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A 6-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 €1821 (95% CI 1813 to 1828) and €75.3 (95% CI 75.1 to 75.5). Compulsory healthcare costs of CAM patients are €225 (95% CI 169 to 281; p<0.001; 12.4%) lower and result mainly from lower hospital care costs (€165; 95% CI 118 to 212; p<0.001) and lower pharmaceutical care costs (€58; 95% CI 41 to 75; p<0.001), especially in the age categories 25–49 and 50–74 years. The costs in the last year of life of patients with CAM, GPs are €1161 (95% CI −138 to 2461; p<0.1) lower. This difference is entirely due to lower hospital costs (€1250; 95% CI 19 to 2481; p<0.05). The mean annual supplementary costs of CAM patients are €33 (95% CI 30 to 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 (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 6 years contributing to more precise estimations, and better representativeness and generalisability of the results.
- The study distinguishes between compulsory and supplementary costs providing a more complete picture of healthcare costs expenditure related to complementary and alternative medicine (CAM).
- The study did not compare two treatments (conventional vs. 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 socioeconomic status of the patients.
- The study concerns a limited data set, since the data set is from only one insurer and the data reflect the behaviour of only a small number of CAM modalities (most general practitioner practices (64%) were anthroposophic). These facts challenge the generalisability 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 (gross domestic product, 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 billions in 2012 to an estimated nearly €80 billions in 2017.[4] Dutch health economists and policymakers have largely ignored the possible contribution of complementary and

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alternative medicine (CAM) and integrative medicine (IM) to the reduction of healthcare costs as an area of research and interest. The economic study presented here, a 6-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional (CON) 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 80% paid for through income taxes: for curative care (Zorgverzekeringswet) and for long-term care (Algemene Wet Bijzondere Ziektekosten). The compulsory health insurances cover costs of most of the 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 (e.g., specific or additional paramedic treatment, complementary therapies; e.g., costs of CAM treatment is paid for up to €500/year).[5] Many supplementary insurances cover costs of CAM treatments like anthroposophic medicine (AM), acupuncture and homoeopathy (HOM). 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 billions this year to €49 billions 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 these new techniques.[3] Of the total growth of public healthcare expenditure, about a quarter is the result of ageing. 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 (specialisation and concentration), more 'neighbourhood care' by 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 copayments, higher deductibles and already saving for higher healthcare expenditure in old age (precautionary savings).[3]

In July 2013, the Dutch healthcare minister Schippers reached an agreement with hospitals, medical specialists, mental healthcare providers, GPs, health insurers and patients' organisations 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. To achieve the reduced expenditure growth, extra measures will be taken to increase the efficiency and improve the quality of care: more care of medical specialists will go to the GP and from the GP to self-care; concentration of complex care; tighter application of medical guidelines and care standards; treatments to be given according to the standards of the medical profession itself; access to the claims of the compulsory health insurances tightened and more transparency about quality and cost of care.[6]

The contribution of CAM

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 CON medicine.[7] The Cochrane Collaboration definition of complementary medicine is that it includes all such practices and ideas that are outside the domain of CON 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 CON 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 emphasises 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 medicine and IM. 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 (CUAs) found were of similar or better quality than 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 vs. usual (CON) care. Study quality of the CUAs of CIM was generally comparable to that seen

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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 per cent 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 CON GPs and CAM GPs.[11] A data set 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 1913 CON GPs were compared with data from 79 GPs with additional CAM training in acupuncture (n=25), HOM (n=28) and AM (n=26). Results showed 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 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 CON GPs and CAM GPs with a larger data set 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 vs. 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 and paramedic care, and (2) costs covered by supplementary insurance. Alternative interventions were: CON GP care compared with care from GPs who know CAM. Outcomes were: differences in healthcare costs and annual mortality rates.

Model overview

Costs were analysed at the patient level using linear and log linear 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 socioeconomic 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 t tests are asymptotically valid by virtue of the central limit theorem, independent of whether the underlying distributions are normal or non-normal. SEs are clustered at the level of the insured to control for the statistical dependence of observations pertaining to a given insured person (ie, observations are independent 'between' individuals but dependent 'within' individuals).

With regard to the 6 years of data, the data set was used as a panel. This means that if an insured person is observed for all 6 years, six observations of annual costs of this person are used in the analysis (taking into account the 'within'-person correlation by clustering SEs 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.

Data set on healthcare costs and demographics

A data set was analysed 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 data set 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.

