI: 23 – 77; p < 0.001) and the third age group (50 – 74 years) (126 Euros; 95% CI: 88 – 164; p < 0.001). Lower hospital costs were found in all age groups, with the largest differences in the third age group (50 – 74 years) (232 Euros; 95% CI: 124 – 341; p < 0.001) and the last age group (75+ years) (219 Euros; 95% CI: 7 – 431; p < 0.05). In addition, the largest difference in total compulsory costs was found in the last year of life (1,161 Euros; 95% CI: -138 – 2,461; p < 0.1), which is completely the result of lower hospital costs (1,250 Euros; 95% CI: 19 – 2,481; p < 0.05).

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (Appendix 2. Table 4) provide the same lower costs for the separate age groups of CAM patients as found in the linear analyses (Table 2). In addition, now there are

also significant lower costs for the CAM group of patients with regard to GP costs in the third age group (50 – 74), lower pharmaceutical costs in the first (0 – 24) and the last age group (75+); and higher paramedic costs in the second (25 – 49) and third (50 – 74) age group.

Table 2. Estimated differences in mean annual total compulsory and supplementary insurance costs: CAM patients compared to CON patients (linear regression model)

	Compulsory insurance costs					Supplementary insurance costs
	Total	GP	Pharmaceutical	Hospital	Paramedic	
All ages	-225***	-3***	-58***	-165***	1	33***
0-24	-80***	-3***	-2	-74***	-2	11***
25-49	-137***	-2**	-50***	-85**	1	32***
50-74	-356***	-1	-126***	-232***	3	52***
75+	-236*	11***	-38	-219**	10	24***
Last year of life	-1,161*	5	67	-1,250**	27	3

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Mortality rates

In the present dataset, the only information available on health outcomes is mortality. During the period 2006 – 2011 80,543 patients died in the CON group (5.26%) and 973 in the CAM group (5.14%). After controlling for all relevant variables (age, postal codes, etcetera), we find that patients with a CAM GP have significantly lower mortality rates in all LMP analyses (Table 3). However, the differences are very small: total group: 0.004 (95% CI: 0.001 – 0.007; $p < 0.05$); men: 0.004 (95% CI: 0.001 – 0.008; $p < 0.1$); women: 0.007 (95% CI: 0.003 – 0.011; $p < 0.05$). The Logit analyses resulted in a significantly higher mortality rate for the total group at the 10% level (but not at the 5% level) (0.066; 95% CI: -0.143 – 0.011; $p < 0.1$), but no significant differences for men and women separately. The Cox proportional hazard analyses resulted in significant higher mortality rates at the 10% level (but not at the 5% level), both for the total group: 1.059 (95% CI: 0.994 – 1.129; $p < 0.1$), and

the group of women: 1.072 (95% CI: 0.987 – 1.165; $p < 0.1$), but no significant difference for men wasere found.

Based on all results, taking into account the small differences in the LPM analyses, the high p-values ($p < 0.1$) in the Logit and Cox proportional hazard analyses and the contradictory outcomes between the LPM analyses on the one hand and the Logit and Cox proportional hazard analyses on the other hand, we conclude that there is no difference in mortality rates between the CON and CAM group of patients.

Table 3. Differences in mortality rates: CAM patients compared to CON patients

	Total	Men	Women
LPM with fixed effects	-0.004**	-0.004*	-0.007**
Logit with fixed effects	0.066*	0.081	0.049
Cox proportional hazard	1.059*	1.043	1.072*

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

Conclusions

The comparison of the healthcare costs of insurees of CON GPs and CAM GPs in a database with data of 1,540,635 patients from the Dutch insurance company Agis during the period 2006-2011 demonstrates:

1. On average annual total compulsory and supplementary healthcare costs of patients treated by a CAM GP are 192 Euros (10.1%) lower than the costs of patients treated by conventional GPs as a result of 225 Euros (12.4%) lower compulsory costs and 33 Euros (44%) higher supplementary costs.
2. The lower mean annual total compulsory healthcare costs are mainly due to lower hospital care costs (165 Euros) and lower pharmaceutical care costs (58 Euros).
3. Lower mean annual total compulsory healthcare costs are demonstrated in all age categories, but the differences are largest in the third age group (50 – 74 years) (total costs: 356 Euros; hospital care: 232 Euros; pharmaceutical care: 126 Euros) and in the last year of life (total costs: 1,093 Euros; hospital care: 1,223 Euros).

4. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a CON GP.

Discussion

In this study the mean annual total compulsory costs, supplementary costs, costs during the last year of life and mortality rates of patients with a conventional (CON) GP (n = 1.52 million; 98.8%) and patients with GPs that know complementary and alternative medicine (CAM) (n = 18,862; 1.2%) were compared in a dataset from the Dutch insurance company Agis over a six year period (2006 – 2011) by means of regression analyses. The mean annual compulsory healthcare costs of patients treated by a conventional GP are 1,821 Euros (95% CI: 1,813 – 1,828). On average annual total compulsory healthcare costs of patients treated by a CAM GP are 225 Euros (95% CI: 169 – 281; $p < 0.001$) (12.4%) lower than patients treated by conventional GPs. Lower total compulsory costs were found in all age categories. Lower pharmaceutical costs were found in the second age group (25 – 49 years) (50 Euros; 95% CI: 23 – 77; $p < 0.001$) and the third age group (50 – 74 years) (126 Euros; 95% CI: 88 – 164; $p < 0.001$). Lower hospital costs were found in all age groups. The largest difference in total compulsory costs was found in the last year of life (1,161 Euros; 95% CI: -138 – 2461; $p < 0.1$), which is completely the result of lower hospital costs (1,250 Euros; 95% CI: 19 – 2481; $p < 0.05$). The mean annual supplementary insurance costs of patients treated by a conventional GP are 75.3 Euros (95% CI: 75.1 – 75.5). On average annual supplementary healthcare costs of patients treated by a CAM GP are 33 Euros (95% CI: 31 – 37; $p < 0.001$) (44%) higher. The absolute lower compulsory costs for all patients for the six years period (2006 – 2011) for the CAM group is 25,463,700 Euros (or on average 4,243,950 Euros per year) compared to the CON group. The extrapolation of the lower costs in the CAM group of patients to the Dutch population (16.8 million inhabitants), if applicable, would result in 3.78 billion Euros lower annual compulsory costs. The absolute lower compulsory and supplementary costs for all patients for the six years period (2006 -2011) for the CAM group is 21,729,024 Euros (or on average 3,621,504 Euros per year) compared to the CON group. The extrapolation of the lower costs in the CAM group of patients to the Dutch population (16.8 million inhabitants), if applicable, would result in 3.23 billion Euros lower annual compulsory and supplementary costs. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a conventional GP.

The first strength of the study is the large sample size of patients and practices. Approximately 9.2% of the Dutch population (1.54/ 16.8 million), and 29.7% of the insurees of Achmea (1.54/ 5.18 million) were included in the study. Compared to the first pilot study [11] there were 10 times more patients from a CON GP (151,952 versus 1,521,773), three times more patients from a CAM GP (5,922 versus 18,862), 4,5 times more CON GP practices (1,913 versus 9,016) and about 1,5 times more CAM practices (79 versus 110). This large sample size allows a more precise estimate of costs and mortality rate differences and increases the representativeness of the sample and the generalizability of the results [13]. The second strength is that the results are based on a relatively long period of six years, also contributing to more precise estimations, and better representativeness and generalizability of the results. Thirdly, this study, unlike the first pilot study [11], distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to CAM. The first limitation of the study is that it did not compare two treatments (CON versus CAM) for a specific indication, in a controlled setting with other health related outcome parameters than mortality, reducing the ability to detect causal relationships between interventions and (cost)effects. Missing information includes costs of out-of pocket expenses, morbidity, work absence, objective disease related outcome measures, subjective health and patient satisfaction. A second limitation is, contrary to the first pilot study [11], that we were not able to analyse at the level of the 6-digit postcode but only at the level of the 4-digit postcode. As a result, the results might not be optimally controlled for socio-economic status of the patients. However, a reanalysis of the data of the first pilot study [11] demonstrated very small differences in results between the analyses with the 6-digit postcode and the analyses with the 4-digit postcode. Another limitation of the study concerns the limited dataset, since the dataset is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most GP practices (64%) were anthroposophic). These facts challenge the generalizability of the results.

