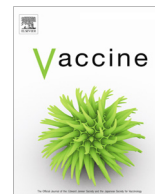


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Review

Complementary medicine and childhood immunisation: A critical review

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ABSTRACT

Background: Vaccination is one of the most significant and successful public health measures of recent times. Whilst the use of complementary medicine (CM) continues to grow, it has been suggested that CM practitioners hold anti-vaccination views. The objective of this critical review is to examine the evidence base in relation to CM practitioner attitudes to childhood vaccination alongside attitudes to vaccination among parents who visit CM practitioners and/or use CM products.

Methods: A database search was conducted in MEDLINE, PubMed, CINAHL, EMBASE and AMED for research articles published between January 2000 and September 2015 that evaluated either CM practitioner or CM user attitudes and intention towards childhood vaccination.

Results: A total of 23 articles were found that detailed the attitudes of CM practitioners to vaccination. A further 16 papers examined the association between the use of CM products and visits to CM practitioners, and immunisation. The interface between CM and vaccination is complex, multi-factorial and often highly individualised. The articles suggest that there is no default position on immunisation by CM practitioners or parents who use CM themselves, or for their children. Although CM use does seem positively associated with lower vaccination uptake, this may be confounded by other factors associated with CM use (such as higher income, higher education or distrust of the medical system), and may not necessarily indicate independent or predictive relationships.

Conclusions: Although anti-vaccination sentiment is significant amongst some CM practitioners, this review uncovers a more nuanced picture, and one that may be more agreeable to public health values than formerly assumed.

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1. Background/introduction

Immunisation is one of the most successful public health measures of the last century, with paediatric vaccines in particular, dramatically reducing the incidence of infectious disease and childhood mortality worldwide. The high rate of childhood vaccination coverage in most high-income countries indicates that paediatric vaccination remains a widely accepted public health measure. However, support for paediatric vaccination is not universal, and vaccine hesitancy – defined as “delays in acceptance or refusal of vaccination despite availability of vaccination services” [1] – is an emerging international public health problem [2]. Some parents choose to delay vaccinating their children, adopt modified schedules, or forego vaccination altogether. Whilst public opposition to vaccination “began with the first vaccinations, has not ceased, and probably never will” [3], several high profile outbreaks of vaccine-preventable diseases have recently brought increased attention on the issue of vaccine hesitancy [4].

Complementary medicine (CM) – a diverse group of healthcare practices not generally considered part of the conventional medical curriculum – is one area that has been portrayed as a possible enabler in vaccine hesitancy. It has been posited by commentators that CM practitioners discourage or actively oppose vaccination [5–8], or that users of alternative models of healthcare may not support vaccination [9]. This hypothesis may be supported by the increasing influence of CM in vaccine misinformation campaigns [10]. As the utilisation and prevalence of CM increases internationally, issues of public protection and safety around the use of CM are emerging as significant public health issues requiring more detailed critical examination by research, policy and practice communities [11]. Moreover, as CM practitioners play an increasingly significant role in contemporary health care – outnumbering conventional providers in some areas [12] – it is increasingly impor-

tant to understand the views, attitudes and practices of CM practitioners in relation to immunisation.

Similarly, attitudes and practices towards immunisation, of parents who use CM services and products needs research attention. The potential impact and influence of CM on childhood immunisation is commonly discussed in the peer-reviewed literature [5–8], yet despite such interest, there has been no attempt to systematically review the impact and influence of CM on childhood vaccinations. Understanding the reasons for low vaccination compliance in certain parts of the community is of major public health interest. CM practitioners may have access to vaccine-hesitant parents and for this reason the attitudes, beliefs and recommendations of CM practitioners as well as the parents who visit them are important to understand. This review aims to address these critical research gaps by investigating and summarising existing empirical research on the impact and influence of CM on childhood immunisation.

2. Methods

For the purposes of this mixed methods review the databases MEDLINE, PubMed, CINAHL, EMBASE and AMED were searched for research articles published between January 2000 and September 2015, using the appropriate terms and subject headings for complementary medicine and vaccination or immunisation (see Table 1). The search was confined to peer-reviewed articles containing an English abstract. Database searches were supplemented by hand searches and all citation lists of papers were reviewed for further references.

The search results were imported into EndNote, a bibliographic management software program, with duplicated items removed. Two reviewers with appropriate research expertise in both qualitative and quantitative methods (JW and JF) screened all remaining titles and abstracts to identify scientific papers reporting empirical research findings. Discrepancies were resolved through discussion. Papers identified as conference presentations, letters to the Editor, and commentary were excluded. In cases where the abstract did not provide enough information, the full article was retrieved and examined by two researchers. Relevant works were also identified by examining citation lists of relevant articles and added to the EndNote library. Due to the significant heterogeneity of research methodologies, no scored quality assessment was conducted. As this was the first systematic approach to reviewing the literature on this topic, all articles were included in the review, and methodological details of each study can be found in Appendix A (Tables 2–4).

Articles related to vaccines that were part of routine childhood vaccination schedules in numerous countries (e.g. hepatitis B) were included, even if the article was not solely focused on childhood vaccination. Articles focused on vaccination in adult communities (e.g. influenza vaccine in the elderly) were excluded. In total, 42 empirical research papers were found to meet the selection criteria and were included in this review (see Fig. 1).

3. Results

As CM issues around practice, utilisation and information can differ significantly, this review has been grouped around these cat-

Table 1

Key terms used in database searches for MEDLINE, PubMed, CINAHL, AMED and EMBASE for complementary medicine and childhood vaccinations.

SEARCH TERMS	
Complementary medicine	Vaccination
Broad descriptor headings^a	
Complementary medicine, traditional medicine, alternative medicine, integrative medicine	Vaccine, vaccination, immunisation (or immunization)
Specific headings^b	
<i>Discipline- or modality-specific</i>	<i>Vaccine specific</i>
Acupuncture, Alexander technique, aromatherapy, Chinese medicine, chiropractic, dietary supplements, herbal medicine, homeopathy, massage, meditation, naturopathy, nutraceuticals, reflexology, spiritual healing, vitamins, yoga	MMR

^a Individual databases have differing subject headings. Search terms relating to those in the table were used but may not be exactly as described.

^b For disciplines and modality specific terms both subject heading searches (e.g. MeSH “Chiropractic”) and keyword searches (e.g. chiropract*[tiab]) were performed, and both searches were performed for all indirect and non-health risk terms. These terms are not exhaustive, as similar terms to those listed above were also used (e.g. botanical extract, botanical preparation, herbal extract, plant extract, medicinal plant, plant medicine, phytodrug and phytotherapy terms were also used for ‘herbal medicine’, as well as differing ‘types’ of herbal medicine such as Western herbal medicine or Chinese herbal medicine).

Table 2
Summary of articles on practitioners and vaccination related to CAM.

