

# THE EVIDENCE BASE FOR COMPLEMENTARY AND ALTERNATIVE MEDICINE: METHODS OF *EVIDENCE MAPPING* WITH APPLICATION TO CAM

David L. Katz, MD, MPH, FACP, Anna-leila Williams, PA-C, MPH, Christine Girard, ND, Jonathan Goodman, ND, Beth Comerford, MS, Alyse Behrman, MPH, Michael B. Bracken, PhD

**David L. Katz, MD, MPH, FACP**, Director, Yale Prevention Research Center, Department of Epidemiology and Public Health, Yale University School of Medicine. **Anna-leila Williams, PA-C, MPH, Christine Girard, ND, Jonathan Goodman, ND, Jonathan Goodman, ND, Beth Comerford, MS, Alyse Behrman, MPH**, Yale Prevention Research Center, Yale University School of Medicine. **Michael B. Bracken, PhD**, Department of Epidemiology and Public Health, Yale University School of Medicine.

**Background** • *There is widespread concern regarding the adequacy of evidence for specific practices under the rubric of “complementary and alternative medicine” (CAM).*

**Objective** • *To map the evidence pertaining to many commonly used CAM practices.*

**Design** • *In 2000, the Yale Prevention Research Center was funded by the Centers for Disease Control and Prevention to conduct a “systematic review” of the evidence underlying CAM. The investigative team, working in collaboration with CAM practitioners, developed a systematic and replicable 9-step process termed evidence mapping. The process stipulates means for specifying the boundaries of the subject to be mapped in MeSH terms, and the characteristics used to situate retrieved articles in the overall map of evidence.*

**Setting** • *Yale Prevention Research Center, Derby, CT.*

**Results** • *Steps completed thus far have led to the identification of over 4,000 papers distributed across 207 condition-treatment pairs. Of these pairs, 58% (n=121) have been studied with one or more RCTs (1,070 total RCTs), and 23% (n=47) have been the subject of one or more meta-analyses (86 total meta-analyses). Thirty-seven condition/treatment pairs (18%) had no identifiable supporting studies.*

**Conclusions** • *The novel methods of evidence mapping reported are useful and practical in characterizing the extent, distribution, and methodologic quality of research pertaining to a broad topic in medicine. Applied to CAM, they suggest that summary judgments about the quantity or quality of underlying evidence are overly simplistic.*

Reprint requests: InnoVision Communications, 169 Saxony Rd, Suite 104, Encinitas, CA 92024; phone, (760) 633-3910 or (866) 828-2962; fax, (760) 633-3918; e-mail, [alternative.therapies@innerdoorway.com](mailto:alternative.therapies@innerdoorway.com).

**E**vidence is among the dominant concepts in modern healthcare.<sup>1-5</sup> Index-Medicus was first established in 1879 as a means of referencing peer reviewed medical literature.<sup>6,7</sup> Online searching became available through Medline first in 1966.<sup>7</sup> Initially available on computer disk and CD-Rom, Internet access to Medline and other databases through electronic search engines now predominates.<sup>8</sup>

Systematic reviews have been reported in the literature for decades.<sup>9-11</sup> The quantitative synthesis of papers, known as meta-analysis, was first introduced almost 100 years ago by Pearson<sup>12</sup> and Goldberger<sup>13</sup> as reported by Chalmers<sup>14</sup> and Winkelstein.<sup>15</sup> Over recent years, meta-analyses have become increasingly prominent in the literature<sup>16-19</sup> and increasingly sophisticated; the merits of meta-analysis versus large randomized controlled trials (RCTs) is a topic of lively debate.<sup>20-22</sup>

While methods have advanced for both the qualitative and quantitative synthesis of evidence pertaining to a narrowly framed question, means for elucidating evidence related to a broad content area in medicine are unspecified. The closest approximation is the Cochrane Collaborative's “field,”<sup>23</sup> a topical area that encompasses a range of related health concerns (eg, indigenous health).<sup>24</sup> Within the expanse of a field, a coordinator facilitates the assembly of review groups to develop and maintain relevant systematic reviews.<sup>25</sup> The value and methodologic rigor of the Collaborative, as well as its resource limitations relative to the vast expanse of medical literature, have recently been highlighted.<sup>26</sup> Since 1996 there has been a Cochrane field for Complementary and Alternative Medicine (CAM).<sup>27</sup>

Other established approaches to characterizing an expanse of evidence include consensus statements,<sup>28</sup> position papers, and expert panel recommendations.<sup>29-30</sup> However, these approaches generally address a relatively narrow expanse of content, and often offer no systematic approach to the characterization of evidence. Systematic reviews are rigorous methodologic techniques for integrating information, but generally focus on narrow areas of content, predicated on discrete and well-formulated questions for success.<sup>31,32</sup>