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GPs and patients

The data set also contains the names and addresses of the GPs who have patients who are insured by Agis, which allows us to distinguish between CON GPs and CAM GPs. We defined a GP as an anthroposophic CAM GP if his or her name appears in the list of GPs with additional training in AM as provided by their professional association.[12] CAM GPs with HOM[13] and CAM GPs with acupuncture[14] 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 data set. Patients who 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 t tests, with clustering of SEs 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 V.10.0. Means with 95% CIs 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 anonymised, no ethical approval was necessary.

RESULTS

GP practices and patients

The data set contained 9126 GP practices: 9016 CON practices and 110 CAM practices. Owing 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 specialised in acupuncture (15%) and HOM (25%). Since some GPs were specialised 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 data set

The data set contains information of more than 1.5 million insurees during the years 2006–2011 (table 1). Nearly 19 000 insurees (1.2%) had a CAM GP throughout this whole period. More than 10 000 other insurees had a CON GP in some years and in other years a CAM GP ('Switchers'). On average, the Switchers group had a CON GP for 3 years and a CAM GP for 3 years. The insurees had a mean age of 41 (SD=23.5). Fifty-three per cent are women. These patients live in 4014 different 4-digit postal codes.

Table 1 Descriptive statistics of the data set

	CON GP	CAM GP	Switchers
Insured (n)	1 521 773	18 862	10 769
Age (year)	41.0	41.6	40.1
Female (%)	52.9	55.2	56.4
'Vogelaarwijk' (%)	15.7	9.3	17.1
Supplementary insured (%)	92.7	93.4	92.1
Compulsory insurance costs (€)			
Total costs	1821	1638	1989
GP costs	133	128	140
Pharmaceutical costs	402	357	474
Hospital costs	1242	1104	1328
Paramedical costs	44	48	47
Supplementary insurance costs (€)	75	115	100

CAM, complementary and alternative medicine; CON, conventional; GP, general practitioner.

Without controlling for relevant differences between the groups, the comparison demonstrates: higher percentages of females in the CAM GP and Switchers groups; higher percentages of insurees living in the 'Vogelaarwijk' in the CON and Switchers groups; €183 lower and €168 higher total compulsory costs in, respectively, the CAM and the Switchers groups; and €40 and €25 higher supplementary costs in, respectively, the CAM and the Switchers groups. 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 online supplementary appendix 1.

Annual total compulsory and supplementary insurance costs

The mean annual total costs of patients treated in CON practices covered by the compulsory insurance were €1821 (95% CI 1813 to 1828; 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 (95% CI 169 to 281; p<0.001; 12.4%) lower. These lower costs are mainly due to lower hospital costs (€165; 95% CI 118 to 212; p<0.001) and lower pharmaceutical care costs (€58; 95% CI 41 to 75; p<0.001).

The mean annual total supplementary costs for patients treated in CON practices were €75.3 (95% CI 75.1 to 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 (95% CI 31 to 37; p<0.001; 44%) higher

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and were highest in the third age group (50–74 years; €52 (95% CI 31 to 37; p<0.001)). Taken together, the mean total annual compulsory and supplementary insurance costs are €192 (10.1%) lower for the CAM group of patients.

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (see online supplementary 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 (95% CI 21 to 140; p<0.01) in the first group (0–24 years); €137 (95% CI 54 to 219; p<0.01) in the second group (25–49 years); €356 (95% CI 227 to 485; p<0.001) in the third group (50–74 years) and €236 (95% CI −9 to 481; p<0.1) in the last group (75+ years). Lower pharmaceutical costs were found in the second age group (25–49 years; €50; 95% CI 23 to 77; p<0.001) and the third age group (50–74 years; €126; 95% CI 88 to 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; 95% CI 124 to 341; p<0.001) and the last age group (75+ years; €219; 95% CI 7 to 431; p<0.05). In addition, the largest difference in total compulsory costs was found in the last year of life (€1161; 95% CI −138 to 2461; p<0.1), which is entirely the result of lower hospital costs (€1250; 95% CI 19 to 2481; p<0.05).

The log linear analyses of the mean total annual compulsory and supplementary insurance costs (see online supplementary 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 significantly 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 groups (75+) and higher paramedic costs in the second (25–49) and third (50–74) age groups.

Mortality rates

In the present data set, 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, etc), 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 to 0.007; p<0.05); men: 0.004 (95% CI 0.001 to 0.008; p<0.1); women: 0.007 (95% CI 0.003 to 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 to 0.011; p<0.1), but no significant differences for men and women separately. The Cox proportional hazard analyses resulted in significantly higher mortality rates at the 10% level (but not at the 5% level), both for the total group: 1.059 (95% CI 0.994 to 1.129; p<0.1) and the group of women: 1.072 (95% CI 0.987 to 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.