Author/ Year	Country	Method	Participants	Sample	Main findings	Additional notes
<i>Practitioners</i> Lee and Kemper [29]	USA	Survey	Naturopaths and homeopaths practising in Massachusetts	N = 67	35% of homeopaths and 20% of naturopaths actively recommended vaccination 9% of homeopaths and 7% of naturopaths actively advised against vaccination	Most practitioners did not actively advise for or against vaccination in their consults with patients
Lee and Kemper [14]	USA	Survey	Chiropractors practising in Massachusetts	N = 90	30% of chiropractors actively recommend childhood vaccinations 7% of chiropractors actively recommend against vaccination 63% advised not making any comments and allowing patients to make up their own minds	
Lehrke et al. [32]	Germany	Survey	Homeopathic and non- homeopathic physicians in Germany	N = 500	There were no differences between homeopathic and non-homeopathic physicians in uptake or acceptance of 'classical' vaccines (tetanus, diphtheria, poliomyelitis) Varicella vaccine was equally refused by both homeopathic and non-homeopathic physicians All other vaccines were less accepted by homeopaths ($p < 0.01$)	Vaccinations were significantly lower in homeopathic group, but when controlled for practice setting (i.e. private practice versus hospital) there were no significant differences between groups
Busse et al. [22]	Canada	Survey	All students enrolled at a Canadian chiropractic college	N = 467	53% of chiropractic students reported agreeing with vaccination Agreement with vaccination was felt most strongly in first year (61%), but got progressively lower until 40% in final year 59% of students said that their original views on vaccination remained unchanged during their years at chiropractic college Most (79.2%) students who supported vaccination said that informal lectures were biased, while most (69.7%) students who were against vaccination suggested that the college presented vaccine information in an unfair way	Those who rated formal vaccination sessions as most important were more likely to have positive opinions of vaccination. Those who rated informal sources as most important were more likely to have anti-vaccination attitudes in later years
Schmidt and Ernst [30]	UK	Content analysis of email responses of CAM practitioners to questions about MMR vaccination	All identified homoeopaths ($n = 168$), chiropractors ($n = 63$) and GPs ($n = 111$) with email addresses on referral databases	N = 126	No homeopaths advised immunisation, 4% advised against immunisation, 3% advised to get immunisation indirectly (i.e. "you probably should", 29% advised to get as much information as possible before deciding, 18% offered no advice in email but suggested appointment, 6% advised getting individual vaccines instead of combination, 4% advised homeopathic alternatives to vaccination 5% of chiropractors advised immunisation, 14% advised against immunisation, 14% advised to get immunisation indirectly, 14% advised getting more information before making a decision, 23% gave no advice and 5% suggested individual vaccines rather than combination	No GPs responded to queries 26% of respondents withdrew responses after finding out nature of study
Wilson et al. [24]	Canada	Survey	Students at a Canadian naturopathic college	N = 312	12.8% of students said that they would actively advise full vaccination 74.4% of students said that they would advise partial vaccination	Having only CM sources of information was associated with lower willingness to vaccinate Willingness to advise full vaccination and trust in public health and biomedicine messages on vaccination decreased in later student years

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Table 2 (continued)

Author/ Year	Country	Method	Participants	Sample	Main findings	Additional notes
Hawk et al. [25]	USA	Survey	Students and faculty at 10 US chiropractic colleges (<i>n</i> = 582) and chiropractic practitioners (<i>n</i> = 496)	<i>N</i> = 496	71.8% of students reported that they thought of immunisation as beneficial A higher proportion of chiropractic students (80%) and chiropractic college faculty (91%) than chiropractic practitioners (62%) thought that chiropractors should provide both pro- and con-arguments on vaccination 56% of chiropractors provide both pro- and con-information on vaccination to patients. 6% of chiropractors provide only con-arguments against vaccination to their patients, while 2% only provide pro-vaccination information 51% of chiropractors obtain information from their patients on their immunisation status	
Russell et al. [15]	Canada	Survey	Registered chiropractors in Alberta	<i>N</i> = 503	25.1% of chiropractors actively encouraged patients to vaccinate, 27.2% actively advised patients against vaccination 9.2% of chiropractors advised patients on vaccination at least weekly, 36.5% advised at least monthly 55.6% of chiropractors said patients had sought their advice about vaccination 63.8% of chiropractors said vaccinations should never be given to children < 1 year old 41.7% of chiropractors thought vaccinations were safe while 48.1% thought they were unsafe 57.9% of chiropractors believed it was better to be naturally infected than vaccinated 56.1% of chiropractors believe vaccinations weaken the immune system	Chiropractic (i.e. 'straight' or 'mixer') and individual beliefs were the most common predictors of vaccination attitudes 88.8% of chiropractors believe the public is not adequately informed of risks of vaccinations and 70.0% believe health officials and medical doctors are not adequately informed of vaccination risks
Oppel et al. [38]	Canada	Survey	Medical doctors practising in British Columbia	<i>N</i> = 197	90% of respondents believed that the vaccine information provided by CM practitioners was inaccurate 79% of respondents believed that advice from CM practitioners made patients less inclined to vaccinate 73% of respondents claimed that they were aware of instances where parents had refused vaccination based on the advice of a CM practitioner	Response rate was below 20%, suggesting possible response bias that may not reflect general medical practitioner opinion
Wilson et al. [27]	Canada	RCT	Naturopathic students in the final year	<i>N</i> = 71	Students split into two groups: one receiving and evidence-based presentation of vaccination information versus presentation from a polio survivor There were no significant differences between two groups on any primary or secondary outcomes. Results were highly individualised and variable across both groups Both interventions increased likelihood students would vaccinate their own child (45% more likely, 3% less likely, 52% no change) A minority of students (23%) were less likely to support vaccination	Challenging the views of those with strongly held belief systems reinforced previously held beliefs

Table 2 (continued)

Author/Year	Country	Method	Participants	Sample	Main findings	Additional notes
Russell et al. [16]	Canada	Survey	Registered chiropractors in Alberta	N = 503	after the intervention. This was most commonly observed in individuals with strongly held belief systems prior to intervention 63.1% of chiropractors expressed interest in being involved in some immunisation activity 40.0% of chiropractors wanted to be able to formally refer to nurses or doctors for answers to immunisation questions, 39.2% did not 39.1% wanted to refer to government information, 40.3% did not 18.4% of chiropractors said they would be interested in displaying pro-vaccination posters in their clinics, 63.0% said they would not 29.1% of chiropractors said that they would be interested in displaying official pamphlets on immunisation, 54.0% said they would not	9.5% of respondents made comments; mainly they believed current information was biased, with insufficient information on risks being provided. Interest in participating in events was lower among those who made comments
Injevan et al. [20]	Canada	Survey	All registered chiropractors in Alberta	N = 503	45% of chiropractors believed that their chiropractic training prepared them to counsel patients on vaccination, whilst 68.2% believed that their continuing education prepared them for this role Those who felt most prepared by chiropractic training used different information sources than those who used continuing education. Reliance on continuing education was correlative with anti-vaccination attitudes	Most chiropractors wanted continuing education on immunisation, with PhD being seen as the most suitable instructor (84%), with medical practitioners (59%) and chiropractors (56%) also seen as appropriate instructors. Analysis of the risks of being vaccinated versus the risks of being unvaccinated was seen as the most valuable area for continuing education (supported by 82%)
Page et al. [36]	Canada	Qualitative interviews	Chiropractors in Calgary, Canada	N = 14	The topic of immunisation arose in clinical encounters by both direct and indirect communications Direct communications were most commonly patient initiated and were prompted by media reports or perceived adverse reactions Factors that most influenced chiropractic opinion of vaccination included their chiropractic training, their philosophy of health or illness (i.e. 'straight' or 'mixer') and personal experience of adverse immunisation events	
Weber et al. [31]	USA	Survey	Naturopaths practising in Washington state	N = 251	Naturopathic physicians provided immunisations in 18.6% of all visits by children under 2 years and in 27.3% of visits of children between the ages of 2 and 5 years	
Salmon et al. [34]	USA	Survey	School nurses at a random sample of 1000 schools in Colorado, Massachusetts, Missouri and Wisconsin	N = 696	A child attending a school with a nurse who had used a CM practitioner for their own personal use was more likely to have a vaccination exemption than a student attending a school where the nurse had not used CAM (OR 1.58, 95% CI: 1.11–2.23)	The influence of CM use depended on specific CM use. The relationship for specific CM, when adjusting for confounders, was as follows: chiropractic (OR 1.44; 95% CI: 1.01–2.04); imagery or energy healing (OR 2.73; 95% CI: 1.21–4.90); High-dose megavitamins (OR 2.31; 95% CI: 1.39–3.85); all other CAM practitioners (OR 2.47; 95% CI: 1.75–3.48)
Medd and Russell [21]	Canada	Survey	All registered chiropractors in Alberta, who had children	N = 325	92.6% of chiropractors had received all routine childhood vaccinations, but only 35.7% would accept adult vaccinations 66.8% of chiropractors had at least	Comments in free text response indicated that the choice of future vaccination was dependent on specifics of disease in question