CAM in the US healthcare system is known to be widely and increasingly popular among the public.<sup>34-35</sup> Concomitantly, there is resistance to the proliferation of CAM practices among conventionally trained practitioners, with deficiencies of “evidence” the pre-

dominant reason cited.<sup>36-39</sup> Health insurers are subject to increasing pressures to reimburse for various CAM practices,<sup>40,41</sup> while uncertain as to the potential costs and/or benefits.<sup>40,41</sup>

In September 2000, The Yale Prevention Research Center (PRC) was awarded a 2-year grant from the Centers for Disease Control and Prevention (CDC) to conduct a “systematic review” of evidence pertaining to CAM. Study objectives were both to map the evidence underlying CAM, and to develop and conduct pilot studies in high-priority areas of deficient evidence; such studies are now ongoing. Efforts to operationalize the broad mandate of the project, and to identify, organize, and characterize the available evidence related to CAM resulted in the emergence of a discrete, multi-step methodology (Table 1), we have termed *evidence mapping*. In this paper, methods of evidence mapping as applied to the topic of CAM are introduced, and their broader implications discussed.

## SEARCH METHODS AND RESULTS

The steps of evidence mapping summarized in Table 1 comprise the methods of this study. Each step is described below, followed by pertinent results.

### Step 1: Identifying and convening the appropriate experts

There is a population of CAM practitioners across diverse disciplines, largely distinct from the conventionally trained medical community. An effort was made to compile advisory subcommittees of CAM practitioners (“practitioner subcommittees”) that would broadly represent the field. Major disciplines within CAM were represented by dedicated groups (eg, naturopathy, chiropractic, acupuncture). Subcommittee composition was modified based on the feedback of members, until consensus was reached that the array of disciplines within CAM was adequately represented; CAM

**TABLE 1** Steps in the Process of Evidence Mapping

Step	Task	Description
1	Identify and convene the appropriate experts	Groups and/or individuals with particular interest, insight, and expertise in that field are assembled to help define the appropriate scope and focus of the project.
2	Apply expert opinion to define the region of evidence to be mapped	This step requires consideration of the various ways of interpreting a broad field, such as CAM, in order to define the general boundaries of evidence of interest. Establishing the appropriate boundaries for the map begins with input from an appropriately representative panel of experts. A semi-structured survey process is used to gather and synthesize input from all participants.
3	Establish the coordinates to be used for positioning within the map	Just as longitude and latitude define position on a geographic map, the confluence of defining features establish position on an evidence map. Such features, or coordinates, include type of intervention, intervention setting, specific condition, age of subjects, etc. The final coordinate is the nature of the evidence (ie, RCT, observational study, etc.).
4	Define the map boundaries in terms of pertinent coordinates	A final consensus is established for the boundaries of the evidence map, defined in terms of the pertinent coordinates or search terms. Once input regarding the boundaries for the evidence map has been gathered and organized, it is circulated to all participants for further refinement. In this process, areas of lower priority may be excluded. Search terms and search strings are established based on conclusions reached in this step.
5	Search the relevant “terrain”	Prevailing methods of searching the published and unpublished literature are applied to all coordinates in the map
6	Draw the map	Evidence retrieved is positioned by use of the pertinent coordinates, and the distribution of evidence plotted on the map
7	Study the map to identify any needed revisions and to establish priorities for detailed assessments	The map is circulated to all participants to identify any obvious omissions or distortions; if any are found, that section of the map is redrawn. For example, if a paper familiar to an investigator is missing, the pertinent literature is re-searched with a wider array of terms. Once revised to the satisfaction of all participants, the map is reviewed to identify areas amenable to systematic review, and areas devoid of or deficient in evidence (“ <i>terra incognita</i> ”).
8	Perform detailed assessments in priority areas	Clusters of evidence provide opportunity for systematic review. Information gaps in priority areas identify opportunities for new and needed pilot studies.
9	Generate reports summarizing the “lay of the land”	Summaries indicating where evidence is distributed and what its quality is, and incorporating references to initiated and needed systematic reviews, meta-analyses, pilot studies, and large trials represent the final step in mapping the evidence for a particular discipline at a given time. Evidence maps should then be updated at reasonable intervals.

disciplines used most prevalently were prioritized. Ultimately, dedicated practitioner subcommittees were formed for Acupuncture/Oriental Medicine, Chiropractic, Energy Therapy, Massage Therapy, Mind-Body/Stress Reduction, Naturopathy/Homeopathy, and Traditional Osteopathy. Participants were surveyed about site of training and site of practice, and subcommittees were reconstituted as required to provide balanced representation of all regions of the country. A region was deemed to be represented if a panel member either trained in, or practiced in, that site.

