



Complementary and alternative medicine research in practice-based research networks: A critical review



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ABSTRACT

Aims: To provide a critical analysis of peer-reviewed literature reporting research from practice-based research networks (PBRNs) relating to complementary and alternative medicine (CAM).

Methods: A comprehensive literature search of peer-reviewed literature reporting PBRN research focusing upon CAM was conducted in PubMed, Ovid Medline, EMBASE, and CINAHL from their inceptions to June 2017. PBRN registry and websites of relevant PBRNs were also searched for further information. With regards to the nested PBRN studies included in our review, no study design restrictions were imposed and both empirical research and relevant methodologically-focused manuscripts were included. Methodological quality was evaluated via a number of established tools.

Results: A total of 51 articles reporting upon CAM research in PBRNs including six articles outlining CAM-focused PBRN establishment were included in the review. The findings of the literature were categorised as either: health services research (including work examining characteristics of patients and practices, doctor-patient communication, and CAM prevalence); effectiveness/safety research; or feasibility research. While 19 studies from non-CAM focused PBRNs tended to report on CAM prevalence and doctor-patient communication about CAM use, 26 articles from CAM-focused PBRNs reported on the characteristics of CAM users, practice patterns, and effectiveness/safety of CAM practice.

Discussion and conclusion: PBRNs - both CAM-focused and non-CAM focused - have provided a useful platform for research investigations around a number of core CAM-related issues. Given the increasing popularity of CAM use in healthcare and the identified benefits of practice-relevant research, further in-depth CAM research nested within PBRN designs is warranted.

1. Introduction

A practice-based research network (PBRN) - defined as “a group of ambulatory practices devoted principally to the primary care of patients, affiliated with each other, and often with an academic or professional organization, to investigate questions related to community-based practice”¹ - provides an interactive approach to evidence generation and utilisation with research topics prioritised to reflect and improve issues in daily routine care.^{1–4} Over recent decades PBRNs have grown in popularity and scope. For example, as of October 2015, PBRNs (across all health areas) in the US were estimated to involve in excess of 29,000 community practices covering over 153,000 healthcare providers who served approximately 27% of the US population.⁵ The benefits of PBRNs include an ability to: examine the content and

patterns of practices offered across diverse clinical settings; offer flexibility in collecting and analysing data from a variety of perspectives, (e.g. practitioners and patients); generate timely practice-relevant research findings using diverse research methods; and help facilitate the translation of research evidence into practice.^{1,6}

Complementary and alternative medicine (CAM), defined as “a group of diverse medical and health care systems, practices, and products that are not presently considered to be part of conventional medicine”⁷ has gained increasing popularity across the globe often alongside conventional healthcare.^{8–10} While accumulative evidence has both supported and disputed the use of different CAM in different clinical areas,¹¹ large gaps have been recognised between research evidence and CAM practice due in part to a lack of interest and resource in this area of health care¹² as well as methodological challenges

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associated with conducting research on some CAM treatments.^{11,13}

In this context, PBRNs can provide a new platform for rigorous practice-based CAM research which has been historically lacking in infrastructure and capacity. Unfortunately, no work to date has provided a comprehensive overview of the peer-review published literature reporting CAM research from PBRNs. In direct response to this significant gap, this paper reports the findings from a critical review examining: the features of established CAM-focused PBRNs; how CAM has been studied within PBRNs; the quality of such CAM PBRN-nested research; and the strengths and challenges of such PBRN-nested research with a view to helping identify possible future research directions in this important sub-field of critical health care scholarship.

2. Methods

2.1. Literature searching and article selection process

We searched PubMed, Ovid Medline, Ovid EMBASE, and CINAHL from their inception up to June 2017 for articles empirically examining any aspects of CAM within established PBRNs - any study design type including randomised controlled trials (RCTs), uncontrolled trials, surveys, cohort studies, study protocols, and qualitative researches were eligible so long as their findings and design pertained to an established and active PBRN (Supplementary file 1). For the purpose of this review, a definition of CAM as established in the peer-reviewed literature was adopted.⁷ For the identification of PBRNs, we followed the definition provided by the American Academy of Family Physicians Task Force – ‘a group of practices devoted principally to the care of patients, affiliated with each other, and perhaps with academic and governmental enterprises, to investigate the phenomena of clinical practice as it occurs in communities’.¹⁴ Only literature published in peer-reviewed journals was included in the review. The PBRN registry developed by the Agency for Healthcare Research and Quality (AHRQ, <https://pbrn.ahrq.gov/pbrn-registry>) was also searched online for relevant articles. Websites of CAM practitioner PBRNs or PBRNs that had published findings identified from our initial database search results were also searched for further information. Study authors and relevant PBRN researchers were contacted where possible if insufficient/unpublished data led to the need for more information in order to ascertain inclusion or exclusion from our review. Reference lists of the included articles were also checked for any further relevant studies. Two independent reviewers (HL and WP) searched and selected articles for inclusion, and disagreements were resolved with a discussion with a third reviewer (JA).

2.2. Data extraction

The author, year of publication, country, study design/size (if applicable), PBRN's name, study condition/population, and article summary were extracted and tabulated from each included study by one reviewer (HL) and double-checked by another reviewer (WP). For surveys, we calculated a response rate where possible if unavailable. Information on official name, geographical coverage, AHRQ registration status, membership/specialty of focus, network size, funding, design features and mission regarding the corresponding CAM-focused PBRN was also extracted from the relevant website where possible.

2.3. Quality assessment

An evaluation of the quality of the included studies was undertaken by two of the research team (HL and WP) employing established tools for respective study designs, (i.e. Cochrane risk of bias assessment tool for RCTs,¹⁵ Critical Appraisal Skills Programme (CASP) qualitative research checklist,¹⁶ and a modified quality assessment system for the other quantitative studies such as surveys and cohort studies (Table 1).^{17–20} Introductory articles outlining PBRN establishment and/

or study protocols were excluded from the quality assessment and any discrepancies between the interpretations of the two members of the research team were resolved through consensus in discussion with another reviewer (JA).

2.3.1. Cochrane risk of bias assessment tool for RCTs

The characteristics of relevant RCTs relating to selection bias (random sequence generation and allocation concealment), performance bias (blinding of participants and personnel), detection bias (blinding of outcome assessment), attrition bias (incomplete outcome data), and reporting bias (selective outcome reporting) were evaluated.¹⁵ Each criterion was assigned a low, high, or unclear risk of bias rating and disagreements were resolved by discussion.

2.3.2. CASP qualitative research checklist

The CASP checklist for qualitative research recommended by the Cochrane Qualitative and Implementation Methods Group was employed in our study.¹⁶ This tool consists of 10 items including screening questions assessing 1) whether there is a clear statement of the aims of the research, and 2) whether a qualitative approach was appropriate. The remaining questions refer to the appropriateness of 3) research design, 4) recruitment strategy, and 5) data collection methods and consideration of 6) the relationship between the researcher and participants, 7) ethical issues; 8) rigorous analysis; 9) whether there is a clear statement of the findings; and 10) the value of the research.

2.3.3. A modified quality assessment system for quantitative studies

This assessment system was modified from an established tool previously employed for assessing neck pain prevalence,¹⁹ CAM prevalence/use,^{17,18} methods in public health services and systems research,²⁰ and observational cohort and cross-sectional studies.²¹ The assessment system consists of nine items reflecting aspects of methodology, reporting of participants' characteristics, and reporting of study results (Table 1). Two authors independently recorded yes, no, or unclear to each item and disagreements were resolved by discussion.