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Table 2 (continued)

Author/ Year	Country	Method	Participants	Sample	Main findings	Additional notes
Downey et al. [49]	USA	Analysis of insurance claims	Analysis of insurance claims for paediatric enrollees in two insurance companies in Washington State	N = 11,144	<p>one immunised child</p> <p>21.8% of chiropractors indicated an interest in referring for vaccination. Those with at least one immunised child were more likely to refer than those without (OR 6.2., 95% CI 1.4–28.4). Those who would accept adult vaccinations (e.g. influenza) were more likely to refer for vaccinations (OR 11.4, 95% CI 5.4–24.0, $p < 0.01$)</p> <p>Diagnosis with a vaccine-preventable disease was significantly more likely among enrollees who saw a CM provider than among those who used conventional care exclusively (1.5% v. 1.3%)</p> <p>Naturopathic care was a significant predictor of reduced rates of all vaccinations (OR 0.22 for MMR, OR 0.23 for Chickenpox, 0.30 for diphtheria/tetanus)</p> <p>Chiropractic care was a significant predictor of reduced rates for MMR (0.67) and Chickenpox (0.58)</p>	
Partouche et al. [33]	France	Survey	General Practitioners in Ile-de-France	N = 209	<p>Doctors who practised CM offered to vaccinate infants significantly less than those who did not offer CM (22.4% v. 40.4%, $p < 0.01$)</p> <p>Doctors who practised CM were less likely to have a favourable opinion of hepatitis B vaccination than those who did not practise CAM (18.1% v. 47.4%, $p < 0.01$)</p>	
Lameris et al. [23]	Canada	Survey	All students enrolled at a Canadian chiropractic college	N = 328	<p>82.6% of students expressed a positive attitude to vaccination, with no significant differences across years</p> <p>75.6% of students thought that all children should receive MMR vaccine</p> <p>76.2% thought that all persons should receive routine childhood vaccinations</p> <p>14.9% of chiropractic students felt confident to discuss vaccination with their patients after their first year of chiropractic education, whilst 61.7% of chiropractic students felt confident after their final year</p>	56.7% of students felt that the chiropractic program adequately prepared them to discuss immunisation
Bean and Catania [19]	USA	Qualitative interviews	Oregon health practitioners including medical doctors ($n = 4$), chiropractors ($n = 5$) and midwives ($n = 4$)	N = 15	<p>Vaccine opposers (4/5 chiropractors and 1/4 midwives) expressed belief that disease-acquired immunity was preferable to vaccine-conferred immunity</p> <p>Vaccine opposers recognised that vaccines are effective in producing herd immunity, however felt they posed substantial health risks and therefore should not be supported. Vaccine opposers promoted use of religious exemptions to patients to avoid, or encouraged selective or delayed schedules</p>	<p>All support groups were influenced by what they saw as “professional norms” in their individual professional groups</p> <p>Vaccine opposers were more likely to suggest personal experiences were more influential than professional pressures</p> <p>Opposers were not always completely opposed to the idea of vaccination, and selective or delayed schedules were seen as an alternative</p>
Puhl et al. [13]	Canada	Survey	Randomly selected sample of Canadian chiropractors	N = 503	Most common practice preferences for immunisation communication were to advise patients to talk to	Anti-vaccination sentiment was clustered around graduates of ‘conservative’ (i.e. ‘straight’)

Table 2 (continued)

Author/ Year	Country	Method	Participants	Sample	Main findings	Additional notes
					medical doctor or nurse (39.0%) or provide both pro- and con-information (38.4%) 56.2% of chiropractors agreed or strongly agreed that vaccinations have a strong part to play in public health while 21.6% disagreed or strongly disagreed 55.8% of chiropractors agreed or strongly agreed that vaccines have a strong evidence base while 20.7% disagreed	chiropractic schools, which were significantly discordant from other schools on vaccination issues ($p < 0.001$).
McGregor et al. [13]	Canada	Survey	Randomly selected sample of Canadian chiropractors	$N = 503$	Prediction models suggest that unorthodox ('straight') perceptions of health practice are related to anti-vaccination sentiment and practices ($\chi^2 = 13.4, p = 0.0002$).	18.8% of chiropractors were aligned with a pre-defined unorthodox perspective of the conditions they treat (i.e. 'straight' chiropractic)
McMurtry et al. [62]	Canada	Focus groups	Medical students, chiropractic students and naturopathic students	$N = 62$	Both formal education and informal socialization were powerful influencers of attitudes to vaccination Many students uncritically accepted the vaccination views of senior or respected professionals Students' preferred multiple perspectives rather than one-sided, didactic instruction Divergences among professional students' perspectives result from differing emphases with respect to lifestyle, individual choice, public health and epidemiological factors—rather than disagreement concerning the biomedical evidence Students from all three healthcare programs cautioned that individual vaccines should be distinguished based on severity and a weighing of costs and benefits (e.g. naturopaths counselled parents to "err on the side of safety" and get child polio vaccine, medical students expressed concern over using new and less tested vaccines produced by pharmaceutical industry) Both medical and naturopathic students saw it as their role to educate themselves and patients on the pros and cons of vaccination, to keep up to date on recent research, and to act as patient advocates Naturopathic students put more emphasis on individualised care, patient choice and empowerment than chiropractors and medical students	All students were open-minded towards paediatric vaccination at the beginning of their training

egories. Articles in this review have been grouped by theme rather than methodologies, as approaching these themes from all methodological aspects allows for improved critical insights. However, quantitative and qualitative research can offer different contextual and empirical insights the methodologies of each paper have also been briefly described in the narrative, and summarised in [Appendix A](#).