Members of the investigative team and expert panel were identified and selected on the basis of having training and experience in CAM research; published on CAM in the peer-reviewed literature; and/or having clinical experience in CAM.

### **Step 2: Applying expert opinion to define the region of evidence to be mapped**

When “complementary and alternative medicine” is entered into Medline as a keyword, more than 40,000 references are retrieved. Despite this voluminous capture, many nutrient and botanical studies are excluded. Thus, initial searches disclosed the need to generate an operationally useful definition of “CAM” that would denote the region of pertinent evidence. A semi-structured survey mechanism was developed to elicit and circulate the input from all participating experts. Experts were at liberty to defend any basis for identifying a condition or practice as a priority, but were encouraged to do so on the basis of actual or potential population impact. Thus, prevalent conditions or treatments frequently applied were prioritized. Panel members were also asked to identify other constituencies that should be consulted. The additional sources of information were: published survey results of allopathic practitioner referral patterns for CAM; published surveys of public CAM utilization patterns; Medicare expenditure data; industry data regarding top-selling supplements and botanicals; and priority research areas of the National Center for Complementary and Alternative Medicine (NCCAM).

### **Step 3: Establishing coordinates for positioning within the map**

The investigative team identified 2 clear priority features for studies of CAM: condition and specific therapeutic intervention. The specificity of the therapeutic intervention became an important consideration because such terms as “naturopathy” encompass as broad an array of treatment modalities as “allopathic medicine,” and therefore are inadequate. Thus, the stipulation of a specific modality (eg, the administration of herbs) was required and deemed acceptable, while the stipulation of a discipline (eg, Chinese medicine) was considered too vague. Similarly, conditions were required to be well-defined. While condition/treatment pairs served to locate evidence within the CAM map, many other coordinates (eg, treatment setting; population characteristics; stage of disease; focus on prognosis, diagnosis or screening, etc.) could be useful in mapping this, or other, evidence domains. Multiple coordinates may be applied, each serving to divide up the overall evidence map into smaller sections.

An evidence mapping project in obesity prevention currently under way in the Yale Prevention Research Center is using as coordinates study setting, level of prevention, intervention, and age of target population (CDC SIP-8(00) Evidence-based Guidelines: Obesity Prevention and Control).

The final coordinate applied, germane to any evidence mapping effort, was specific study methodology. A hierarchy of evidence was used, with the RCT, or meta-analysis of trials, at the top. The hierarchy is consistent with prevailing views on the methodologic rigor of various study types.<sup>12</sup>

### **Step 4: Apply the specified coordinates and selection process to define the study/paper inclusion set**

Researchers began by electronically searching the literature for survey data of patients' utilization patterns of CAM in the US. Medline identified 22 prevalence studies, 11 of which specified conditions for which patients use CAM.<sup>33,42-51</sup> Eisenberg's<sup>33</sup> national telephone survey identified 14 conditions for which patients seek CAM, although sampling of minority populations in this study was non-representative. Several other smaller studies captured CAM use patterns by some of these subgroups.<sup>43,44,46,48</sup>

Of the 11 pertinent papers retrieved, 6 also identified the specific CAM interventions patients used to treat particular conditions.<sup>33,42-44,48,50</sup> These condition-intervention pairs were entered on a master list. When a condition was identified without an associated intervention, the condition was circulated to the CAM practitioner panels to specify the appropriate intervention(s) in common use.

In 7 instances the surveys reported categories of disease in lieu of specific conditions (ie, cancer, ENT problems, neurologic problems, gastrointestinal problems, lung problems, pain, skin problems).<sup>33,42,45,47,48,50,51</sup> These condition categories were circulated to the provider and research panel members to obtain information on specific conditions within each category. Such inquiries were conducted by use of a standardized questionnaire, circulated electronically. The process was used to replace such vague terms as “gastrointestinal disorder” or “skin conditions”<sup>33</sup> with specific conditions (eg, irritable bowel syndrome; inflammatory bowel disease; eczema, psoriasis, etc.). The process continued in an iterative fashion until no new conditions were identified. In addition to the particular diagnoses of interest, practitioners were instructed to provide the corresponding treatments.

Using Medline, 9 surveys of US medical doctors' use of CAM were found; 5 of these studies looked at attitudes and referral patterns and did not specify patient conditions. Four studies specified the medical conditions that prompt conventional medical doctors to refer patients for CAM.<sup>45,52-54</sup> There was considerable redundancy in the condition-intervention pairs reported by the medical doctors and patient surveys. Three new conditions emerged; these were matched to interventions by the subcommittees, and added to the master list of paired entries.