2.4. Presentation of the results

The results from the included literature is presented in terms of two categories (articles from CAM-focused PBRNs and articles from non-CAM focused PBRNs). First, the features of CAM-focused PBRNs and introductory articles on CAM-focused PBRN establishment are summarised followed by analysis of the empirical findings reported in papers on CAM conducted within both CAM-focused PBRNs and non-CAM focused PBRNs according to their themes and designs. Finally, the quality of the included articles is presented.

3. Results

3.1. Study inclusion

Our initial database and hand searches retrieved 399 articles. After removal of 26 duplicates, 373 articles remained. Of these, 292 articles were excluded following review of the title and abstract, and 81 full-text articles were retrieved for further assessment. A total of 51 articles met the inclusion criteria and were included in the review. Fig. 1 shows details of the selection process.

3.2. Description of the reviewed studies

The reviewed studies were published from 1998 to June 2017. Out of 51 included articles, 37 papers (72.5%) were published within the last 10 years. A majority of the included studies were nested within PBRNs conducted in the US (72.5%, n = 37), Australia (9.8%, n = 5), Canada (5.9%, n = 3), Canada and the US (7.8%, n = 4), Canada, the US and Europe (2.0%, n = 1), and Australia, Canada and the US (2.0%,

Table 1
A modified quality assessment system for quantitative studies other than RCTs.

Items of quality assessment ^a	Comments
Methodology:	
A Is the research question or objective explicitly defined?	Yes if the authors clearly described their goal
B Is the study design appropriate for the stated study objective?	Yes if the study design is considered adequate for study objective.
C Is the sampling strategy appropriate?	Yes if the study reports on the representativeness of its sample.
D Is non-response bias adequately addressed?	Yes if it adequately reports non-response bias.
E Is the response rate identified and sufficient?	Yes if it is provided or can be calculated and > 70%.
F Is the risk of recall bias low?	Yes if data were collected prospectively or retrospectively within the past 12 months.
Reporting of participants' characteristics:	
G Are the participants' basic characteristics clearly described?	Yes if condition/status of patients/parents of paediatric patients, or practitioners' clinical expertise/experience are clearly described.
H Is there a description of the core features of the relevant PBRN?	Yes if information on PBRN where the study was conducted or reference is clearly given.
Reporting of study results:	
I Do the results and conclusion adequately address the research question(s) as stated?	Yes if the reviewers agree that reported results and conclusion adequately address the research question(s).

* Yes, No, or Unclear is given to each item. PBRN, practice-based research network; RCT, randomised controlled trial.

n = 1). The study designs of the included articles varied including surveys (n = 33), prospective observational studies (n = 6), an RCT (n = 1), an uncontrolled trial (n = 1), study protocols (n = 2), a retrospective medical record review (n = 1), a cross-sectional observational study (n = 1), a qualitative study (n = 1), and non-empirical manuscripts detailing the design and establishment of the relevant PBRN (n = 6). One article reported on two different studies,²² resulting in 52 studies included in the review (Table 3). Of the 51 articles

included in the review, 32 (62.7%) came from CAM-focused PBRNs and the other 19 studies (37.3%) were generated from non-CAM focused PBRNs.

3.3. Quality of the included studies

Articles outlining PBRN establishment and study protocols reported in eight articles were excluded in quality assessment, leaving 43 articles

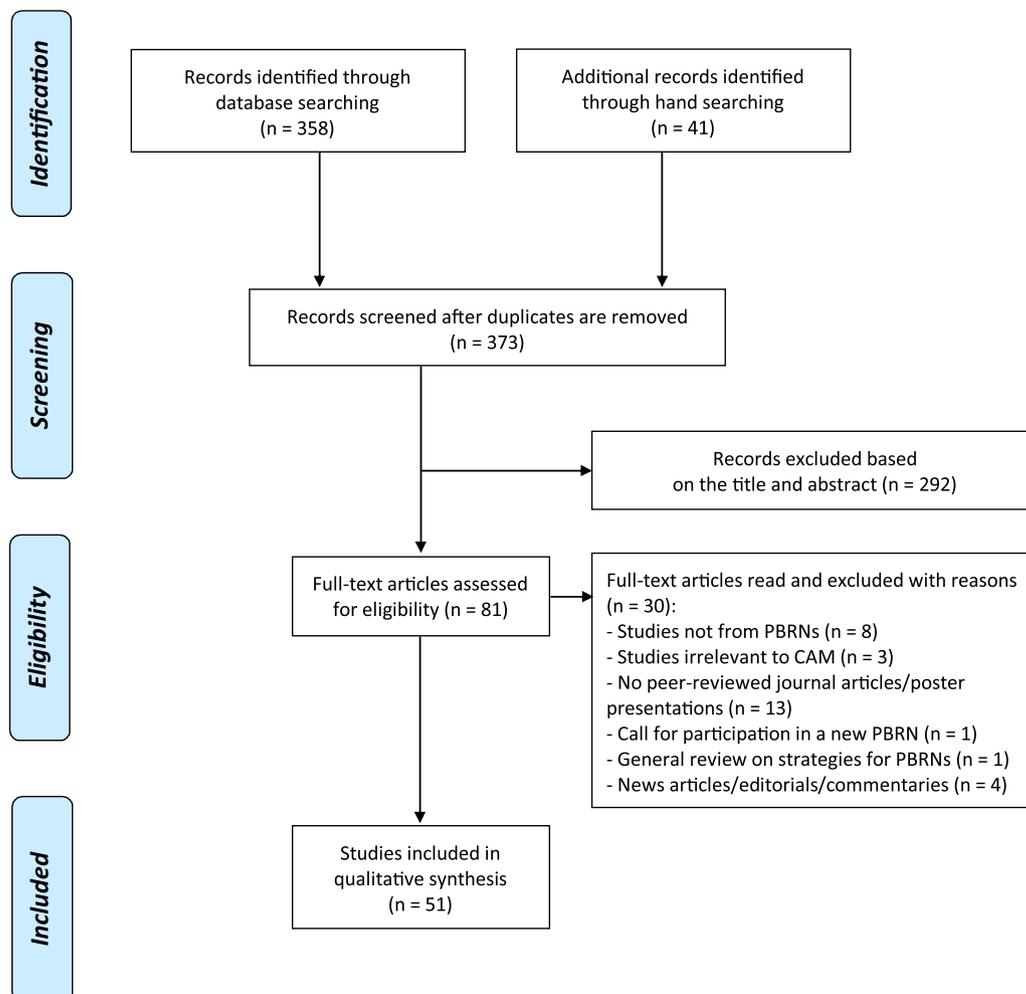


Fig. 1. PRISMA flowdiagram for literature searching.

CAM = Complementary and Alternative Medicine; PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Table 2
Quality assessment of quantitative studies other than RCTs.