3.1. Research on vaccination and CM practitioners

A total of 23 articles were found that detailed the attitudes of CM practitioners to vaccination, across five different practitioner groups, namely chiropractors (16), naturopaths (5), general practi-

tioners who practice CM (2), homeopaths (2) and school nurses who visit CM practitioners themselves (1). The data have been categorised around the following categories: *CM practitioner personal attitudes to vaccination*, *CM practitioner practice characteristics related to vaccination*; *the impact of CM practice on biomedical practitioner attitudes and practices related to vaccination*; *CM practitioner interactions with patients around vaccination and the attitudes of students training to become CM practitioners related to vaccination*.

3.1.1. CM practitioner perceptions and attitudes to vaccination

The research on CM practitioner attitudes to vaccination suggests there is significant heterogeneity of opinion – across geographic settings and within disciplines. Most studies focused on

Table 3
Summary of articles relating to patient use of CAM and childhood vaccination.

Author/Year	Country	Method	Participants	Sample	Main findings	Additional notes
<i>Patients</i> Gellin et al. [47]	USA	Telephone survey	Nationally representative sample of parents with children under the age of 16	N = 1600	Compared to parents with a 'biomedicine orientation', parents with an 'alternative medicine orientation' were: – less likely to rate immunization being very important (89.4% v. 75.5%) – more likely to opt out of childhood immunizations than parents with a biomedicine orientation (11.2% v. 24.9%) more likely to have government or school requirements as primary motivator for immunization (12.1% v. 6.0%)	
Kulig et al. [45]	Canada	Qualitative interviews	Persons of Dutch ethnic background, Hutterites and parents and practitioners who engage in alternative health beliefs and practices in Southwest Alberta	N = 47	Safety with regard to short- and long-term effects on child health were the major concern among those with alternative health beliefs. Approximately one-third of those with alternative health beliefs thought vaccines were acceptable, one third thought certain immunisations were acceptable and one third thought no immunisations were acceptable.	
Fong and Fong [41]	Australia	Survey	Parents attending non-surgical hospital visits with overnight stay for their children	N = 120	Parents who used CAM for their family's health were more likely to have inadequate vaccination for their child's age (OR 4.2, $p < 0.05$).	
Smailbegovic et al. [46]	UK	Survey with follow-up interviews	Mothers of children resident in the London borough of Hackney who were identified as not completing the full immunisation course	N = 76	CAM use was identified by 29% of parents in this study, but no parents intended to use it instead of biomedicine or as a replacement to vaccination	Vaccine safety was the major concern, with 34% of parents perceiving that having their child immunised with a particular vaccine was more risky than non-immunisation
Wilson et al. [42]	Canada	Clinical audit	Chart review of all paediatric and adolescent patients attending a naturopathic college clinic in Canada	N = 482	Being partially vaccinated or unvaccinated was associated with CAM product use (OR 2.86, $p < 0.01$) Factors associated with partial or unvaccinated status were younger age ($r = 0.14$, $p = 0.02$), greater use of CAM products ($r = 0.16$, $p < 0.01$), and attending CCNM for advice on vaccination ($r = 0.25$, $p < 0.01$)	
Cassell et al. [18]	UK	Survey	Mothers of children in Brighton, England	N = 452	32.6% of non-compliant (with vaccination schedule) mothers had consulted a homeopath, compared with 10.1% of compliant mothers Non-vaccinators were significantly more likely to have visited a homeopath (67.5%) compared to vaccinating mothers (15%)	Whilst there was a significant negative association with homeopath consultation and vaccination, there was no significant association with consulting acupuncturists, Ayurvedic practitioners, herbalists or kinesiologists and vaccination There was no significant association between any CAM and delayed schedule

Table 3 (continued)

Author/Year	Country	Method	Participants	Sample	Main findings	Additional notes
Benin et al. [51]	USA	Qualitative interviews	Mothers 1–3 days post-partum and again at 3–6 months post-partum	N = 33	Vaccinators and non-vaccinators differed on their trusted sources of information. Vaccinators trusted their paediatrician, whereas non-vaccinators did not trust biomedicine and trusted homeopaths and naturopaths for medical advice	Knowledge of vaccination was poor among both vaccinators and non-vaccinators Lack of trust of non-vaccinators in biomedicine was often due to previous negative experiences with biomedicine
Zutavern et al. [48]	Germany	Prospective Cohort Study	Children under 2 years	N = 3097	At 2 years of age, 28% of children had been treated homeopathically and 4.5% had been treated by a heilpraktiker. Both homeopathy and heilpraktiker visits were associated with lower immunisation rates for all immunisations except diphtheria and tetanus	
Zuzak et al. [43]	Switzerland	Survey	Paediatric patients presenting to an urban, tertiary paediatric emergency department	N = 1600	Refusal of basic vaccination was higher in CAM users compared to non-users (18.6% v. 3.5%, $p = 0.001$) The rate of vaccination refusal was highest among patients who consulted physicians practising herbal medicine (63.6%), anthroposophical medicine (52.4%) and homeopathy (43.0%)	Original parent's choice determined vaccination among those seeking CAM physicians. Only anthroposophical and Chinese medicine physicians were influential in determining parent choice about vaccination Having CAM coverage for health insurance was associated with non-vaccination There were similar rates for non-childhood vaccinations among CAM users and non-users
Jessop et al. [39]	Ireland	Prospective cohort study	Singleton children participants in Lifeways Cohort Study	N = 749	Having a mother who had ever used CAM was associated with lower uptake of MMR vaccine (OR 2.65; $p < 0.01$)	
Jessop et al. [40]	Ireland	Prospective cohort study	Children in rural and urban areas of Ireland	N = 749	Having a mother who had ever visited a CAM practitioner was associated with receiving no vaccinations (OR 3.69, CI: 1.05–12.90), though the relationship was not significant for partial vaccinations	23.8% of children used some form of CAM
Gaudino and Robison [50]	USA	Retrospective cohort study	Parents of 2004–5 Oregon schoolchildren	N = 2900	Compared to vaccinators, exemptors were more likely to: have strong vaccine concerns (OR 15.3; 95% CI 6.4–36.7); have had a homebirth (OR 3.6; 95% CI 1.6–8.0); distrust local medical doctors (OR 2.7; 95% CI 1.0–7.5); reported chiropractic care for their youngest children (OR 3.9; 95% CI 1.8–8.5) Exemptors preferred naturopathic healthcare for themselves (48.9%) compared to vaccinators (13.1%) and reported that their youngest school-age children usually	When multivariate analysis was performed use of naturopathic medicine was no longer significant, suggesting it was not an independent variable Fewer exemptors (63.1%) than vaccinators (77.8%) reported being advised by any health practitioner to get all vaccinations

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Table 3 (continued)