The current results with regard to differences in healthcare costs confirm the results of our first smaller pilot study [11] with only 153,000 insurees and observations during a four-year period. In addition, the current study with 10 times as many patients and a two-year longer period of observations, enabled to estimate the cost differences more precisely. Whereas in this first study estimation of mean annual total compulsory costs of CAM patients were in the range of 0 – 30% lower than these of patients of CON GPs, the mean cost differences are now estimated to be 12.4% lower (range: 9.3 – 15.4%) for the CAM group.

Like in the first study, the lower total compulsory costs are mainly the result from lower hospital and pharmaceutical costs. Lower costs for CAM in this study are also in line with the results of the recent review of Herman et al. [10] on economic evaluation of CAM and CIM, demonstrating that 29% of comparisons made in the 56 higher-quality studies showed a health improvement with cost savings for the CIM therapy versus usual (conventional) care. Since most CAM patients in the current study were treated in an anthroposophic practice, comparison with other economic studies on anthroposophic medicine (AM) is justified. Kienle et al. [13,15] reviewed the few economic investigations on AM, demonstrating less or equal costs in AM compared to CON treatment, due to reduced hospital admissions and less prescriptions of medications. Hamre et al. [15] found that in patients starting anthroposophic therapies for chronic disease, total healthcare costs did not increase in the first year, and were significantly reduced in the second year by 416 Euros (95% CI: 264 – 960) compared to the pre-study year. This reduction was largely explained by a decrease of inpatient hospitalisation. With regard to differences in mortality rates between CON and CAM patients, the results do not confirm the (weak) evidence of lower mortality rates that were found in the first study [11]. The conclusion is now that CAM patients do not have lower or higher mortality rates than CON patients.

With regard to the healthcare costs differences reported in the Results section, we can hypothesize four types of explanations. First, the differences could be due to selection on unobservables in patients' GP choice. For example, patients who are healthier and more health-conscious or patients with a strong preference to minimize exposure to medical interventions might be more likely to choose a CAM GP. In both cases, costs will be lower due to lower demand for healthcare. A standard approach to control for selection on unobservables in a non-experimental setting is to use Instrumental Variables (IV). A potential instrumental variable in this case is the distance between a patient's home and the various GPs, cq. a change in distance as a result of a move of a patient or practice. We intend to explore this approach in future work. With respect to selection, several studies that compare the health status of patients treated in CAM and in conventional medicine in primary care settings find that patients treated in CAM practices suffer more often from severe and chronic illnesses (e.g., [16, 17]). This suggests that if we could control for severity and chronicity of illnesses (with additional data), the estimated compulsory cost differences might be larger. Second, the results could be due to undertreatment by CAM GPs. In the present dataset, we were only able to analyse mortality and found that patients with a CAM GP tend to have