Authors	Dimensions of quality assessment ^a									Total items with yes (out of 9 items)
	Methodology					Reporting of participants' characteristics		Reporting of study results		
	A	B	C	D	E	F	G	H		
Adams ²⁵	✓	✓	✓			✓	✓		✓	7/9
Edman ²⁶	✓	✓				✓	✓		✓	6/9
Elder ²⁷	✓	✓			✓	✓	✓		✓	7/9
Steel ²⁸	✓	✓	✓			✓	✓		✓	7/9
Yang ²⁹	✓	✓				✓	✓		✓	6/9
Alcantara ³⁰						✓	✓		✓	3/9
Alcantara ³¹	✓	✓	✓			✓	✓		✓	7/9
Anderson ³²	✓	✓	✓			✓	✓		✓	7/9
Woggon ³³	✓	✓				✓	✓		✓	4/9
Wolever ³⁴	✓	✓	✓			✓	✓		✓	6/9
Degenhardt-R ^{22**}	✓	✓	✓			✓	✓		✓	6/9
Degenhardt-P ^{22**}	✓	✓				✓	✓		✓	4/9
Edman ³⁵	✓	✓				✓	✓		✓	5/9
Licciardone ³⁶	✓	✓	✓			✓	✓		✓	7/9
Munk ³⁷	✓	✓			✓	✓	✓		✓	6/9
Abrams ³⁸	✓	✓				✓	✓		✓	5/9
Maguire ³⁹	✓	✓				✓	✓		✓	6/9
Alcantara ⁴⁰						✓	✓		✓	3/9
Alcantara ⁴¹	✓	✓	✓			✓	✓		✓	7/9
Evans ⁴²	✓	✓				✓	✓		✓	4/9
McKee ⁴³	✓	✓	✓			✓	✓		✓	7/9
Wolever ⁴⁴	✓	✓	✓			✓	✓		✓	7/9
Hawk ⁴⁵	✓	✓				✓	✓		✓	6/9
Alcantara ⁴⁶	✓	✓				✓	✓		✓	5/9
Alcantara ⁴⁷	✓	✓				✓	✓		✓	3/9
Callahan ⁴⁸	✓	✓	✓			✓	✓		✓	7/9
Alcantara ⁴⁹	✓	✓				✓	✓		✓	4/9
Redwood ⁵⁰	✓	✓				✓	✓		✓	4/9
Sleath ⁵¹	✓	✓	✓			✓	✓		✓	6/9
Tyler ⁵²	✓	✓				✓	✓		✓	4/9
Wiley-Exley ⁵³	✓	✓	✓			✓	✓		✓	6/9
Flannery ⁵⁴	✓	✓		✓		✓	✓		✓	7/9
Hawk ⁵⁵	✓	✓				✓	✓		✓	4/9
Sleath ⁵⁶	✓	✓	✓			✓	✓		✓	6/9
Kuo ⁵⁷	✓	✓				✓	✓		✓	5/9
Dailey ⁵⁸	✓	✓	✓	✓	✓	✓	✓		✓	8/9
Burge ⁵⁹	✓	✓			✓	✓	✓		✓	7/9
Hawk ⁶⁰	✓	✓				✓	✓		✓	4/9
Hawk ⁶¹	✓	✓				✓	✓		✓	3/9
Ottolini ⁶²	✓	✓			✓	✓	✓		✓	5/9
Hawk ⁶³	✓	✓				✓	✓		✓	4/9
Palinkas ⁶⁴	✓	✓	✓		✓	✓	✓		✓	7/9

* Refer to Table 1 for codes. **This article by Degenhardt²² has 2 study reports, i.e. a retrospective medical record review and a prospective observational study and they were labelled as Degenhardt-R and Degenhardt-P, respectively. ✓ indicates yes while empty cells mean no/unclear. RCT, randomised controlled trial.

subject to quality assessment.

3.3.1. Risk of bias in the included RCTs

The sole randomised placebo-controlled trial reported in the literature meeting our inclusion criteria²³ was considered to be of high quality because it was given a low risk of bias for all criteria.¹⁵

3.3.2. Quality of the included studies other than RCTs

3.3.2.1. Qualitative studies. One qualitative study²⁴ was evaluated as meeting all but one of the CASP checklist items for qualitative research.¹⁶

3.3.2.2. Quantitative studies. A total of 42 quantitative studies reported in 41 publications were evaluated using a modified quality assessment system (Table 2).^{17–21} The median number of quality assessment system items addressed in the studies was six out of nine items, with a minimum score of three and a maximum of eight. A majority of the evaluated studies were ranked as ‘no/unclear’ for items C (representativeness of sample), D (non-response bias), and E (response rate) - these papers failed to report the representativeness

of the study sample, possible difference between the study sample and non-responders, and/or the response rate, or to achieve a sufficient response rate. In addition, the information/description on the core features of the relevant PBRN upon which the studies were based was not reported in 18 of the 41 publications.

3.4. Features of CAM-focused PBRNs

Thirty-two of the 51 reviewed articles were generated from eight CAM-focused PBRNs. Of the eight CAM-focused PBRNs, four focused on chiropractic, two on osteopathy, and one each on integrative medicine and a mix of CAM professions. Six PBRNs were US-based and two CAM-focused PBRNs were Australian-based. Seven of the eight CAM-focused PBRNs were registered with the AHRQ PBRN registry requiring a minimum of five practice locations and 15 clinicians; a director and a mission statement; and a minimum of 50% of the membership being primary care clinicians. In the case of those PBRNs with less than 50% of members who are primary care clinicians, the project was registered as an affiliated PBRN.⁶⁵ Network size varied greatly across the CAM-focused PBRNs: CAM-focused PBRNs recruited between 19 and 3500

Table 3
Characteristics of the included studies.