Author/Year	Country	Method	Participants	Sample	Main findings	Additional notes
					received naturopathic (24.6% versus 2.2%) or chiropractic (23.8% versus 2.8%) healthcare More exemptors than non-exemptors recalled discussing immunization pros and cons with child healthcare providers (84.2% versus 68.7%) and believed that some or many parents in their community were not vaccinating their children (44.4% versus 22.0%)	
Busse et al. [37]	Canada	Survey	Parents of children under the age of 16 years presenting for naturopathic paediatric care	N = 95	Approximately half (47.4%) of parents discussed vaccination with the naturopath 62.2% of respondents perceived that their naturopath had neutral views on vaccination and 84.4% said the naturopath's views were fair and impartial 62.2% of respondents said that their discussion on vaccination with the naturopath had no influence on their decision to vaccinate, 24.4% said they were less likely to vaccinate and 13.4% said they were more likely to vaccinate Having a naturopath as the sole source of their information was associated with having at least 1 unvaccinated or partially vaccinated child (OR 3.57, $p = 0.02$) 45.3% of respondents said that they'd discussed vaccination with both their conventional and naturopathic providers, however 31.6% said that they regarded their naturopath as the most trustworthy source of information while 15.8% regarded their conventional physician as the most trusted source of information	25.9% of parents suggested that they felt less comfortable continuing conventional care as a result of being pressured to vaccinate by their conventional physician 16.1% reported being told that their continued access conventional care was dependent on being fully vaccinated Feeling pressured to vaccinate was associated with a higher likelihood of having at least 1 unvaccinated or partially vaccinated child (OR 3.07, $p = 0.03$) 44.2% of respondents said that they did not have enough information to make a decision on vaccination
Jones et al. [55]	USA	Survey	Parents of fully vaccinated children ($n = 1630$) or children with at least one vaccination exemption ($n = 815$)	N = 1367	Parents who used the internet for vaccine information were more likely to regard CAM practitioners as a good or excellent source of information (OR 1.55, 95% CI 1.12–2.14) than those who did not use the internet for vaccine information Parents who used the internet for vaccine information were less likely to regard the following as a good or excellent source of information: conventional healthcare providers (OR 0.59, 95% CI 0.42–0.85); Vaccine Information Statements (OR 0.49, 95% CI 0.35–0.69), professional	

Table 3 (continued)

Author/Year	Country	Method	Participants	Sample	Main findings	Additional notes
					organisations (OR 0.56, 95% CI 0.39–0.80), local or state health departments (OR 0.60, 95% CI 0.43–0.84) or the CDC (OR 0.57, 95% CI 0.39–0.83) than those who did not use the internet for vaccine information	
Akins et al. [35]	USA	Case-control study	Children with autism spectrum disorders and developmental disorders and the general population	N = 578	Immunisation status was not predictive of CAM use	
Bystrom et al. [44]	Sweden	Qualitative interviews	Parents in an area with high density of anthroposophic institutions	N = 20	Vaccinating parents had a strong degree of trust in the health system and used CAM alongside allopathic medicine when appropriate Non-vaccinators preferred CAM over biomedicine Both groups shared a holistic worldview	CAM community was split into four main groups: conformers (follow immunisation recommendations – primary motivation is to avoid disease & believe vaccination is safe as it has been used for years); pragmatists (concerned with the safety of vaccines and therefore delay, when they vaccinate the choice is pragmatic – measles is dangerous), attentive delayers (agreed with vaccination though were concerned with vaccine safety and thought 18 months was too young, and therefore preferred to delay until 3 or 4 years to give child time to grow. Would vaccinate in a high-risk scenario like an outbreak) and promoters of natural immunity (represents those postponing beyond 5 years or refusing vaccination, believing that natural diseases strengthen the immune system physically and mentally, and is seen as a natural part of life)

chiropractor attitudes on vaccination, and found significant disparity within this practitioner group. One study found that 56.2% of qualified chiropractic practitioners believed that vaccination was an important public health measure [13] whilst only 25.1–30% actively recommend vaccination [14,15]. Lee et al. [14] found that whilst 30% of chiropractors recommended immunisation, 63% felt it important not to make comments or recommendations to allow patient choice. Russell et al.'s [16] study of Alberta chiropractors found that the majority of chiropractors (63%) wanted to take a more active role in immunisation activity, with the most common form of activity being the ability to refer to nurses or medical doctors for answers to immunisation questions, and the ability to refer to government vaccination services and information sources. This support did not extend to 'in-clinic' activities such as displaying of pro-vaccination posters or displaying official vaccination pamphlets, though approximately one-third of chiropractors did express interest in these measures.

Heterogeneity appears to exist even within discrete CM practitioner groups such as chiropractors, whose attitudes to vaccination appear to be influenced by philosophical beliefs (i.e. 'straight' versus 'mixer' chiropractic). 'Straight' chiropractors (those who believe vertebral subluxation is the primary origin of all disease;

approximately one-fifth of the chiropractic population) are significantly more vaccine hesitant than 'mixer' chiropractors [13,15,17,18] (those who focus on musculo-skeletal conditions and interpret diagnosis and treatment in a biomedical model). Personal experiences were reported by vaccine opposing chiropractors as being more influential in determining opposition than professional norms [19]. CM practitioners seem open to non-CM information sources on immunisation. A Canadian study of chiropractors found that qualifications in research (PhD) or biomedicine (MD) were seen as more important than chiropractic qualifications for instructors providing vaccination classes [20].

Exploring vaccination behaviours of CM practitioners, who are themselves parents, offers further insight into their personal attitude to childhood vaccination. A survey of Canadian chiropractors, limited to those who had children, found that two-thirds had at least one immunised child, and those with an immunised child were six times more likely to refer for immunisations than those without an immunised child [21].

3.1.2. CM student attitudes to immunisation

Most CM practitioner students do appear to support vaccination, at least at the start of their studies, with studies of chiroprac-

Table 4
Summary of articles on CAM information and childhood vaccinations.

Author/Year	Country	Method	Participants	Sample	Main findings	Additional notes
<i>Information</i> Nasir [52]	International	Content analysis of websites	26 websites randomly selected from top sites returned using key search terms	N = 26	58% of anti-vaccination sites were associated with individuals or groups practising or promoting CAM as indicated by direct statements on their page Homeopathy and naturopathy were the most common therapies cited	17% of sites were operated by conventional physicians
Kata [54]	USA and Canada	Content analysis of websites	First 10 Google search results for vaccine, vaccination and immunisation were put into US and Canadian Google sites	N = 60	6% of Canadian sites and 24% of US sites were anti-vaccination CAM was promoted as vaccination alternatives on 88% of anti-vaccination sites 75% of sites critiqued biomedicine, suggesting, for example, that germ theory was wrong 88% of anti-vaccination sites suggested children should get diseases 'naturally'	Beyond safety, civil liberties and conspiracy theories were the major objections to vaccination
Ernst [53]	International	Content analysis of websites	First 12 sites from search with CAM type (chiropractic, homeopathy, naturopathy) and measles	N = 36	The majority (86%) of sites did not recommend immunisation, and only 6% actively recommended immunisation 25% recommended homeopathic alternatives to vaccination 50% of sites recommended natural alternatives to measles treatments 6% of sites doubted germ theory 31% of sites claimed immunisation was harmful 25% of sites stated immunisation was not useful or necessary	

tic and naturopathic students indicating support ranging from 53% to 83% [22–24]. A US survey shows chiropractic faculty support for vaccination reaching 90% [25]. However, in some circumstances support for partial vaccination was higher than for full vaccination [13]. In both chiropractic and naturopathic programs, formal education was not associated with a reduction in vaccination support; however, practitioners relied on informal, unaccredited, variable or ad-hoc avenues of education such as continuing professional development for information about vaccination [24,26].