Independent of the queries generated from the survey literature, the practitioner subcommittees were asked for responses to: “What 5 conditions do you most commonly treat in your practice?” and “How do you treat these conditions?” Responses from the sub-

committees created additional condition-intervention pairs that were added to the master list.

To assure public health relevance, the master list of conditions was compared against the ten leading causes of death in the United States for all ages.<sup>55</sup> The leading causes of death contained three conditions that had not been previously identified: HIV, cerebrovascular accidents, and liver disease. These conditions were circulated to the Expert Panel and the subcommittees to be matched with interventions; these pairs were then added to the master list.

Additionally, the list of top selling botanicals and supplements was compiled from the American Botanical Council<sup>56</sup> and the National Nutritional Foods Association.<sup>57</sup> These were also sent to the Expert Panel and the subcommittees to be paired with conditions for which their use was considered appropriate and consistent with common practice. All new condition-intervention pairs were added to the master list.

A search of the survey data of US patients' use of CAM yielded 12 studies that identified 31 conditions. When searching the survey data to determine the conditions for which conventional physicians refer to CAM, 5 studies identified 19 conditions. After eliminating redundancy with the patient use data, 35 conditions remained. The CAM practitioner panels were surveyed about the conditions they most commonly see and the associated interventions. This survey provided 2 additional conditions. The lists of top-selling supplements and botanicals were circulated among the expert panel and practitioner panels to be paired with appropriate conditions. This provided 3 new conditions. All conditions were matched with appropriate interventions to yield 126 condition/intervention pairs. Several of the "conditions" provided by the practitioner subcommittees were vague headings; 7 categories (cancer, skin disease, gastrointestinal problems, musculoskeletal problems, lung problems, psychological problems and pain) were subdivided into specific components. For example, cancer was subdivided into breast cancer, lung cancer, prostate cancer, and colon cancer, which created 4 new conditions and when matched with interventions, 13 new condition/intervention pairs.

Once this process was completed, the previously identified conditions were compared to the leading causes of death in the US.<sup>58</sup> Three of the leading causes of death (stroke, liver disease and AIDS) emerged as new conditions and were paired to interventions by the Expert Panel and practitioner panels, yielding 7 more condition/intervention pairs. Searches were completed on a total of 207 condition/intervention pairs.

#### **Step 5: Searching the evidence bounded by the map**

Each condition-intervention pair was searched with the following study design terms: RCT, meta-analysis, review article, case-control study, controlled clinical trial, intervention study, case reports, data collection, and pilot study, as well as review, systematic review, and meta-analysis. Electronic searches were completed using Medline, Psychinfo (where appropriate), Allied and Complementary Medicine (AMED), and Cochrane Controlled Trials Register. Note that the use of electronic search engines was limited to those in wide use among diverse practitioners, and more

or less universally accessible, to assure that results would be pertinent to the widest possible readership. Specialty search engines such as MANTIS (formerly CHIROLARS) were not used.

The searches, conducted from 12/00-2/01, investigated each database from the earliest date available to the present (Medline 1966; Psychinfo 1987; AMED 1983; Cochrane Controlled Trials Register 1995) and included articles in all languages (see Table 2). EMBASE and CISCOM were sampled by electronically searching approximately 20 condition/intervention pairs in each. No additional citations to those found via the previously listed databases were identified; consequently, systematic use of these services was deferred.

A systematic search for unpublished literature began by contacting the Expert Panel and Practitioner Subcommittees. From these sources, a list of 23 CAM organizations was compiled. These organizations were contacted via email and asked to provide samples of and/or sources for unpublished literature on CAM. Eight of these 23 responded. Links to peer-reviewed journals, websites with publicity about the organization(s), books reporting the organization's activities, and case reports were provided as responses. Inquiries for unpublished reports continued until the responses became redundant with the other sources of information. In contrast to other methods used for reviewing a more narrowly defined topic, such as those applied by the Cochrane Collaborative,<sup>59</sup> evidence mapping did not initially stipulate any exclusion criteria for articles retrieved. The mapping process was intentionally inclusive to define the range of pertinent evidence, leaving exclusions on quality grounds for the latter steps.

#### **Step 6: Plotting the distribution of studies retrieved (i.e., "drawing the map")**

All articles retrieved in the search step were entered into a matrix with position defined by 3 coordinates, condition by intervention by methodology. Spreadsheets were created to list the number of articles retrieved in each category of methodology pertaining to each of the condition/treatment pairs. The spreadsheets constitute the map of evidence across the subject of interest. A representative spreadsheet from the present study is shown in Table 3.