equal mortality rates. However, a number of studies have reported that patients seeking CAM or anthroposophic care have longer lasting and more severe health problems than patients in conventional care. At the same time, these patients report fewer adverse side effects of treatments and higher patient satisfaction (e.g., [16-18]). These findings combined with the results in this study provide some indication that undertreatment by CAM GPs is unlikely. Firmer conclusions require more detailed data on outcomes. Thirdly, the results could be due to better practices of CAM due to a stronger focus on preventive and curative health promotion, less overtreatment and better communication and professional relationships. For example, a CAM GP might try a low-cost CAM treatment first. As mentioned, the primary professional orientation of CAM doctors is to strengthen the self-healing capacity of the body and the self-management of the patient. This approach is associated with prescribing fewer conventional pharmaceuticals, tests and operations. Nissen et al. [19, p. 14], based on a review of the literature on citizens' attitudes and needs concerning CAM in Europe, concluded that 'many citizens in Europe value the practice of CAM, particularly the CAM provider-patient relationship, and the patient-centred and holistic approach aspired to by many CAM providers.' Van Dulmen [20] concluded in a Dutch study comparing patients visiting conventional general practitioners (GPs) and three types of CAM GPs (homeopathy, acupuncture and naturopathy), that, contrary to expectations, patients do not consult a CAM physician because they are disappointed with mainstream GP care. CAM patients primarily appear to be seeking a physician who takes the time to talk with them and who will treat their complaints from a holistic viewpoint. Ernst and Hung [21] described the published evidence on the expectations of CAM users (in order of prevalence): hope to influence the natural history of the disease; disease prevention and health/ general well-being promotion; fewer side effects; being in control over one's health; symptom relief; boosting the immune system; emotional support; holistic care; improving quality of life; relief of side effects of conventional medicine; positive therapeutic relationship; obtaining information; coping better with illness; supporting the natural healing process; and the availability of treatment. In addition CAM GPs might focus more on the relationship and communication. For example Esch et al. [16] found that AM patients appreciated that their physicians listened to them (80.0% vs. 67.1%, $p < 0.001$), spent more time (76.5% vs. 61.7%, $p < 0.001$), had more interest in their personal situation (74.6% vs. 60.3%, $p < 0.001$), involved them more in decisions about their medical care (67.8% vs. 58.4%, $p = 0.022$), and made it easy to tell the physician about their problems (71.6% vs. 62.9%, $p = 0.023$). AM patients gave significantly better rating as to information and support (in 3 of 4 items, $p < 0.05$) and for thoroughness

(70.4% vs. 56.5%, p < 0.001). AM patients showed significantly higher treatment satisfaction in all of the five items than CON patients. These results are consistent with other studies demonstrating high patient satisfaction with AM [13,14]. For instance, in a Dutch survey (Consumer Quality Index, a national standard to measure healthcare quality from the perspective of healthcare users), 2,099 patients reported very high satisfaction with anthroposophic GP practices (8.4 and 8.3 on a scale: 0-10, 10 indicating the best possible score) [18]. These results are consistent with AM theory, which emphasizes relationship and communication, as well as shared decision-making [14]. More AM patients expressed a general treatment satisfaction (56.1% vs. 43.4%, p < 0.001) and saw their expectations completely fulfilled at follow-up (38.7% vs. 32.6%, p < 0.001). AM patients reported significantly fewer adverse side effects (9.3% vs. 15.4%, p = 0.003), and more other positive effects from treatment (31.7% vs. 17.1%, p < 0.001). Fourthly, the lower costs could be related to the fact that patients interested in CAM might have higher out-of-pocket expenses since not all CAM treatments are covered by supplementary insurance. Clarifying the role of out-of-pocket expenses is an empirical issue that requires additional data.

The major implication of this study and other economic evaluations of CAM is that there is sufficient evidence now to justify more professional interest in CAM from conventional healthcare professionals and policymakers. We can also conclude that there is sufficient good evidence that CAM can be cost-effective compared to conventional medicine, that the contribution of CAM might result in substantial diminishing of healthcare costs and therefore can provide a contribution to national healthcare policies aiming at controlling and diminishing healthcare expenditures. Therefore more investment in the study of the cost-effectiveness of CAM modalities with their additional health promotion medicines and therapies is indicated. The main unanswered questions in the current study are: where do the cost differences come from (to which indications and which therapies do they pertain to?) and what are the health-related effects of CAM treatment (objective parameters (e.g., lowering of blood pressure), quality of life, patient-reported outcomes, sick-leave, etcetera)? Future research should therefore focus on and (1) exploring to what extent selection on unobservables and causal effects explain the lower costs of patients with a CAM GP; and (2) exploring in more depth the costs differences between patients of CON GPs and CAM GPs in order to develop adequate, testable hypothesis of cost-effectiveness of specific CAM treatments for specific indications, and to transfer the cost differences related knowledge from CAM to CON GP practices in order to diminish healthcare expenditures in CON

practices; (3) designing and executing highly controlled, comparative effectiveness research projects [22] with more health related outcome parameters than mortality rate only; and (4) replication studies based on similar, large datasets with other CAM modalities (acupuncture, TCM herbal treatment, etcetera) and with other insurance companies to explore and confirm the present results.