Studies of Canadian naturopathic [24] and chiropractic [22] students; however, have indicated that support for vaccination decreases after each year of CM training, and suggest this is most influenced by the presence of informal education activities (peer opinion and informal seminars), rather than formal education in the curriculum. Further, more recent studies in the same chiropractic student group uncovered higher support for vaccination than these previous studies, with no significant differences between years [23]. Studies indicate that only 45–61.7% of chiropractic students thought their formal training adequately prepared them to discuss vaccination with patients [23,26].

Although personal experiences are known to shape views on vaccination before formal education, incorporating emotional or personal stories into formal education does not appear to influence CM practitioner student opinions on vaccination. A Canadian qualitative study of medical, chiropractic and naturopathic students uncovered philosophical factors, such as advocating for individual choice and other 'whole person' factors, were important to CM providers, whilst biomedical students tended to focus on larger scale evidence-based public health benefits of vaccination.

A Canadian randomised-controlled trial of two education interventions (one group receiving an evidence-based presentation and the other receiving a presentation by a polio survivor) in the final year of naturopathic education found no significant differences between the two groups on any primary or secondary outcomes [27]. However, results were highly individualised and variable across both groups. A minority of students (23%) reported being

less likely to support vaccination after the intervention. This was mostly observed in individuals with strongly held belief systems prior to the intervention, suggesting that challenging the views of those CM practitioners with strongly held beliefs may simply reinforce previously held beliefs. However, both interventions increased the likelihood that students would vaccinate their own children, highlighting the potential beneficial role of any educational intervention in CM practitioner training.

3.1.3. CM practitioner practice characteristics related to vaccination

The majority of CM practitioners do not appear to be active in making recommendations around vaccination. Approximately one-in-ten chiropractors make recommendations about immunisations weekly, while one-third advise at least once per month [28]. One study investigating the attitudes of naturopaths and homeopaths towards vaccination found a low level of vaccine promotion amongst these practitioner groups with 35% of homeopaths and 20% of naturopaths actively recommending vaccination [29]. Further, 9% of homeopaths and 7% of naturopaths actively recommended against vaccination whilst the majority did not actively advise either way.

A British study of email responses by CM and biomedical practitioners to questions about the MMR vaccine found that few (3–18%) CM practitioners directly or indirectly advised getting the vaccination, a minority directly or indirectly advised against it (4–14%), with the remainder advising to seek further information or making no comment [30]. No biomedical providers responded to the question and thus comparison was not possible.

Where practitioner scope enabled CM practitioners to provide vaccinations, some practitioners have exercised this option. Naturopathic practitioners in practice in Washington state, where naturopaths have broader prescriptive rights than other US states, provided vaccinations in nearly one-fifth (18.6%) of all visits by children under 2 years, and in over one-quarter (27.3%) of visits of children between the age of 2 and 5 years [31].

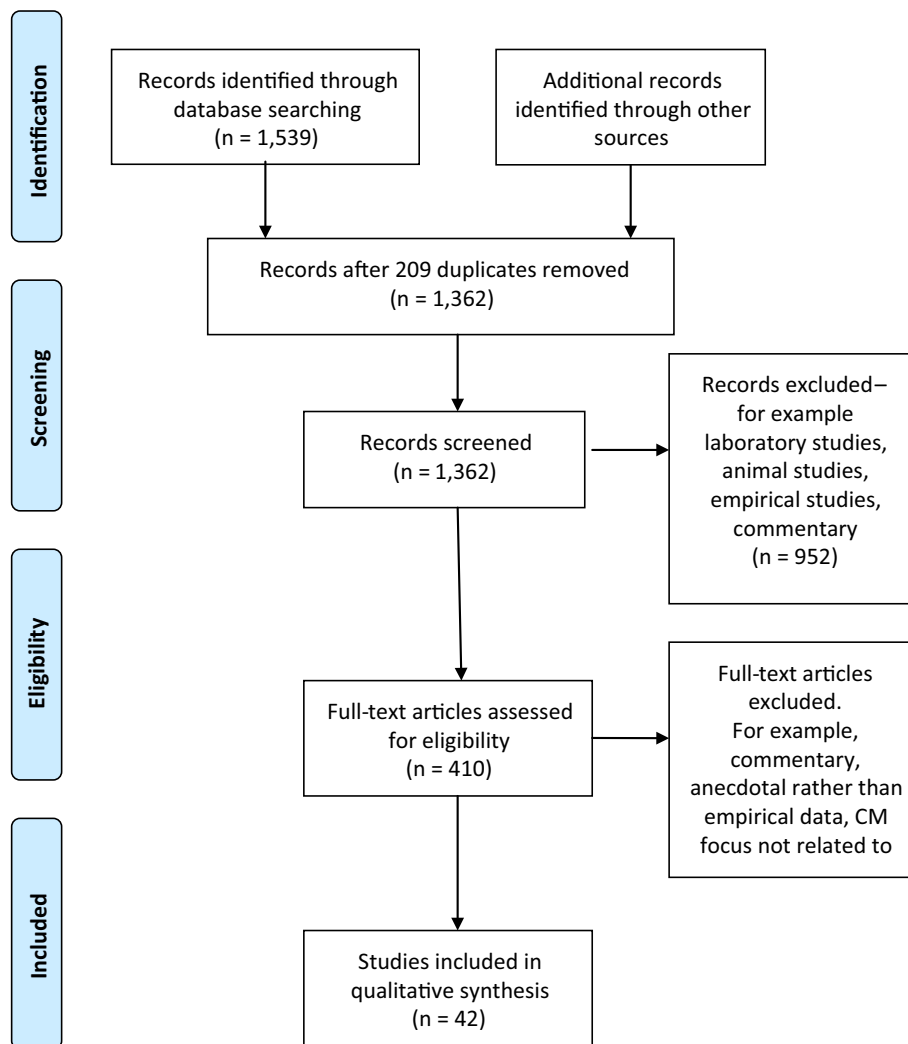


Fig. 1. PRISMA flow chart.

3.1.4. Impact of CM training/use on immunisation attitudes and practices of biomedical practitioners

The attitudes and practices related to vaccination of medical practitioners who utilise CM in practice is highly correlated to their use of CM. A German survey of medical practitioners with homeopathic qualifications/practice found that support for all vaccinations except tetanus, diphtheria and poliomyelitis was lower among medical practitioners with a homoeopathic qualification than those without [32]. French general practitioners who practised CM were significantly less likely to offer vaccinations to infants or have a favourable opinion of vaccination than general practitioners who did not [33]. This impact also appears to be related to use of CM by biomedical providers for personal health. A study of school nurses in the US, for example, found that exemption rates were higher at schools where the school nurse had used CM for personal reasons [34].

3.1.5. CM practitioner patient influence and communication on vaccination

Where interactions between CM practitioners and patients in relation to vaccination do occur, they may not necessarily be directed by the practitioner. Discussion in relation to immunisation in CM consultations is usually patient-initiated, and approximately half of all patients initiate discussion about immunisation with their CM practitioner [35,36].