Author	Country	PBRN	Study design	Condition /population (n)*	Contents
Adams ²⁵	Australia	ACORN	Online/postal survey	Chiropractors (n = 2005)	In-depth chiropractic workforce survey on chiropractor/practice characteristics, and clinical management in a nationally representative sample of Australian chiropractors (response rate: 43%)
Edman ²⁶	USA	BraveNet	Questionnaire survey	Patients with gastrointestinal disorders visiting integrative medicine clinics (n = 402)	Cross-sectional survey of a convenience sample of patients with GERD, IBS, and IBD on the association of perceived stress with quality of life and symptom management (response rate: NA)
Elder ²⁷	USA	KAN	Prospective observational feasibility study	Patients with chronic low back pain (n = 104) and primary care providers (n = 67) who referred the patients to community massage therapists	A repeated measures cohort study of referring chronic low back pain patients to community massage therapists to test feasibility and effectiveness
Yang ²⁹	USA	BraveNet	Questionnaire survey	A subset of patients (n = 2015) in BraveNet (n = 4182) who had BMI data and were receiving integrative medicine care	Survey of characteristics and motivation of obese patients seeking integrative medicine care (response rate: NR)
Steel ²⁸	Australia	PRACI	Online survey	CAM practitioners (n = 1264)	Baseline workforce survey on CAM practitioner/practice characteristics in Australian CAM practitioners (response rate: NA)
Adams ⁶⁷	Australia	ACORN	Protocol of a PBRN	Chiropractors (n = 1680)	Protocol of a nationwide Australian chiropractor database established using multifaceted recruitment and promotion strategies (response rate: 36%)
Alcantara ³⁰	Australia	ICPA PBRN	Questionnaire survey	Chiropractic Patients mainly with musculoskeletal problems (n = 126)	Examination of feasibility of questionnaires in a chiropractic PBRN (response rate: NR)
Dusek ⁷²	USA	BraveNet	Protocol of a cohort study	Patients attending integrative medicine centres	Protocol of a prospective, 10-year observational evaluation in an integrative medicine PBRN
Adams ⁶⁶	USA	ACORN	Protocol of a PBRN	Chiropractors	An overview of the 1 st nationwide Australian chiropractic PBRN
Alcantara ³¹	Australia	ICPA PBRN	Online survey	Chiropractors (n = 162)	Examination of chiropractors' attitudes and utilization of evidence-based practice via online survey (response rate: 32.4%)
Alcantara ⁶⁸	USA	ICPA PBRN	Protocol of a PBRN	Chiropractors	An overview of an international chiropractic PBRN
Anderson ³²	USA	TARGET Kids!	Prospective cohort study	Healthy children (0-5 years) attending primary care (n = 5044)	A cohort study on vitamin D supplementation and wheezing involving children from paediatric or family practices in a primary care PBRN
Woggon ³³	Canada	CSRN	Questionnaire survey	Scoliosis patients attending chiropractic clinics (n = 189)	Adverse events data from 3198 responses over a year from patient survey (response rate: 25%)
Wolever ³⁴	USA	BraveNet	Questionnaire survey	Patients in integrative medicine clinics (n = 4182)	Psychosocial profiles of 4182 patients from an integrative medicine PBRN via questionnaire survey (response rate: NR)
Degenhardt ²²	USA	DO-Touch.NET	1) Retrospective medical record review 2) Prospective observational study	1) 2569 clinic visits 2) 299 clinic visits	1) 1-year billing data analysed to collect diagnosis information 2) Prospective observational study regarding diagnoses and symptom relief
Edman ³⁵	USA	BraveNet	Questionnaire survey	Self-identified cancer patients attending 8 integrative medicine centres (n = 353)	Comparison of characteristics of cancer patients with the larger non-cancer cohort (n = 3513) in an integrative medicine PBRN (response rate: NR)
Licciardone ³⁶	USA	CONCORD PBRN	Questionnaire survey	Patients attending osteopathic clinics (n = 668)	Patient and osteopath survey on patient characteristics and osteopathic practice patterns in an osteopathic PBRN (response rate: NR)
Maguire ⁷⁴	Canada	TARGET Kids!	Protocol of a pragmatic RCT	Healthy children (0-5 years) recruited during routine health maintenance visits (n = 750)	Protocol of a pragmatic RCT in a paediatric PBRN on the effect of high dose vitamin D supplementation on achieving reductions in URI and asthma exacerbations
Munk ³⁷	USA	KAN	Prospective observational feasibility study	Community massage therapists (n = 25)	Challenges and solutions in recruitment and retention of massage therapists, and practice-based massage protocol design
Steel ⁷¹	Australia	PRACI	Protocol of a PBRN	CAM practitioners	An overview of a national PBRN for 14 CAM professions in Australia
Abrams ³⁸	USA	BraveNet	Prospective observational study	Chronic pain patients visiting integrative medicine clinics (n = 409)	Prospective observational evaluation of personalized multimodal approach to chronic pain in an integrative medicine PBRN up to 6 months
Maguire ³⁹	Canada	TARGET Kids!	Cross-sectional observational study	Healthy children (0-5 years) recruited during routine health maintenance visits (n = 1898)	Cross-sectional study of association of vitamin D supplementation and 25-hydroxyvitamin D status in early childhood (blood samples obtained from 56% of participants)
Alcantara ⁴⁰	USA	ICPA PBRN	Questionnaire survey	Pregnant women with breech presentation	24 chiropractors participated in the survey and provided data involving 63 breech presentations (chiropractor response rate: 1.1%).

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Table 3 (continued)

Author	Country	PBRN	Study design	Condition /population (n)*	Contents
Alcantara ⁴¹	USA	ICPA PBRN	Questionnaire survey	Pregnant women (n = 126)	Survey data on 126 pregnant women seeking chiropractic care (response rate: NR)
Evans ⁴²	USA	ICON	Questionnaire survey	Chiropractors (n = 27)	Feasibility test of survey instruments in 530 patient visits in a chiropractic PBRN (response rate: NR)
Licciardone ⁷⁰	USA	CONCORD PBRN	Protocol of a PBRN	Osteopaths	An overview of an osteopathic PBRN
McKee ⁴³	USA	NYC RING	Uncontrolled trial	Chronic pain patients visiting community health centres (n = 185)	Feasibility and acceptability of offering acupuncture as an adjunct to usual care in an urban community health centre setting
Wolever ⁴⁴	USA	BraveNet	Questionnaire survey	Patients visiting integrative medicine clinics (n = 4182)	Survey of characteristics and motivation of patients seeking integrative medicine care (response rate: NR)
Hawk ⁴⁵	USA	ICON	Questionnaire survey	Patients (n = 1891) and chiropractors (n = 38)	Survey of chiropractors and their patients on practice characteristics regarding important health promotion and disease prevention in a chiropractic PBRN (response rate: NR)
Alcantara ⁴⁶	USA, Canada, Europe	ICPA PBRN	Questionnaire survey	Chiropractors (n = 548)	Survey of characteristics of paediatric chiropractic practice (response rate: 37%)
Alcantara ⁴⁷	USA	ICPA PBRN	Questionnaire survey	21 chiropractors providing 577 paediatric cases and 239 parents of paediatric patients reporting on a similar number of children	Survey of chiropractors and parents of paediatric patients on safety and effectiveness of spinal manipulative therapy (chiropractor response rate: 1%; parental response rate: NR)
Callahan ⁴⁸	USA	NC-FM-RN	Postal survey	Patients self-reporting OA, RA, FM, and chronic joint symptoms (n = 2140)	Survey on arthritic patients' CAM use; sample drawn from family medicine PBRN (n = 1077) and a musculoskeletal database (n = 1063) (response rate: 52.2%)
Shelley ⁵⁴	USA	RIOS Net	Qualitative study	Patients (n = 114), clinic staffs (n = 41) and primary care clinicians (n = 19)	Qualitative study using focus group, in-depth interview, and video vignette to explore barriers limiting patient-clinician communication about traditional medicine/CAM use
Alcantara ⁴⁹	USA	ICPA PBRN	Questionnaire survey	38 chiropractors providing 812 paediatric cases and 390 parents of paediatric patients reporting on 389 cases	Self-administered questionnaire survey of chiropractors and parents of paediatric patients on patient conditions and reasons of seeking chiropractic care (chiropractor response rate: 1.8%; parental response rate: NR)
Redwood ⁵⁰	USA	Unnamed PBRN	Online survey	Chiropractors (n = 71)	Electronically administered survey to chiropractic college faculty and practicing chiropractors on their identity as CAM practitioners (response rate: 37%)
Sleath ⁵¹	USA	NC-FM-RN	Postal survey	Patients with OA (n = 557)	Survey on conventional and CAM treatment use in patients with OA in a family medicine PBRN (response rate: 62%)
Tyler ⁵²	USA	CLEAR-eN	Questionnaire survey	Women attending community family health centres (n = 185)	Survey on calcium supplement use in women attending family medicine practices (response rate: NR)
Wiley-Exley ⁵³	USA	NC-FM-RN	Postal survey	Patients self-reporting OA, RA, FM, and chronic joint symptoms (n = 2068)	Survey on patients' CAM use for musculoskeletal disorders and medical scepticism (response rate: 52.2%)
Flannery ⁵⁴	USA	KAN	Postal survey	Community clinicians (n = 112)	Survey on how primary care clinicians communicate with patients about CAM and to determine interest in additional education about CAM (response rate: 63.7%)
Hawk ⁵⁵	Canada and USA	Unnamed PBRN	Prospective observational pilot study	Patients (n = 181) and chiropractors (n = 37)	Pilot testing of feasibility of patient educational materials on the hazards of tobacco use in a chiropractic practice setting (chiropractor response rate: 9.8%)
Sleath ⁵⁶	USA	NC-FM-RN	Postal survey	Patients self-reporting OA, RA, FM, and chronic joint symptoms (n = 752)	Survey on physicians' participatory decision-making style and patients' reporting of CAM use in family medicine practices (response rate: 48.1%)
Kuo ⁵⁷	USA	SPUR-Net	Questionnaire survey	Patients visiting primary care clinics for routine care (n = 322)	Survey on herbal use and characteristics of its users in a primary care PBRN (response rate: NR)
Dailey ⁵⁸	USA	MetroNet	Questionnaire survey	Ethnically diverse women (40-55 years) attending family practice centres (n = 397)	Survey on herbal use and menopause symptoms in a family medicine PBRN (response rate: 92%)
Taylor ²³	USA	PSPRN	RCT	URIs in children (2-11 years) (n = 524)	Randomized, placebo-controlled trial testing the effectiveness of herbal medicine in a paediatric PBRN
Burge ⁵⁹	USA	RRNeST	Questionnaire survey	Not specified; mostly Latino patients in family practices in South Texas (n = 575)	Survey on CAM use in a family practice residency programs research network (response rate: 78%)
Hawk ⁶⁰	Australia, Canada and USA	Unnamed PBRN	Questionnaire survey	Patients visiting chiropractic clinics (n = 7651)	Survey on characteristics of patients and practices in a chiropractic PBRN (response rate: NR)
Hawk ⁶¹	Canada and USA	Unnamed PBRN	Questionnaire survey	Chiropractors (n = 172) and patients who had visited their practices at least once before survey (n = 2987)	Survey on patient characteristics and satisfaction with chiropractic care (response rate: NR)