#### **Step 7: review and revision of the map and establishment of priorities for detailed assessments**

Once the overall map of retrievable evidence was drawn, it was circulated to the members of the investigative team to define the regions of highest priority for further scrutiny in the form of systematic review, or pilot study development. Priority areas were chosen based on gaps in the evidence base, the clustering of studies amenable to qualitative or quantitative synthesis, public health impact of the condition or treatment, or any combination of these.

Condition-intervention pairs were given a priority score based on the following formula: one point each for appearing in the survey literature of patients' utilization patterns of CAM in the United States<sup>33,42-51</sup> and/or referral patterns of conventional medical doctors;<sup>45,52-54</sup> one point for being identified via survey of the practitioner subcommittees as a commonly treated condition; one point each for

being among the top ten conditions and/or interventions for which the public most frequently submits inquiries to NCCAM; and a weighted 2 points for appearing in the top 10 most costly conditions as identified by the Medical Expenditure Panel Survey 2000 and/or appearing among the 10 leading causes of death in the United States for all ages as identified by the CDC.<sup>60</sup> Weight was given to the most costly conditions and the leading causes of death in an effort to maintain public health relevance for morbidity and mortality. A maximal priority score of 9 is derived from summing scores in each category.

**Step 8: Performing abstractions and detailed assessments (systematic review and possible meta-analysis in priority areas)**

All of the citations mapped are to be abstracted using a standardized process. Two abstractors will evaluate each study, with appropriate training and monitoring in place to assure standardization. The Cochrane collaboration manual, 'The Cochrane Reviewers' Handbook 4.0 will be used as one resource;<sup>61</sup> data abstraction forms from the *Guide to Community Preventive Services* (CDC) will also be reviewed, modified, and applied as indicated. Discrete content areas in which a cluster of articles amenable to qualitative but not quantitative synthesis will be handled as systematic reviews. Qualitative reviews rely on methods subject to considerable debate.<sup>62</sup> For purposes of this project, the methods developed by CDC and applied to the *Community Guide for Preventive Services* are being used.<sup>63</sup> For clusters of articles addressing a shared outcome with comparable methods, meta-analysis will be performed as indicated. Abstractions will

be recorded, and reviews formatted, using appropriate software, such as REVMAN,<sup>64</sup> facilitating dissemination, including submission to the Cochrane library.

**Step 9: Generating print and searchable electronic reports summarizing the extent and quality of evidence**

By the completion of step 8, the process of evidence mapping will have: plotted the number, distribution, size, and methods of studies addressing a broad content area; performed a systematic abstraction of each paper; provided detailed analysis in priority "regions" of the map in the form of systematic review and meta-analysis; and identified those areas of the map conducive to additional systematic review. The final reports produced thus characterize the extent of pertinent evidence, the overall quality of retrievable evidence, areas appropriate for qualitative or quantitative synthesis, key evidence gaps, and those methods convincingly shown to be effective or ineffective.

Within the initial project year, steps 1–7 have been completed and steps 8 and 9 initiated. A "map" of the evidence underlying CAM has been produced, and reports to follow, indicating where evidence is abundant, where scant, and where research is most needed to fill in the gaps in the evidence base. The application of these methods to the CAM literature has led to the mapping of evidence related to 207 condition-intervention pairs, identifying 4,108 studies.

The total of 4,108 articles identified includes 1,070 RCTs and 86 meta-analyses. Of 207 condition/treatment pairs, 58% (n=121) had been studied with 1 or more RCTs, and 23% (n=47) had been the sub-

**TABLE 2** Example of Condition-Intervention Pair and Sources of Evidence. The retrieval for each search engine refers only to additional papers uniquely identified that were not captured by the other engines used.

Topic	Medline (1966–July 2001)							Data	
	Randomized, controlled trial	Clinical, controlled trial	Meta-analysis	Review	Case Control	Intervention	Case Report	Collection	Pilot Project
Stress/ Massage	19	10	1	10	0	9	1	0	3
	AMED (1983-July 2001)								
	0	1	0	5	0	5	1	0	0
PsychInfo (1987-July 2001; only appropriate for mental health)									
	11	0	0	11	0	4	1	0	0
Cochrane Controlled Trials Register (1995-July 2001)									
	1	0	0	0	0	0	0	0	0

The search pair is defined by condition (stress) and treatment (massage). Clinical controlled trial (not randomized). Retrieval is listed by search engine/data-base used.

TABLE 3 Distribution of papers retrieved for a single intervention and the conditions to which it is applied.

Chiropractic and...