Acknowledgements

We would like to thank Agis (Achmea) and especially Dr. Hugo Smeets and Mr. Henk Evers for providing the dataset for the study.

Competing interests

We have read and understood the BMJ Group policy on declaration of interests and declare the following interests:

- Dr. Erik W. Baars receives a part of his salary from the Professorship Anthroposophic Healthcare of the University of Applied Sciences Leiden, The Netherlands. The professorship works closely with those in the AH professional field and works on practical problems using applied research which focuses on three main categories: (1) investigating efficacy and safety, (2) developing and delivering optimal quality, and (3) improving communication about AH.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Contributors

PK was the project lead for the statistical analyses. EB and PK wrote the manuscript. All authors reviewed the manuscript and contributed to manuscript revisions. EB is the guarantor for this study.

Funding

The only financial support for the study was provided by the Stichting Triodos Foundation. These financial resources were only used to cover the costs of Achmea for providing the dataset for the study. The researchers did not receive any funding for salaries or other costs.

Role of the study sponsors

Not applicable.

Statement of independence of researchers from funders

Funders played no part in article selection, analysis, interpretation, or decision to publish.

Data sharing

Details of how to obtain additional data from the study can be obtained from EB (baars.e@hsleiden.nl).

Previous publication

A part of the content of our study results was published in February 2014 as a Dutch article in the Dutch journal Economisch Statistische Berichten for economists in The Netherlands [23].

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Appendix 1

The Switcher group

From the total group of 10,769 Switchers, during the period 2006 – 2011, 6,224 patients switched one time; 2,992 patients switched two times (= back to their first type of GP); 1,282 patients switched three times; 241 patients switched four times and 30 patients switched five times. From the Switchers group that started with a CAM GP, 69.3% ends up with a CON GP. From the Switchers group that started with a CON GP, 70.5% ends up with a CAM GP. As a result the total percentages of CAM patients and CON patients hardly change.

When we analyze the changes in compulsory costs after switching in the subgroup that switched only one time, the total compulsory costs after switching are higher, independent of the direction of the switch. Switching from a CON to a CAM GP results in 337 Euros higher costs ($p < 0.001$), switching from a CAM to a CON GP results in 372 Euros higher costs ($p < 0.001$). After correction for observed differences between the groups by means of linear regression analyses, switching from a CON to a CAM GP results in 34 Euros lower costs (not significant: $p = 0.83$) and switching from a CAM to a CON GP results in 360 Euros higher costs ($p < 0.079$).

When we analyze the changes in supplementary costs after switching in the subgroup that switched only one time, we see that switching from a CON to a CAM GP results in 23 Euros higher costs ($p < 0.001$), and that switching from a CAM to a CON GP results in 1 Euro lower costs (not significant: $p = 0.78$). After correction for observed differences between the groups by means of linear regression analyses, switching from a CON to a CAM GP results in 1 Euro higher costs (not significant: $p = 0.816$) and switching from a CAM to a CON GP results in 2 Euros higher costs (not significant: $p = 0.803$).

~~Since we are mainly interested in the differences in costs between patients that have a CAM GP and patient that have a CON GP for the whole period of six years (2006-2011), the Switcher group is left out of the following analyses.~~

Appendix 2

Table 4. Estimated differences in mean annual total compulsory and supplementary insurance costs: CAM patients compared to CON patients (loglinear regression model)

	Compulsory insurance costs					Supplementary insurance costs
	Total	GP	Pharmaceutical	Hospital	Paramedic	
All ages	-.114***	-.121***	-.281***	-.185***	.028**	.496***
0-24	-.071***	-.018**	-.169***	-.152***	.017	.344***
25-49	-.088***	-0.14**	-.267***	-.153***	.021*	.433***
50-74	-.173***	-.025***	-.418***	-.220***	.036*	.653***
75+	-.072**	.026*	-.176***	-.124**	.055	.355***
Last year of life	-.146**	.026	-.143	-.287**	.178	.134