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Table 3 (continued)

Author Country	PBRN	Study design	Condition /population (n)	Contents
Ottolimi ⁶² USA	Children's National Medical Center PRN	Questionnaire survey	Parents of paediatric patients (n = 348)	Survey of a convenience sample of parents on CAM use among children in paediatric primary care settings (response rate: 85%)
Hawk ⁶³	Unnamed PBRN	Questionnaire survey	Patients (≥ 55 years) visiting chiropractic practices (n = 805)	Survey on characteristics of older patients seeking chiropractic care (response rate: NR)
Canada and USA	SURF NET	Questionnaire survey	Patients attending family practice clinics (n = 542)	Survey on characteristics of primary care patients using CAM (response rate: 89%)
USA Canada and USA	Unnamed PBRN	Protocol of a PBRN	Patients and chiropractors	Establishment of a practice-based research program for chiropractic practices

* the number of participants is not available depending on study design, e.g. protocol. ACORN, Australian Chiropractic Research Network; BMI, body mass index; BraveNet, Bravewell integrative medicine research network; CAM, complementary and alternative medicine; CLEAR-eN, Cleveland Clinic Ambulatory Research Network; CONCORD, Consortium for Collaborative Osteopathic Research Development; CSRN, CLEAR (Chiropractic, Leadership, Educational, Advancement and Research) Scoliosis Research Network; DO-Touch.NET, Doctors of Osteopathy Treating with Osteopathic manipulative medicine; determining its Usefulness in Current Healthcare; FM, fibromyalgia; GERD, gastroesophageal reflux disease; IBD, inflammatory bowel disease; IBS, irritable bowel syndrome; ICON, integrative chiropractic outcomes network; ICPA, international chiropractic pediatric association; KAN, Kentucky Ambulatory Network; MetroNet, Metropolitan Detroit practice-based research network; NA, not applicable; NC-FM-RN, North Carolina Family Medicine Research Network; NR, not reported; NYC RING, New York City Research & Improvement Network Group; OA, osteoarthritis; PBRN, practice-based research network; PRACI, Practitioner Research and Collaboration Initiative; PRN, pediatric research network; PSPRN, Puget Sound Pediatric Research Network; RA, rheumatoid arthritis; RCT, randomized controlled trial; RIOS Net, Research Involved in Outpatient Settings Network; RRNeST, Residency Research Network of South Texas; SPUR-Net, Southern Primary-care Urban Research Network; SURF*NET, San Diego Unified Research in Family Medicine Network; TARGET Kids!, The Applied Research Group for Kids; URI, upper respiratory infection.

network members. All CAM-focused PBRNs were supported by universities and/or relevant professional associations, except one focused upon integrative medicine that was supported by a not-for-profit organisation. Official websites were identified for seven of the CAM-focused PBRNs while detailed information of one US-based chiropractic-focused PBRN remains currently unavailable (Table 4).

Six articles outlining PBRN establishment related to three chiropractic-focused PBRNs,^{66–69} one osteopathy-focused PBRN,⁷⁰ and one mixed CAM profession-focused PBRN⁷¹ (Table 3). More details on PBRN establishment from the six articles are outlined in Supplementary file 2.

3.5. Studies from CAM-focused PBRNs (26 articles)

Twenty-seven studies reported in 26 of the articles included in the review analysed data from eight CAM-focused PBRNs. Below we present relevant findings from these PBRNs in one of three categories (health services research, effectiveness and safety of CAM practices/interventions, and feasibility of instruments/interventions in PBRN settings). Some articles reported on findings that addressed more than one theme.

3.5.1. Health services research (18 articles)

3.5.1.1. Patient characteristics: who seeks CAM and why? (12 articles). Eleven questionnaire surveys^{26,29,34–36,41,44,49,60,61,63} and one retrospective medical record review,²² five each from chiropractic and integrative medicine PBRNs, and two from osteopathy PBRNs, were conducted to investigate characteristics and motivations of patients using different CAM. A total of 4182 patients visiting integrative medicine clinics in a US integrative medicine PBRN, BraveNet, completed a set of questionnaires regarding their psychological features³⁴ and why they sought integrative medicine.⁴⁴ Additionally, two questionnaire surveys involving subsets of these 4182 patients from the BraveNet, reported on the characteristics and motivation of obese patients seeking integrative medicine (n = 2015),²⁹ and on correlation of perceived stress with quality of life and pain rating in patients diagnosed with gastrointestinal disorders (n = 402).²⁶ In another patient survey conducted in BraveNet, self-identified cancer patients were compared with a non-cancer cohort regarding demographic and psychological characteristics, and reasons for seeking integrative cancer care.³⁵ A retrospective medical record review analysed one-year billing data from 2569 office visits to two university-based clinics in an osteopathy-focused PBRN.²² In another paper reporting on a study from the Consortium for Collaborative Osteopathic Research Development (CONCORD) PBRN, osteopaths collected information of diagnosis and practice patterns for consecutive patient visits during a month on pre-developed cards for research purposes.³⁶ The remaining five surveys included in the review which reported on patient characteristics were all conducted via chiropractic PBRNs with focus upon sub-populations including pregnant women,⁴¹ older patients aged over 55,⁶³ and parents of children receiving chiropractic care.⁴⁹ Lastly, two PBRN-nested questionnaire surveys examined chiropractic patients' satisfaction and diagnoses/complaints.^{60,61}