	RCT	Clinical, controlled trial	Meta-analysis	Review*	Case Control	Intervention	Case Report	Data Collection	Pilot Study
ADHD	1	0	0	0	0	0	0	0	0
Arthritis	0	0	0	5	0	0	3	2	0
Back	25	2	4	47	2	1	43	34	7
Chronic Fatigue	0	0	0	0	0	0	0	1	0
Constipation	0	0	0	0	0	0	0	0	0
Dysbiosis	0	0	0	0	0	0	0	0	0
Facial Pain	0	0	0	0	0	0	0	1	0
Fibromyalgia	1	1	0	3	1	0	0	3	2
GERD	0	0	0	0	0	0	0	0	0
Headache	7	0	0	6	1	1	8	3	2
Hiatal Hernia	0	0	0	0	0	0	0	0	0
Hip Pain	1	0	0	0	0	0	0	0	0
IBS	0	0	0	1	0	0	0	0	1
Musculoskeletal NOS	0	0	0	5	1	0	1	8	3
Neck Pain	15	1	4	16	2	7	10	0	11
Peptic Ulcer	0	1	0	0	0	0	0	0	0
PMS	2	0	0	0	0	0	1	1	0
Sciatica	0	0	0	1	0	0	6	0	1
Sprain	0	1	0	0	0	0	4	1	0
Strain	1	1	0	4	1	0	3	2	0
Stress	0	1	0	1	0	0	0	1	1

Chiropractic manipulation is the intervention; the conditions are listed in column 1; RCT, randomized controlled trial. \*Review is both systematic and standard review article; intervention is an uncontrolled intervention study; and data collection is a cross-sectional or other descriptive study. Systematic reviews are encompassed in the Review category due to a searching restriction on Medline. Systematic reviews will be distinguished from all other types of reviews in the abstraction process.

ject of 1 or more meta-analysis. There were 85 condition-intervention pairs (41%) for which no RCTs had been published to date and of these, 37 pairs (18%) had no identifiable studies of any design completed. These obvious “data gaps” have been identified as priority areas for future study. The top 25 priority condition-intervention pairs resulting from a quantitative rating system, and the associated number of RCT’s and meta-analyses, are shown in Table 4.

## DISCUSSION

This paper introduces the concept of evidence mapping, and establishes a sequence of procedural steps. Evidence mapping is a means of systematically organizing the base of evidence pertaining to a broad topic within medicine or public health so that the distribution, breadth, depth, methodology, and overall quality of pertinent evidence is characterized and made readily accessible.

The methods developed here are related to, and indeed derivatives of, other established approaches to evidence synthesis. In particular the Cochrane field<sup>23</sup> is in many ways comparable to the evidence map. The map differs from the field in that an attempt is made to characterize the full distribution of evidence in the map, whereas a Cochrane field serves as a unifying content area within which related reviews are conducted. Thus, the Cochrane field does not specifically address the papers and reports that fall between,

rather than within, the specific reviews undertaken.

Other differences from the Cochrane approach are noteworthy. Cochrane reviews typically set quality criteria at the beginning, thus excluding many papers for methodologic limitations. The process of mapping is less exclusive, characterizing the distribution of methodologically weak, as well as strong, papers. Part of the intent of the mapping process is to identify where there is likely to be strong evidence, where there is likely weak evidence, and where there is no evidence. The distinction between the latter 2 requires an inventory of topical papers, even if methodologically flawed. In the case of CAM in particular, deficiencies of evidence relate in some cases to a lack of studies, and in other cases, to flaws in methodology.<sup>65,66</sup> Finally, the mapping process includes a range of study methods, whereas Cochrane reviews are generally restricted to RCTs.<sup>61</sup>

While methods in common use allow for the elucidation of evidence pertaining to a range of related questions,<sup>31,32</sup> such methods are of limited utility when applied to broad areas. While some Cochrane reviews are relatively broad,<sup>67,68</sup> none covers the expanse of an entire field; evidence mapping serves this purpose.

The adaptation and application of these methods to diverse topics in medicine is feasible, and of potential value. Since clusters of trials amenable to methods of synthesis would be more apparent through mapping, such syntheses (systematic review

TABLE 4 Top 25 priority condition-intervention pairs, and the associated number of randomized controlled trials and meta-analyses.