Those who seek CM services may also have a higher level of trust in CM providers compared to biomedical providers. A study of paediatric patients attending a student naturopathic clinic, found that CM patients had greater trust in CM practitioners as a source of reliable information on immunisation compared to medical providers [37]. Whilst about half of all naturopathic patients discussed immunisation issues with both their biomedical and naturopathic provider (45.3%), twice as many patients nominated the naturopathic practitioner (31.6%) as their preferred source of information compared to their medical practitioner (15.8%).

Increased levels of trust in practitioners may influence the perception of information provided by practitioners. The majority of patients from the Canadian study above also reported that they perceived their naturopath held neutral opinions on immunisation and provided unbiased information [37]. The study also found that feeling pressured by their medical practitioner to vaccinate resulted in naturopathic patients being three times more likely to choose not to vaccinate, and generally medical practitioners were seen as biased sources of information by providing only pro-vaccine or incomplete information.

The majority (62.2%) of patients visiting naturopaths for paediatric presentations were not influenced by immunisation discussions with their naturopath, though 24.4% reported being less likely to vaccinate and 13.4% more likely to vaccinate after this discussion. This compared to medical practitioner interactions having

no influence (40.7%), making parents more likely to vaccinate (42.0%) and making parents less likely to vaccinate (17.3%). Patient perceptions of the accuracy and impact of CM practitioner immunisation advice appears to conflict with biomedical practitioner perceptions of CM practitioner immunisation advice. For example, a Canadian survey of medical practitioners found that 90% of respondents believed the vaccine information provided by most CM practitioners was inaccurate, and 79% believed that this advice made the majority of patients less inclined to vaccinate [38].

3.2. CM users and childhood immunisations

A total of 16 papers examined the association between the use of CM products and visits to CM practitioners, and immunisation. The primary findings are presented here. The data have been categorised under relationships between parental personal CM use (which is usually self-prescribed without the influence of a practitioner) and vaccination status and CM practitioner use and vaccination status.

3.2.1. Personal CM product use and vaccination status

CM use – either by parents or for children – is associated with lower childhood vaccination uptake. Studies from Ireland [39,40] show that parental use of CM is associated with lower vaccination uptake for their children. Use of CM for paediatric treatment is associated with lower vaccination rates in studies from Australia [41], Canada [42], and Switzerland [43]; however, rather than a simplistic arrangement, there appears to be a spectrum of vaccination beliefs among CM users. A qualitative study of parents in a Swedish anthroposophic community (anthroposophic medicine being an alternative medical paradigm based on the teachings of Rudolf Steiner), found parents who vaccinated their children and those that did not vaccinate their children had a multitude of highly individualised attitudes and behaviours related to vaccination, rather than one hegemonic belief system [44]. A qualitative study of traditionally vaccine hesitant religious and ‘alternative’ Canadian communities found that those who identified as belonging to alternative health groups were more concerned with issues of risk and safety of vaccines than those with religious objections, with mistrust of biomedicine and pharmaceutical companies also a primary motivator [45].

A specific causative relationship between CM and vaccine hesitancy is difficult to identify. A British study found that even though CM use was high among vaccine-hesitant parents, none reported using CM as a replacement for vaccination, instead nominating individual scenario risk assessments as the primary motivators for their CM use (for other conditions) and choice not to vaccinate [46]. A telephone survey of a nationally representative sample of US parents indicated that the ‘medicine orientation’ of parents may influence vaccine decision-making, as parents with an ‘alternative medicine orientation’ more likely to accept anti-vaccine information, and having significantly lower vaccination rates than parents who identified as having a ‘conventional medicine orientation’ [47]. These findings suggest that pre-existing parental beliefs may predispose them to both CM use and anti-vaccination sentiment, rather than a causal link existing between the two.

3.2.2. The impact of CM practitioner use on vaccination status

The influence of CM practitioner use on childhood vaccination uptake is more difficult to determine, as there appears to be significant heterogeneity across regions, disciplines and time. A British study found that mothers who were non-compliant with their child’s vaccination schedule were more likely to have consulted a homeopath, but found that there was no association between vaccine non-compliance and visits with acupuncturists, Ayurveda practitioners, herbalists, kinesiology or yoga practitioners [18]. A

German study found that both homeopath and heilpraktiker (naturopathic profession in Germany) visits were associated with lower immunisation rates for all childhood immunisations except diphtheria and tetanus [48]. A cohort study of all parents of schoolchildren in the US state of Oregon found that parents who used chiropractic care for their child were nearly four times as likely to be vaccine hesitant than parents who did not [28]. The study also found that distrust of local medical practitioners – itself a common driver of CM practitioner use – was associated with a nearly three-fold increase in vaccine hesitancy [28]. An analysis of insurance claims of paediatric enrollees in two large insurance companies in the US state of Washington found that diagnosis with a vaccine-preventable disease was higher among enrollees who saw a CM provider versus those who did not (1.5% versus 1.3%) and that both naturopathic and chiropractic care were associated with lower childhood vaccination rates [49].

Whilst vaccine-hesitant parents may be more likely to consult CM practitioners, their decision to vaccinate may not be influenced by CM practitioners. For example, a Swiss study found that while vaccine refusal was most common among parents who consulted providers practising herbal medicine, traditional Chinese medicine, anthroposophy and homeopathy, in most cases parents retained their original personal views on vaccination [44]. Only parents consulting with providers practising anthroposophy or traditional Chinese medicine were independently swayed to not vaccinate by their practitioner. While significant correlations often exist between CM use and non-vaccination, these do not always extend to an independent relationship between CM and non-vaccination. Gaudino and Robison’s study of Oregon schoolchildren, for example, found that non-vaccinators were significantly more likely to use naturopathic care for their children compared to vaccinators, but that multivariate analysis did not identify naturopathic care as an independent predictor of vaccine hesitancy, while other factors such as higher income, education (factors associated with higher CM use) and simply not being told to get all vaccines in the schedule were independently predictive of non-vaccination [50].

In a Canadian study, those who reported having a naturopath as their most trusted source of information on vaccination were three-and-a-half times more likely not to vaccinate, and parents who discussed vaccination with their naturopath were one-and-a-half times more likely not to vaccinate [37]. However, a causative link is difficult to establish, given an earlier clinical audit of paediatric patient files identified that partial or unvaccinated status of a child itself was a predictor of attending the naturopathic clinic for vaccination advice, as was a higher than normal self-reported incidence of vaccine-associated risk event history [42]. Additionally, qualitative work by Benin et al. [51] suggests vaccinators and non-vaccinators were predisposed to trust different practitioners regardless of the advice that they received, with non-vaccinators more likely to trust CM providers, often due to previous negative experiences with conventional medicine providers and practices.