3.5.1.2. Practitioner characteristics and practice patterns (9 articles). The characteristics of practitioners and their practices were reported in nine studies from chiropractic-focused, osteopathic-focused, mix CAM profession-focused, and integrative medicine-focused PBRNs.^{25,28,31,34,36,45,46,50,60} One questionnaire survey nested within the BraveNet PBRN examined the most frequently provided services in integrative medicine clinics,³⁴ and via the osteopathy CONCORD PBRN, 668 osteopaths reported on the types of examination provided for their patients.³⁶ In six surveys from chiropractic PBRNs, two online surveys asked chiropractors' attitudes and utilization of evidence-based practice³¹ and their identity as CAM practitioners⁵⁰ with response

Table 4
Characteristics of the CAM-focused PBRNs from the included studies in the review.

Name	Geographical coverage	AHRQ registration	Membership/ specialty	Size**	Funding	Features/mission	Website
ACORN	National/ Australia	Yes	Chiropractors	> 1680	Chiropractors' organization of Australia	Facilitating closer engagement and communication between chiropractors and researchers; advancing broad rigorous scientific investigation to inform chiropractic patient care; conducting research on chiropractic that is practice and practitioner relevant; promoting and growing critical research capacity and helping produce a sustainable research culture in Australian chiropractic; facilitating and encouraging chiropractic research network building and collaborations across Australia and internationally	http://www.acorn-arccim.com/
BraveNet	National/ US	Yes	Integrative medicine centres	19	Bravewell Collaborative	Transforming health care and improving the health of the public through integrative medicine	http://www.bravewell.org/current_projects/bravenet/
CONCORD PBRN	National/ US	Yes	Osteopaths	> 20	Osteopathic Research Centre at Texas College of Osteopathic Medicine	To provide the evidence base for osteopathic medicine by conducting patient-centred research today and training the investigators of tomorrow	https://www.umhsc.edu/texas-college-of-osteopathic-medicine/CONCORD-PBRN
CSRN	International/ US-based	Yes	Chiropractic scoliosis specialists	> 50 centres	CLEAR scoliosis institute	To implement an effective chiropractic system of scoliosis care to help people worldwide through research and spinal rehabilitation	https://www.clear-institute.org/
DO-Touch.NET	National/ US	Yes	Osteopaths	159	A.T. Still University	To promote and conduct practice-based research that will further the practice of osteopathic manipulative medicine	http://www.do-touch.net/
ICON/ unnamed PBRN	National/ US	No	Chiropractors	NA	NA	To conduct collaborative research through a partnership between researchers and practitioners with the ultimate goal of enhancing the health of the public and contributing to the scientific evidence base related to health promotion and disease prevention	No website
ICPA PBRN	International/ US-based	Yes	Chiropractors/ paediatrics	3500	ICPA	Establishing and advancing the chiropractic family wellness lifestyle on a global basis	http://icpa4kids.com/research/PBRN/ABOUT.htm
PRACI	National/ Australia	Yes	Complementary medicine practitioners	748	Endeavour College of Natural Health	Strengthening the development of meaningful and practice relevant research in complementary healthcare; Supporting productive communication and engagement between complementary healthcare practitioners and researchers; Stimulating and developing a sustainable research culture within complementary healthcare in Australia; Facilitating the development of research networks in a range of complementary healthcare fields across Australia and internationally; Progressing broad, rigorous scientific investigation to inform complementary healthcare patient care	https://praci.com.au/

* as of November 2016.

** from respective websites as of October 2016. ACORN, Australian Chiropractic Research Network; AHRQ, Agency for Healthcare Research and Quality; BraveNet, Bravewell Integrative Medicine Research Network; CAM, complementary and alternative medicine; CONCORD, Consortium for Collaborative Osteopathic Research Development; CSRN, CLEAR (Chiropractic, Leadership, Educational, Advancement and Research) Scoliosis Research Network; DO-Touch.NET, Doctors of Osteopathy Treating with Osteopathic Manipulative Medicine: determining its Usefulness in Current Healthcare; ICPA, international chiropractic pediatric association; IM, integrative medicine; NA, not available; PBRN, practice-based research network.

rates of 32.4% and 37%, respectively. Three questionnaire surveys were about what advices for health promotion were given in their chiropractic practice,⁴⁵ paediatric chiropractic practice patterns,⁴⁶ and characteristics of non-musculoskeletal complaints in chiropractic practices.⁶⁰ The other in-depth chiropractic workforce survey involving 2005 chiropractors reports secondary analysis of baseline PBRN data on practitioner/practice characteristics and clinical management from the Australian Chiropractic Research Network (ACORN), with a response rate of 43%.²⁵ Lastly, via Practitioner Research and Collaboration Initiative (PRACI), a PBRN for a mix of CAM professions, one paper reports upon an online workforce survey analysis examining the characteristics of PBRN members.²⁸

3.5.2. Effectiveness and safety of CAM practices/interventions (7 articles)

Seven articles reported findings from CAM-focused PBRN-based studies which examined the effectiveness and/or safety of CAM practices.

Following a prospective observational study where 252 patients completed patient-reported outcomes during six month evaluation,³⁸ another prospective, 10-year cohort study evaluating the effect of integrative medicine care using the electronic data capture system is being conducted.⁷² Four questionnaire surveys from two chiropractic PBRNs examined effectiveness and safety of chiropractic practice. One survey reported safety of chiropractic care for patients with scoliosis from CLEAR (Chiropractic, Leadership, Educational, Advancement and Research) Scoliosis Research Network (CSRN),³³ and the other three all from International Chiropractic Pediatric Association (ICPA) PBRN, examined perceived therapeutic effectiveness of chiropractic care in pregnant women⁴¹ and breech presentation,⁴⁰ and perceived effectiveness and safety of chiropractic spinal manipulation for children by practitioners and parents.⁴⁷ Lastly, a prospective observational study involving 259 patients from an osteopathy-focused PBRN, Doctors of Osteopathy Treating with Osteopathic manipulative medicine: determining its Usefulness in Current Healthcare (DO-Touch.NET) reported on effectiveness of osteopathic manipulative treatment.²²

3.5.3. Feasibility of instruments/interventions in PBRN settings (3 articles)

Three studies tested the feasibility of survey instruments or interventions in chiropractic practices. A patient survey examined the feasibility of patient satisfaction/patient reported outcome measurement instruments within the ICPA PBRN.³⁰ Another chiropractic PBRN, Integrative Chiropractic Outcomes Network (ICON), produced a paper reporting the feasibility and appropriateness of the survey instrument focusing on prevention and health promotion in a questionnaire survey involving 530 patient visits.⁴² Lastly, a pilot observational study from an unnamed chiropractic-focused PBRN, tested the feasibility of a patient educational leaflet on tobacco cessation in chiropractic practices.⁵⁵

3.6. Features of non-CAM focused PBRNs where CAM studies were conducted

Nineteen studies were conducted in 12 different non-CAM focused PBRNs. According to AHRQ's classification, nine out of the 12 non-CAM PBRNs are primarily focused upon family medicine or primary care networks and the other three were all paediatric-focused. Except for the Canadian TARGET Kids! PBRN, all non-CAM focused PBRNs had a regional (non-national) membership coverage. The largest non-CAM focused PBRN reviewed, the North Carolina Family Medicine Research Network (NC-FM-RN), has over 4700 registered patients from 16 family medicine practices.⁷³ The funding sources for non-CAM focused PBRNs were heterogeneous and often multiple for the same PBRN. Official websites were located for five out of the 12 non-CAM focused PBRNs and online information from non-official websites was available for three non-CAM focused PBRNs. We could not locate any online information for the other four non-CAM focused PBRNs - Children's

National Medical Center Pediatric Research Network, NC-FM-RN, Puget Sound Pediatric Research Network (PSPRN), and Residency Research Network of South Texas (RRNeST) (Supplementary file 3).