Condition-Intervention Pair	Priority total	Number Randomized, Controlled Trials	Number of existing Meta-analyses (date)	Number of Total Studies
Depression/vitamins	8	41	1 (1994)	112
Diabetes/herbs	8	11	1 (1999)	18
Arthritis/herbs	7	3	1 (1999)	9
Rheumatic disease/massage	7	0	0	1
Arthritis/acupuncture	7	17	1 (1997)	64
Depression/meditation	7	0	0	1
Depression/relaxation	7	11	0	23
Depression/spiritual healing	7	2	0	3
Depression/homeopathy	7	0	0	1
Smoking cessation/acupuncture	7	7	2(1990,1999)	14
Diabetes/hypnosis	7	0	0	7
Breast cancer/herbs	7	5	0	10
Colon cancer/herbs	7	0	0	1
Lung cancer/herbs	7	6	0	9
Prostate cancer, herbs	7	0	0	10
Breast cancer/nutrition	7	3	0	12
Colon cancer/nutrition	7	6	1 (2000)	12
Lung cancer/nutrition	7	0	1 (2000)	5
Breast cancer/vitamins	7	0	0	17
Colon cancer/vitamins	7	4	0	10
Lung cancer/vitamins	7	3	0	6
Prostate cancer/vitamins	7	3	0	9
Asthma/herbs	7	3	0	28
Asthma/nutrition	7	42	2 (2000, 2000)	129
Fatigue/herbs	7	2	0	2

A maximal priority score of 9 is derived as the sum of scores of 0 (no) or 1 (yes) for inclusion of the pair in published surveys of public utilization;<sup>33, 42-46, 47-51</sup> inclusion in surveys of allopathic physician referrals to CAM;<sup>45, 52-54</sup> inclusion among the most commonly treated conditions by CAM providers consulting to the study; and inclusion among the most common inquiries to NCCAM. A score of 0 (no) or 2 (yes) was provided in two categories: inclusion of the condition among the ten leading causes of death in the US; and inclusion of the condition among the ten highest-cost conditions in the Medicare system.

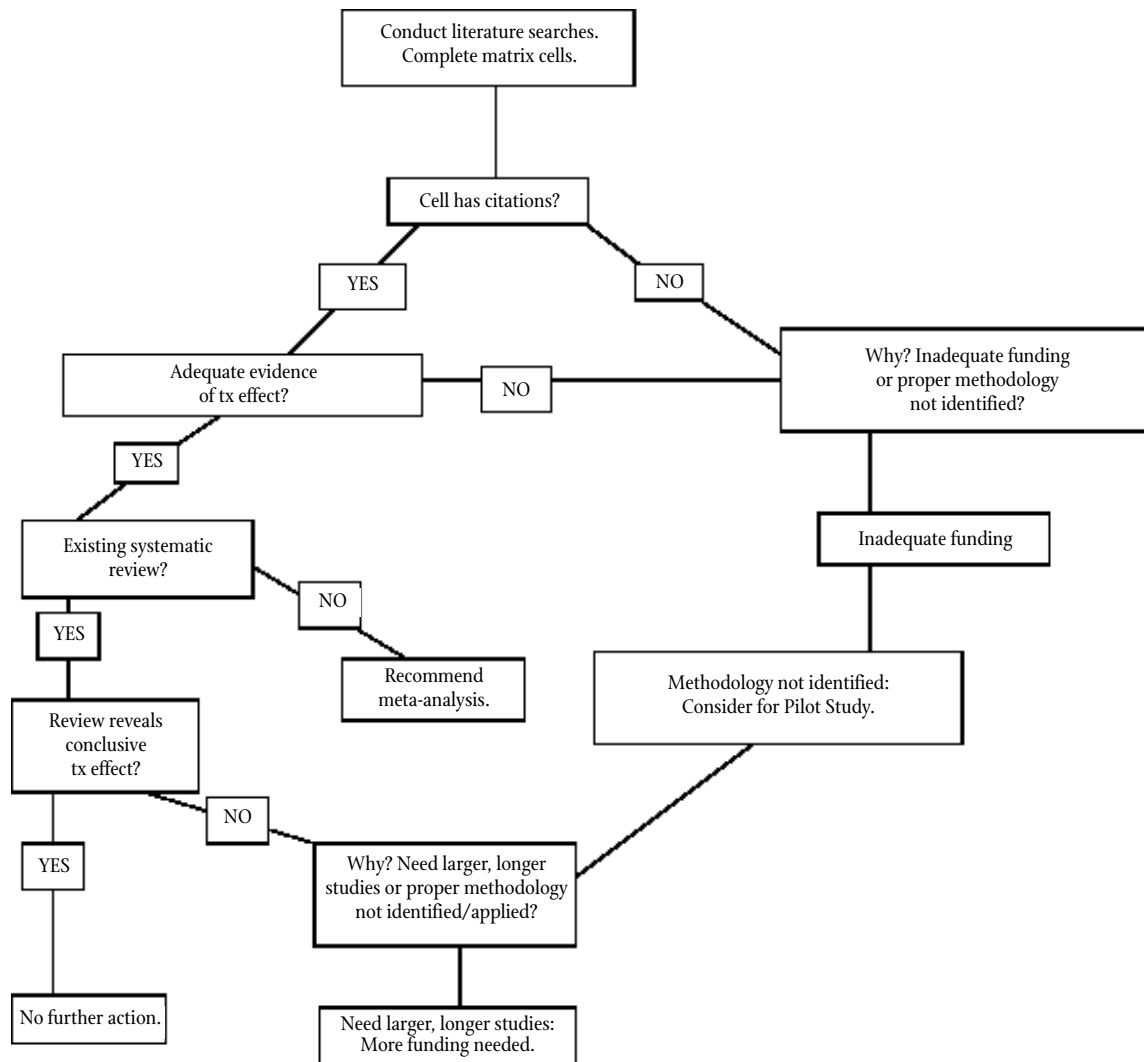
or meta-analysis) might be expedited. Gaps in the evidence related to a lack of trials would be evident at a glance, while additional gaps related to issues of quality would be disclosed following detailed abstraction.