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 (10.1%) lower than the costs of patients treated by CON GPs as a result of €225 (12.4%) lower compulsory costs and €33 (44%) higher supplementary costs.
2. The lower mean annual total compulsory healthcare costs are mainly due to lower hospital care costs (€165) and lower pharmaceutical care costs (€58).
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–

Table 2 Estimated differences in mean annual total compulsory and supplementary insurance costs (€): CAM patients compared with 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	−1161*	5	67	−1250**	27	3

*p<0.1; **p<0.05; ***p<0.01.
CAM, complementary and alternative medicine; CON, conventional; GP, general practitioner.

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74 years; total costs: €356; hospital care: €232; pharmaceutical care: €126) and in the last year of life (total costs: €1093; hospital care: €1223).
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 CON GP (n=1.52 million; 98.8%) and patients with GPs who know CAM (n=18 862; 1.2%) were compared in a data set from the Dutch insurance company Agis over a 6-year period (2006–2011) by means of regression analyses. The mean annual compulsory healthcare costs of patients treated by a CON GP are €1821 (95% CI 1813 to 1828). On average, annual total compulsory healthcare costs of patients treated by a CAM GP are €225 (95% CI 169 to 281; p<0.001; 12.4%) lower than patients treated by CON 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; 95% CI 23 to 77; p<0.001) and the third age group (50–74 years; €126; 95% CI 88 to 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 (€1161; 95% CI −138 to 2461; p<0.1), which is entirely the result of lower hospital costs (€1250; 95% CI 19 to 2481; p<0.05). The mean annual supplementary insurance costs of patients treated by a CON GP are €75.3 (95% CI 75.1 to 75.5). On average, annual supplementary healthcare costs of patients treated by a CAM GP are €33 (95% CI 31 to 37; p<0.001; 44%) higher. The absolute lower compulsory costs for all patients for the 6-year period (2006–2011) for the CAM group are €25 463 700 (or on average €4 243 950/year) compared with 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 billions lower annual compulsory costs. The absolute lower compulsory and supplementary costs for all patients for the 6-year period (2006–2011) for the CAM group are €21 729 024 (or on average €3 621 504/year) compared with the CON group. The extrapolation of the lower costs in the CAM group of patients with the Dutch population (16.8 million inhabitants), if applicable, would result in €3.23 billions lower annual compulsory and supplementary costs. Patients with a CAM GP do not have significantly lower or higher mortality rates than patients with a CON GP.

Table 3 Differences in mortality rates: CAM patients compared with 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<0.1; **p<0.05; ***p<0.01
CAM, complementary and alternative medicine; CON, conventional; LPM, linear probability model.

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 with the first pilot study,[11] there were 10 times more patients from a CON GP (151 952 vs. 1 521 773), three times more patients from a CAM GP (5922 vs. 18 862), 4.5 times more CON GP practices (1913 vs. 9016) and about 1.5 times more CAM practices (79 vs. 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 generalisability of the results.[15] The second strength is that the results are based on a relatively long period of 6 years, also contributing to more precise estimations and better representativeness and generalisability of the results. Third, 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 vs. 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. Hence, the results might not be optimally controlled for socioeconomic 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 data set, since the data set 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 generalisability 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 4-year period. In addition, the current study with 10 times as many patients and a 2-year longer period of observations enabled us to estimate the cost differences more precisely. While in this first study estimation of mean annual total compulsory costs of CAM patients were in the range of 0–30% lower than those of patients of CON GPs, the mean cost differences are now estimated to be 12.4% lower (range 9.3–15.4%) for the

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CAM group. As in the first study, the lower total compulsory costs are mainly the result of 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 vs. usual (CON) care. Since most CAM patients in the current study were treated in an anthroposophic practice, comparison with other economic studies on AM is justified. Kienle *et al*[13 15] reviewed the few economic investigations on AM, demonstrating less or equal costs in AM compared with CON treatment, due to reduced hospital admissions and less prescriptions of medications. Hamre *et al*[13] 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 (95% CI 264 to 960) compared with the prestudy 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 cost differences reported in the Results section, we can hypothesise 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 minimise 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. A potential instrumental variable in this case is the distance between a patient's home and the various GPs, for example 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 CON medicine in primary care settings find that patients treated in CAM practices suffer more often from severe and chronic illnesses.[14 16] 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 data set, 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 CON care. At the same time, these patients report fewer adverse side effects of treatments and higher patient satisfaction.[14 16 17] 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. Third, 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 CON pharmaceuticals, tests and operations. Nissen *et al*,[18] 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 (p.14)." Van Dulmen *et al*[19] concluded in a Dutch study comparing patients visiting CON GPs and three types of CAM GPs (HOM, 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[20] 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 CON 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*[14] found that AM patients appreciated that their physicians listened to them (80% 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 ratings 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.[15 12] For instance, in a Dutch survey (Consumer Quality Index, a national standard to measure healthcare quality from the perspective of healthcare users), 2099 patients reported