3.7. Studies from non-CAM focused PBRNs (19 articles)

Nineteen articles reported findings from non-CAM focused PBRN-based studies which examined characteristics of patients seeking CAM, doctor-patient communication about CAM use, CAM use/prevalence, the effectiveness and/or safety of CAM practices, and the feasibility of instruments/interventions in PBRN settings. Some articles reported on findings that belonged to more than one theme.

3.7.1. Health Services Research (14 articles)

3.7.1.1. Patient characteristics: who seek CAM and why? (2 articles). Two postal surveys based on a large patient database of the US-based NC-RM-RN were published: 1296 patients with osteoarthritis were sent questionnaires about their characteristics and CAM/conventional medicine use, and 62% of them replied.⁵¹ The other postal survey reported on patient characteristics, medical scepticism, and CAM use with a response rate of 52.2% from 2068 patients with chronic joint symptoms, 1344 patients consulting specialists and 724 patients consulting family practitioners, respectively.⁵³

3.7.1.2. Doctor-patient communication about CAM (5 articles). Our review identified five studies of doctor-patient communication about CAM use conducted via non-CAM PBRNs - one via paediatric PBRN,⁶² and four from family medicine/primary care PBRNs.^{24,54,56,57} These papers report on four postal/questionnaire surveys,^{54,56,57,62} and one qualitative research²⁴ with all examining aspects of patients' communication about their CAM with their doctors. One regional US family physician PBRN - the Kentucky Ambulatory Network (KAN) - with a response rate of 63.7% mailed community clinicians a four-page self-administered questionnaire to examine perspectives about their patients' CAM use and to determine interest in additional education about CAM.⁵⁴ Another postal survey from the NC-FM-RN, a family medicine PBRN in North Carolina, US, questioned patients with arthritis, fibromyalgia, and chronic joint symptoms about their CAM-focused communication with their doctors, physician use of a participatory decision-making style, and medical scepticism.⁵⁶ Two questionnaire surveys focused upon patients' disclosure of CAM use to their doctors. One was a survey involving patients visiting primary care physicians for routine care and drawing upon Southern Primary-care Urban Research Network (SPUR-NET) in Houston, US which examined patients' disclosure regarding their herbal medicine use to physicians or pharmacists,⁵⁷ and another survey of 348 parents of paediatric patients via Children's National Medical Center Pediatric Research Network (PRN) which reported on CAM treatment of their children without the advice from or disclosure to their paediatricians.⁶² Lastly, one paper drawing upon the Research Involved in Outpatient Settings Network (RIOS Net) PBRN reports findings from a qualitative study of patients, clinicians and clinic staff regarding the barriers limiting patient-clinician communication about CAM use.²⁴

3.7.1.3. CAM use/prevalence (8 articles). Eight papers reported on CAM use/prevalence of which six were drawn from family medicine PBRNs^{48,52,57–59,64} and two from observational studies.^{32,39} The use of CAM treatment was examined in arthritic patients in primary care and specialty settings in a postal survey.⁴⁸ Similarly, patients attending family practice clinics affiliated with a family medicine PBRN in San Diego, US,⁶⁴ and Latino patients attending family practices in South Texas⁵⁹ were questioned about their CAM use in questionnaire surveys. Another family medicine PBRN focused on underserved populations in Detroit, US, questioned ethnically diverse women including those with menopausal symptoms about their use of selected herbal medications (phytoestrogens, St. John's wort, *Ginkgo biloba*, and ginseng) in the

previous six months.⁵⁸ Another family medicine PBRN focusing on osteoporosis prevention was drawn upon to examine the use of calcium supplements in women attending community health centres in Cleveland, US⁵² and a further family medicine-focused PBRN, conducted in Texas, reported the use of herbal medicines amongst ethnically diverse women recruited via primary care practices.⁵⁷

Two observational studies were published from a paediatric PBRN undertaken in Canada.^{32,39} A cohort study analysed baseline maternal and child vitamin D supplementation data for 5044 children and wheezing data from follow-up visits from 2478 children.³² The other cross-sectional study analysed blood samples from 1898 children, using patient survey, anthropometric measurements, and laboratory data to examine the association of vitamin D supplementation and cow's milk intake with 25-hydroxyvitamin D status in early childhood.³⁹

3.7.2. Effectiveness and safety of CAM practices/interventions (2 articles)

One RCT and a protocol for an RCT were each published from two separate paediatric PBRNs undertaken in the US and Canada.^{23,74} In a regional paediatric PBRN and an complementary medical centre in Seattle, US, a randomised placebo-controlled trial of herbal remedy (Echinacea) for upper respiratory infection in children was conducted over a four-month period.²³ Another pragmatic RCT involving preschool-aged children recruited from a Canadian paediatric PBRN will compare the effect of high dose vitamin D supplementation with standard dose for a minimum of four months in achieving reductions in upper respiratory infection and asthma exacerbations.⁷⁴

3.7.3. Feasibility of instruments/interventions in PBRN settings (3 articles)

Three studies tested the feasibility of CAM interventions or CAM therapist recruitment strategies in family medicine PBRN settings.^{27,37,43} Drawing upon the New York City Research and Improvement Networking Group (NYC Ring), a PBRN focusing exclusively on the urban underserved, researchers tested primary care physicians' acceptance of referral to 14 weekly acupuncture treatments as an adjunct treatment for their patients' chronic pain in the urban community health centre setting.⁴³ Challenges and solutions in recruitment and retention of community-based massage therapists, and feasibility and effectiveness of massage therapy in patients with chronic low back pain were reported in two prospective observational feasibility studies from a family physician PBRN, KAN, in the US.^{27,37}

4. Discussion

This paper reports the first critical review of the features of CAM-focused PBRNs, how CAM has been researched within PBRNs, and the quality of such studies. Out of 51 included articles, 37 papers (72.5%) were published over the past 10 years, and this appears to be in line with a wider growing interest in CAM amongst the research community.^{75,76} Thirty-two included articles report on CAM-focused PBRNs and the other 19 articles report studies nested within non-CAM focused PBRNs focused upon family medicine/primary care or paediatrics. The majority of reviewed articles originating from CAM-focused PBRNs report either the characteristics of patients who use CAM treatments (12 articles) or CAM practitioner/practice patterns (9 articles). The effectiveness and/or safety of CAM practices were also reported in seven articles. Meanwhile, doctor-patient communication about CAM use and CAM use/prevalence emerged as the most researched themes relating to this area from non-CAM focused PBRNs.