Applying reasonable criteria to establish priorities, such gaps could serve to guide both investigators and funding agencies. Systematic review of studies in portions of the map dense with trials could support conclusions regarding definitive treatment effect, or lack thereof, and could help in the avoidance of excessive replications. The plotting of evidence and its detailed abstraction could help guide resource allocations and the development of programs and policies. Evidence maps would also support inferences about reasons for some of the gaps they expose, such as funding shortages, competing priorities, or methodologic challenges; reasons for other gaps would emerge following detailed review. Various approaches to the characterization of evidence could be incorporated into maps for different uses. As with any maps, evidence maps require updating at reasonable intervals to keep pace with a changing landscape.

This paper makes a more specific contribution to CAM. While a thorough characterization of the evidence base underlying those

CAM practices included requires completion of detailed abstractions in the final steps of the project, much has already been revealed. The distinction between conventional medical practice and CAM cannot casually be ascribed to evidence. Evidence is neither wholly adequate nor wholly deficient, in quantity or quality, across the broad range of practices subsumed by "CAM." Rather, the evidence varies greatly in abundance and methodologic rigor across topics. There are, indeed, CAM practices supported by RCTs, as there are practices largely unsubstantiated by any meaningful scientific evidence. The sample map provided in Table 3 reveals at a glance how diverse the landscape of CAM evidence is. Of note, even this generous retrieval of studies is exclusive of search engines used more or less exclusively by CAM practitioners, such as MANTIS; only widely used and accessible search engines were applied.

Given the popularity of CAM,<sup>33-35</sup> the often cited resistance of conventional practitioners to its spread,<sup>70-71</sup> and its unresolved reimbursement issues,<sup>40, 72, 73</sup> a characterization of the underlying evidence seems urgently needed, and indeed overdue. Widely divergent opinions<sup>74</sup> about the evidence for CAM in general, and its comparison to the evidence for conventional practices,<sup>74, 76</sup> have themselves been



**FIGURE 1** Evidence-Mapping Operational Algorithm. The flow diagram indicates how the process of evidence mapping leads to conclusions about the adequacy, or deficiency, of evidence and its distribution.

based insufficiently on evidence. The pertinent evidence is readily provided by the map now being completed. An explicit goal of this effort is for future dialogue regarding the known and unknown benefits and harms of various CAM practices to be evidence-based.

There are noteworthy limitations to the methods described here. Defining the boundaries of this or any evidence map is a somewhat subjective step. This potential weakness is substantially mitigated if the criteria and procedures for reaching closure are fully described. Similar subjectivity is operative in the establishment of “best” coordinates for any given map, the selection of participating experts, the establishment of inclusion/exclusion criteria for studies, and the means of accessing the gray literature. While clearly of concern, such challenges are not unique to evidence mapping. The quality of RCTs included in systematic reviews, for example, is somewhat

subjective, and not determined in a consistent manner.<sup>77</sup> As noted, some sources of CAM research were not included in the search. As has been true of meta-analysis and systematic review,<sup>78,80</sup> application of evidence mapping will necessarily initiate a process of ongoing revision, improvement, and adaptation of methods.

These and other limitations notwithstanding, evidence mapping is presented as a discrete and replicable process, conducive to the charting of evidence across broad expanses of medicine and public health practice. These methods should be further refined, but are useful in their current form. As applied to CAM, these methods highlight the value and importance of collaboration between researchers and the practitioners of the particular disciplines under study. They also reveal that generalizations regarding the evidence underlying CAM, or summary distinctions from conventional care



based on the availability of evidence, are oversimplified views of a diverse landscape.

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