3.3. Anti-vaccine information sources and the promotion of CM

Three studies explored the role of CM in anti-vaccination information sources. These studies suggest there is an association between anti-vaccination information sources and the promotion of CM, though most of this promotion is independent of CM practitioners. Some of the same factors that appear to drive anti-vaccination attitudes are associated with CM use among the populace, which may be partly responsible for an association between anti-vaccination information sources and CM use. An early (2000) study of anti-vaccination websites found that more than half (58%) were associated with groups or individuals practising CM, as indicated by direct statements on their web page, with

17% operated by medical practitioners [52]. A study focusing on online measles immunisation information provided by three CM professions (chiropractic, homeopathy and naturopathy) found significant opposition to vaccination, with just over 5% directly recommending immunisation, 25% recommending homeopathic vaccination and 50% recommending natural alternatives to measles treatment in place of immunisation [53]. However, CM appears to be significantly associated with anti-vaccination sites even in the absence of CM practitioner involvement, with 88% of anti-vaccination sites promoting CM treatments as alternatives to vaccination [54]. Internet users who used the Internet for any type of health information were also more likely to regard CM practitioners as a good or excellent source of vaccination information than non-Internet users, and were less likely to trust conventional sources of information such as government sources or conventional physicians [55].

4. Discussion

This article provides the first critical and comprehensive review of the impact and influence of CM on childhood vaccination uptake and acceptability. The evidence shows that anti-vaccination sentiment within CM professions is significant, however, this review also highlights that the association between CM and immunisation is complex. The heterogeneity in impact of CM use on childhood vaccination uptake across CM disciplines, users and regions also points to the need for discipline- and regional-specific research. In many instances, anti-vaccination attitudes are not pervasive through CM communities, but may be limited to significant sub-groups within those communities. For example, anti-vaccination sentiment amongst chiropractors largely centres on graduates of 'conservative' (i.e. 'straight') chiropractic schools, and it is not known if these views/beliefs are also representative of the beliefs of other CM professionals with anti-vaccination sentiments.

Previously, assumptions on CM practitioner attitudes towards vaccination have been based largely on anecdotal or personal experience [6]. Research data, however, uncovers a more complex picture, and one that may be more amenable to public health values than previously assumed. Likewise, the success of some campaigns targeted at 'alternative' communities has begun to question previously held assumptions of the hegemony of anti-vaccination sentiment in these communities [56]. Although relatively high levels of anti-vaccination sentiment present important public health challenges that need to be addressed, the significant pro-vaccination element within CM communities may also present fertile opportunities in CM education, practice and use to improve vaccination uptake and reduce misleading vaccination information.

A perceived link between CM and anti-vaccination sentiment is evident from the literature reviewed. Declining to vaccinate was reported a form of CM itself (just as herbal medicine or chiropractic was) in two studies excluded in this review because they did not provide meaningful analysis of any link between CM use and vaccination [57,58]. Other studies had been confident that CM adherence was contra-indicative of vaccine acceptance and have utilised CM use as a variable to identify a range of socio-cultural determinants of vaccine-hesitancy [59]. Anti-vaccination sentiments are often a proxy for deeper concerns in a much wider discourse about medicine, the state and the body [60]. Such sentiments are also part of what seems to be a growing distrust of health professionals, pharmaceutical manufacturers and government [28]. Given that these same factors have been posited as fuelling the growth of CM use [61], it is perhaps unsurprising then that the two issues have become linked.

There is a public health imperative to provide evidence-informed education for CM practitioners and their patients about

the safety, quality and public health benefit of immunisation. Studies found that chiropractic practitioners, for example, believed their formal education underprepared them for discussing immunisation issues with parents [20,23]. They expressed a need for continuing education – preferably from non-chiropractic sources – focused on the risks of immunisation versus the risks associated with contracting the disease [20]. Studies exploring multiple practitioner groups found chiropractic, naturopathic and medical students share the belief that it is their responsibility to keep up to date with immunisation research, and to educate patients on the pros and cons of immunisation [62]. Evidence-based and accessible education – both formal and informal in the form of undergraduate and continued professional development – is critical to equipping the CM workforce with the knowledge required to appropriately address questions about vaccination raised by patients. If these educational initiatives do not exist, studies in this review indicate the knowledge vacuum can become readily filled by informal education activities that do not support public health immunisation activities. It is imperative that CM practitioners are exposed to evidence-based immunisation education to improve their knowledge of vaccination and to ensure that appropriate information is provided to CM patients.

Whilst the number of CM practitioners who actively recommend against vaccination is a major public health issue that needs addressing, a secondary concern is the question of why many CM practitioners believe that discussing childhood vaccination with parents is not appropriate. It is incongruent that despite many CM professionals supporting vaccination as an important public health measure – many do not actively recommend vaccination to their patients. There appears to be an overriding philosophy of allowing the patient to 'make his or her own mind up' and a belief in the importance of individualised care, patient choice and empowerment [62]. Research is needed to determine why many CM practitioners focus on the notion of patient choice as opposed to upholding critical public health policy.

Further difficulties in assessing the influence of CM use on vaccine uptake are due to many studies reporting demographic characteristics among vaccine hesitant parents that are also known to occur among CM users (higher income levels, higher education levels) [9,43,56]. In some studies, this has meant that multivariate analysis has failed to uncover an independent relationship between vaccine hesitancy and CM use. For example, an analysis of Oregon schoolchildren found that non-vaccinators were significantly more likely to use naturopathic care for their children compared to vaccinators, but that multivariate analysis did not identify naturopathic care as an independent predictor of vaccine hesitancy [50]. As many of the articles uncovered in this review focused heavily on correlation rather than causation, their results should be viewed as drivers for further examination of the potential influence of CM on vaccination attitudes and practices, rather than supporting the hypothesis that the two factors are independently related.

The lack of a formal quality assessment of included studies is a potential limitation of this review, and the study findings should be interpreted with this in mind. However, given the broad scope of methodological approaches in this review, and the need for an expansive view of all empirical literature on the topic it was deemed necessary to include all studies, with specific details to be noted in the summary tables and (where necessary) in the narrative. The heterogeneity of methodological studies may also serve as a potential limitation, as our mixed studies review may not have allowed for the same depth of analysis of individual articles as a review focused solely on quantitative or qualitative synthesis [63]. However, given the large body of commentary focused on the purported interface between CM and vaccination, the breadth of this review – including all empirical studies on this topic for

the first time – serves as an important foundational step in developing and informing a more rigorous and focused research agenda in this area.

This review of empirical studies suggests current assumptions of the interface between CM and vaccination are overly simplistic, and the issue is complex, multi-factorial and often highly individualised. Research is needed to identify beliefs, motivations and intentions of individual CM practitioner groups and individual CM practitioners in regard to childhood vaccination. Such research is particularly important as a major limitation of this review is the majority of studies evaluating parental and CM practitioner attitudes to immunisation were conducted between 2000 and 2010, prior to the increased focus on anti-immunisation issues generated by recent outbreaks but during the peak influence of gastroenterologist, Andrew Wakefield's, discredited research that proposed a link between the MMR vaccine and autism [64], which may have influenced attitudes to immunisation.

5. Conclusion

The relationship between CM users and practitioners, and vaccination is complex and there does not appear to be one default position. Whilst anti-immunisation sentiment seems higher among CM users and practitioners as opposed to users and practitioners of conventional medicine, this review highlights an opportunity for pro-immunisation CM practitioners to more actively engage in conversations about immunisation with parents. This line of communication may be of particular benefit for vaccine-hesitant parents who may not trust traditional sources of information when making decisions about immunisation. This review also highlights an education need for some members of the CM practitioner community in relation to immunisation.

Appendix A

See Tables 2–4.

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