Our analysis identifies some distinctive features of CAM-focused PBRNs in comparison with non-CAM focused PBRNs. First, the geographical coverage of the CAM-focused PBRNs varies significantly to that of non-CAM focused PBRNs; while all non-CAM focused PBRNs except a Canadian paediatric PBRN were US-based and regional/local or city-wide (non-national), all eight CAM-focused PBRNs, two Australia-based and six US-based, had national/international coverage. Second, it is common for a PBRN to have individual members and/or

member practices⁷⁷ and non-CAM focused PBRNs in this review focused upon family medicine clinicians, paediatricians, or a combination of practice members across family medicine, paediatrics, internal medicine, nursing and/or other specialties. The one exception was NC-FM-RN, the largest non-CAM focused PBRN with over 4700 registered patients from 16 family medicine practices in North Carolina.⁵⁸ In contrast, the eight CAM-focused PBRNs included in this review involved exclusive membership of corresponding practitioners except an integrative medicine network that had 19 integrative medicine centres as members. Third, while non-CAM focused PBRNs had various funding sources including National Institute of Health (NIH), AHRQ, not-for-profit foundations, and state and federal funders, all CAM-focused PBRNs except BraveNet (which was supported by the not-for-profit organisation), have been established and supported by universities or associations representing relevant professions – a situation that may reflect a lack of priority for CAM research (both PBRN or non-PBRN in design) amongst national health research schemes and/or a lack of strategic research capacity in the CAM field.⁷⁸

A number of comparisons between studies from CAM-focused PBRNs and those from non-CAM focused PBRNs should be noted. The research priorities of CAM-focused PBRNs were different from those of non-CAM focused PBRNs. Thirty-two out of the 51 articles (62.7%) included in the review reported health service research: such studies drawing upon CAM-focused PBRNs were more likely to report findings on the profile of patients who use CAM, and practitioner/practice patterns while health service research studies from non-CAM focused PBRNs reported on CAM use/prevalence and doctor-patient communication around CAM use. In addition to this, three feasibility studies were reported from CAM-focused PBRNs and non-CAM focused PBRNs, respectively. While three studies from CAM-focused PBRNs tested whether a survey instrument/patient education leaflet was successfully implemented in their PBRN settings, three studies from non-CAM focused PBRN examined the feasibility of physicians' acceptance of or referral of patients to CAM treatments as an adjunct to their practice. Such discrepancies in research focus may well reflect the different purposes and aims of the CAM-focused and non-CAM focused PBRNs serving different needs in their respective practice base.

CAM-focused PBRNs reported seven studies on effectiveness/safety of CAM practice (22%) but only two such studies were conducted within non-CAM focused PBRNs (11%). While two studies from non-CAM focused PBRNs used an RCT design to examine the effect of a CAM intervention, seven studies examining the effectiveness/safety of practices from CAM-focused PBRNs all adopted prospective observational study or survey designs which may not be best suited to determine effectiveness. Therefore, the effectiveness claims from surveys or observational studies conducted in CAM-focused PBRNs in this review may need a careful interpretation. At the same time, further CAM PBRN research is required building upon this early work to help undertake and advance examination of efficacy/effectiveness research around different CAM.

Lastly, methodological quality of the included quantitative studies from non-CAM focused PBRNs was higher than that of the included studies from CAM-focused PBRNs (6.5 vs. 5) (Table 2). Among the items of quality assessment, none of the included studies from CAM-focused PBRNs were given yes for adequate addressing of non-response bias (item D) and sufficient response rate provided (item E) (Table 1). These two items belong to the methodology domain in the quality assessment system and it calls for more rigorous research designing and reporting in this field. Nevertheless, it needs to be noted that the quality assessment tool employed was not designed specifically to evaluate PBRN-based features nor formally validated to critically appraise various quantitative study designs and these points can be interpreted as limitations of our review. The professional coverage of one of the CAM-focused PBRNs (ACORN), for example, is the highest coverage of any profession, anywhere in the world via such a PBRN design – a feature that illustrates the relative rigour and potential impact of at least some

PBRN designs established in the CAM research field when compared to those non-CAM PBRN field.⁷⁹

Several gaps in the reviewed literature were identified in regard to study findings and methodological quality. A majority of the reviewed articles (84.3%) were from the US with good representation also identified from Australian researchers. In contrast, no relevant European or Asian PBRN studies were identified in our search. With regards to the European context, this is an interesting finding given that early surveillance systems in the United Kingdom and the Netherlands inspired family physicians in other countries to create research networks similar to PBRNs for frontline clinical practice for the past decades.⁸⁰ It would appear there is much opportunity for CAM-focused PBRN work to be developed in Europe and Asian countries.

While more than half of the methodological quality items, i.e. median score of 6 out of the 9, were satisfied in our quality assessment of quantitative studies, a majority of the studies that had been subject to quality assessment failed to clearly address the representativeness of the study sample, possible difference between the study sample and non-responders, and to achieve a sufficient response rate. Researchers planning studies on CAM within PBRN settings should take caution to minimise these methodological weaknesses and poor reporting.

Despite these gaps our review reports the first critical evaluation of the literature on CAM research via PBRNs, and provides a useful resource for researchers and policy makers interested in understanding the landscape and opportunities for developing CAM research within PBRNs.

There is much opportunity and need for further research engagement and capacity building around CAM research within PBRN settings.¹¹ A PBRN provides excellent opportunity to conduct CAM-focused implementation science and translational research in order to help promote evidence-based practices in the field.⁸¹ In addition, PBRNs provide direct access to the experience and daily routine care of CAM practice and as such have been and can continue to help focus research questions and enquiries in ways that are of direct pertinence and impact for grass-roots CAM practice and patient outcomes.⁸² An established PBRN also provides a significant opportunity to help facilitate translation and implementation with core practitioner members engaged with the network over time, open to greater research exposure and involvement and, in some cases, potentially developing enthusiasm around integrating further evidence-based findings into their CAM patient care.⁶ Establishing and sustaining a (CAM-focused) PBRN in a rapidly changing healthcare environment – especially in a field such as CAM where resources, research culture and research capacity are in many cases severely limited – is challenging.⁶⁷ Nevertheless, a number of key PBRN features which promote a closer connection between practitioners and researchers do highlight the benefits and justification for developing such networks where possible.

5. Conclusions

This first critical overview of CAM research in PBRNs reveals this approach to research design has provided an effective platform to accommodate research enquiry around a number of important core topics and issues including information on the profile of CAM users, CAM practice patterns, CAM use/prevalence, and the effectiveness/safety of CAM practice, and doctor-patient communication relating to CAM use. Given the increasing popularity of CAM use in healthcare and the potential benefits of practice-relevant research, further development of CAM-relevant PBRNs holds much potential for advancing research, capacity building, the impact and translation of findings and ultimately informing effective, safe CAM patient care.

Disclosures

None.

Competing interests

The authors declare there are no competing interests.

Author contributions

All authors contributed to planning this critical review paper and approved the final version of the manuscript. HL, WP, and JA designed the study; HL, WP, AS, and RR searched the literature; HL, WP, and JA analysed the data; HL wrote the first draft; HL, WP, AS, DS, and JA contributed to revisions and the final version of the manuscript.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.ctim.2018.12.023>.

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