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very high satisfaction with anthroposophic GP practices (8.4 on a scale: 0–10, 10 indicating the best possible score).[17] These results are consistent with AM theory, which emphasises relationship and communication, as well as shared decision-making.[12] 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). Fourth, 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 CON healthcare professionals and policymakers. We can also conclude that there is sufficient good evidence that CAM can be cost-effective compared with CON medicine and 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 therapies do they pertain?) 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 (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 an 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[21] with more health-related outcome parameters than mortality rate only and (4) replication studies based on similar, large data sets with other CAM modalities (acupuncture, Traditional Chinese Medicine (TCM) herbal treatment, etc) and with other insurance companies.

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Contributors PK was the project lead for the statistical analyses. EWB and PK wrote the manuscript. All authors reviewed the manuscript and contributed to manuscript revisions. EWB is the guarantor for this study and the Open Access publication costs of BMJ Open.

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Competing interests EWB 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.

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Data sharing statement No additional data are available.

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.[22]

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Correction

Baars EW, Kooreman P. A 6-year comparative economic evaluation of healthcare costs and mortality rates of Dutch patients from conventional and CAM GPs. *BMJ Open* 2014;4:e005332. Three references were missing in the submitted article and should have been included during the proofing stage (references 12, 13 and 14). As a result, some of the reference numbers in the Discussion section do not match the numbered references in the reference list at the end of the article. The references affected in the text are listed below:

'Kienle *et al*[13 15] reviewed...' should be 'Kienle *et al*[16 17] reviewed...' (Kienle *et al*, 2006; Kienle *et al*, 2011).

'Hamre *et al*[13] found...' should be 'Hamre *et al*[18] found...'

'...patients treated in CAM practices suffer more often from severe and chronic illnesses.[14 16]' should be '.. patients treated in CAM and in CON medicine in primary care settings find that patients treated in CAM practices suffer more often from severe and chronic illnesses.[19 20]'

'At the same time, these patients report fewer adverse side effects of treatments and higher patient satisfaction.[14 16 17]' should read 'At the same time, these patients report fewer adverse side effects of treatments and higher patient satisfaction.[19–21]' (Esch *et al*, 2008; Marian *et al*, 2008; Koster *et al*, 2014).

'Nissen *et al*,[18] based on a review...' should be 'Nissen *et al*,[22] based on a review...' (Nissen *et al*, 2012).

'Van Dulmen *et al*[19] concluded...' should be 'Van Dulmen *et al*[23] concluded...' (Van Dulmen *et al*, 2010).

'Ernst and Hung[20] described...' should be 'Ernst and Hung[24] described...' (Ernst & Hung, 2011).

'For example, Esch *et al*[14] found...' should be 'For example, Esch *et al*[19] found...' (Esch *et al*, 2008).

'These results are consistent with other studies demonstrating high patient satisfaction with AM.[15 12]' should be 'These results are consistent with other studies demonstrating high patient satisfaction with AM.[16 17]' (Kienle *et al*, 2006; Kienle *et al*, 2011).

'...practices (8.4 on a scale: 0–10, 10 indicating the best possible score).[17]' should be '...practices (8.4 on a scale: 0–10, 10 indicating the best possible score).[21]' (Koster *et al*, 2014).

'These results are consistent with AM theory, which emphasises relationship and communication, as well as shared decision-making.[12]' should be 'These results are consistent with AM theory, which emphasises relationship and communication, as well as shared decision-making.[17]' (Kienle *et al*, 2011).

'...(3) designing and executing highly controlled, comparative effectiveness research projects[21]...' should be '(3) designing and executing highly controlled, comparative effectiveness research projects[25]' (Fisher *et al*, 2012).

In the section 'Previous publication' the reference number cited should be 26 (not 22). (Kooreman & Baars, 2014).

The correct reference list is below.

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