*: p-value < 0.1; **: p-value < 0.05; ***: p-value < 0.01

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When we analyze the changes in compulsory costs after switching in the subgroup that switched only one time, the total compulsory costs after switching are higher, independent of the direction of the switch. Switching from a CON to a CAM GP results in 337 Euros higher costs ($p < 0.001$), switching from a CAM to a CON GP results in 372 Euros higher costs ($p < 0.001$). After correction for observed differences between the groups by means of linear regression analyses, switching from a CON to a CAM GP results in 34 Euros lower costs (not significant: $p = 0.83$) and switching from a CAM to a CON GP results in 360 Euros higher costs ($p < 0.079$).

When we analyze the changes in supplementary costs after switching in the subgroup that switched only one time, we see that switching from a CON to a CAM GP results in 23 Euros higher costs ($p < 0.001$), and that switching from a CAM to a CON GP results in 1 Euro lower costs (not significant: $p = 0.78$). After correction for observed differences between the groups by means of linear regression analyses, switching from a CON to a CAM GP results in 1 Euro higher costs (not significant: $p = 0.816$) and switching from a CAM to a CON GP results in 2 Euros higher costs (not significant: $p = 0.803$).

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Additional file 1

EVEREST Statement: Checklist for health economics paper

	Study section	Additional remarks
Study design		
(1) The research question is stated	Introduction	
(2) The economic importance of the research question is stated	Introduction	
(3) The viewpoint(s) of the analysis are clearly stated and justified	Methods; Discussion	
(4) The rationale for choosing the alternative programmes or interventions compared is stated	Methods	
(5) The alternatives being compared are clearly described	Introduction; Methods	
(6) The form of economic evaluation used is stated	Introduction; Methods	
(7) The choice of form of economic evaluation is justified in relation to the questions addressed	Introduction; Methods; Discussion	
Data collection		
(8) The source(s) of effectiveness estimates used are stated	Methods	
(9) Details of the design and results of effectiveness study are given (if based on single study)	N/A	
(10) Details of the method of synthesis or meta-analysis of estimates are given (if based on an overview of a number of effectiveness studies)	N/A	
(11) The primary outcome measure(s) for the economic evaluation are clearly stated	Methods	
(12) Methods to value health states and other benefits are stated	Introduction; Methods	
(13) Details of the subjects from whom valuations were obtained are given	Methods	
(14) Productivity changes (if included) are reported separately	N/A	
(15) The relevance of productivity changes to the study question is discussed	N/A	
(16) Quantities of resources are reported separately from their unit costs	Methods; Tables 2-4	
(17) Methods for the estimation of quantities and unit costs are described	Methods; Tables 2-4	
(18) Currency and price data are recorded	Methods; Tables 2-4	
(19) Details of currency of price adjustments for	NA	

inflation or currency conversion are given		
(20) Details of any model used are given	Methods-Model overview	
(21) The choice of model used and the key parameters on which it is based are justified	Methods	
Analysis and interpretation of results		
(22) Time horizon of costs and benefits is stated	Methods; Discussion	
(23) The discount rate(s) is stated	N/A	
(24) The choice of rate(s) is justified	N/A	
(25) An explanation is given if costs or benefits are not discounted	N/A	
(26) Details of statistical tests and confidence intervals are given for stochastic data	N/A	
(27) The approach to sensitivity analysis is given	N/A	
(28) The choice of variables for sensitivity analysis is justified	Methods; Tables 2-4	Confidence intervals are given
(29) The ranges over which the variables are varied are stated	Tables 2-4	
(30) Relevant alternatives are compared	Introduction; Methods	
(31) Incremental analysis is reported	Discussion	We describe the extrapolation from the lower costs in the CAM group of patients to the Dutch population
(32) Major outcomes are presented in a disaggregated as well as aggregated form	Tables 2-4	
(33) The answer to the study question is given	Discussion; Conclusion	
(34) Conclusions follow from the data reported	Conclusion	
(35) Conclusions are accompanied by the appropriate caveats	Discussion; Conclusion	