IDENTIFYING COMPLEMENTARY AND ALTERNATIVE MEDICINE USAGE INFORMATION FROM INTERNET RESOURCES: A SYSTEMATIC REVIEW

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SUMMARY

Objective—Identify and highlight research issues and methods used in studying Complementary and Alternative Medicine (CAM) information needs, access, and exchange over the Internet.

Methods—A literature search was conducted using Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines from PubMed to identify articles that have studied Internet use in the CAM context. Additional searches were conducted at Nature.com and Google Scholar.

Results—The Internet provides a major medium for attaining CAM information and can also serve as an avenue for conducting CAM related surveys. Based on the literature analyzed in this review, there seems to be significant interest in developing methodologies for identifying CAM treatments, including the analysis of search query data and social media platform discussions. Several studies have also underscored the challenges in developing approaches for identifying the reliability of CAM-related information on the Internet, which may not be supported with reliable sources. The overall findings of this review suggest that there are opportunities for developing approaches for making available accurate information and developing ways to restrict the spread and sale of potentially harmful CAM products and information.

Conclusions—Advances in Internet research are yet to be used in context of understanding CAM prevalence and perspectives. Such approaches may provide valuable insights into the current trends and needs in context of CAM use and spread.

Keywords (MeSH)

Internet; Complementary Therapies; Informatics

INTRODUCTION

According to a Pew Research Center survey, 87% of adults use the Internet (1), with 74% of them using a social networking site (2). As of September 2012, 72% of adult Internet users

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in the United States reported using online sources for health information (3). In a socio-cultural context, the Internet is conceptualized as having democratizing effects and promoting therapeutic pluralism (4). Use of online health information can play an important role in development of personal empowerment and making informed choices regarding treatment options (5–8). Studies have described the possibility of encountering misleading online health information (9–11), including cases where social influence biased health communications pose a threat to public health (12). For example, negative health sentiments (e.g., refusal to vaccinate for non-medical reasons) can spread across social networks as a contagion feeding on social reinforcement (13). Additionally, aggregation of collective judgments are susceptible to manipulation (14). Increased access to information online can result in hostility during medical consultations (15). Such public health challenges may be addressed through understanding and monitoring health information seeking and sharing behavior across social media.

The Internet provides a medium for attaining information about complementary and alternative medicine (CAM) (16–19). According to a Pew Internet Project survey, 35% of Internet users looked online for CAM information (20). The cost, convenience in buying supplements, or dissatisfaction with health services may be reasons for online seeking of CAM remedies (21). The prospects of social media in promoting effective CAM treatments has been considered (22); however, sentiment towards finding CAM treatments varies across Internet resources (23). Often, patients searching for health information encounter predatory websites marketing CAM products with no proven medicinal effect that has been evaluated in scientific studies (24). Furthermore, the search for CAM treatments may result in the retrieval of differing or conflicting treatments (25).

This review investigated research issues, methods, and findings surrounding the availability and spread of information and opinions regarding CAM over the Internet. The increased online availability of CAM information and related discussions implores the need for developing of methods for modeling and monitoring CAM trends and perspectives. The goals of this review were thus to: (1) understand the current state of research for identifying the availability, use and spread of CAM information from within Internet resources; and (2) elucidate the need for developing strategies to prospectively identify and monitor CAM usage.

METHODS

Literature Search, Filtering, and Review

A systematic literature search was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines (26). MEDLINE was searched using PubMed in September 2015 for articles that have studied Internet or social media use in context of CAM, using the following query: (("Internet" OR "Social Media") AND ("complementary therapies" OR "alternative medicine" OR "medicinal plants" OR " traditional Chinese medicine" OR "ayurveda" or "herbal" or "naturopathic"))

PubMed uses the process of automatic term mapping to match the query against subjects using MeSH translational table. When a query term matches the MeSH descriptor, the query

expands to include all the terms underneath it in the hierarchy. For the MeSH descriptor "complementary therapies," it expands to include acupuncture, homeopathy along with other complementary therapies. The matching also extends to "All Fields" which includes the titles and abstracts. Additional articles were identified from Nature.com and Google Scholar (scholar.google.com) using combinations of the following keywords: social media; internet; online health forum; data mining; health topics; consumer health information; online health information; or, blogs. The resulting articles were screened to include those that reflected contemporary research issues and methods within the realm of Internet and social media based analysis. These articles were used to supplement those identified from the primary PubMed/MEDLINE search query (which was restricted to CAM and used mostly in results section) and reflected a comparative view of advances made in Internet and social media research in discussion section.

The titles and abstracts of retrieved articles were considered for further analysis using the criteria listed in Table 1. The full text was then read for included articles and a thematic analysis was conducted (27). Finally, the investigation methodology of online CAM information assessment, use, exchange and spread were extracted from each article.

RESULTS

The PubMed search resulted in 667 articles; 66 additional articles were identified from Nature.com and Google Scholar. Out of these, 120 articles (16.4%) met the inclusion criteria. Figure 1 summarizes the article selection process. The articles were inspected to identify resources and methods used in studying the availability, use and spread of CAM information. A summary of the resources and methods described in these articles is provided in Tables 2 and 3, respectively.

Theme 1: Internet-based Surveys as a Tool for Ascertaining CAM Usage Data

Owing to the widespread use among public, the Internet can be a valuable tool for administering surveys. Online surveys for gaining insight into the CAM related information seeking behavior has been shown as one such useful application. Online surveys have linked standardized questionnaires to patient Internet portals. In one German study, a questionnaire was developed that addressed CAM usage, disclosure to physicians, source of information, objectives for using CAM, and perceived reasons for cancer. Of the 170 participants in this study, 131 (77%) were using CAM and 107 (63%) informed their physicians (28). The Global Online Sexuality Survey enables studying the sensitive topic of erectile dysfunction among Arabic-speaking Internet users in the Middle East (29). In this study, the authors reflected that while there is a 45.1% prevalence of the condition, only 4.5% use phosphodiesterase type 5 inhibitors (e.g., sildenafil and tadalafil) frequently, compared to 11% using herbal medications frequently. These studies suggest that use of alternative therapies for specific health concerns is prevalent, and Internet surveys identify whether they are being reported or discussed with clinicians, including sensitive topics where patient privacy may be a concern.

Theme 2: Predictors for the Use of Internet for CAM Information

Several studies have focused on identifying the predictors for use of the Internet for searching health information. Investigating the predictors for Internet use in context of CAM information search is essential. Such information may be important for understanding the priorities and used to guide the design of better approaches to reach wider population with tailored resources for helping make better judgments regarding CAM use. Seven studies described methods for identifying predictors for using the Internet to search for CAM information. Chilsholm proposed a behavioral model for describing online health information seeking and identifying the predictors of use (30). Using the Pew Internet and American Life Survey 2006 dataset, health information search behavior was modeled using hierarchical logistic regression with independent variable of predisposing factors (age, sex, race, and education), enabling factors (Internet connection) and need factors (health condition or status). The online health information seeking behavior was identified as being dependent on ethnicity, with Hispanics being more likely to search for CAM information (30). The Internet has been shown to be a source of information for CAM among cancer patients (31). An Italian multi-center survey of patients with chronic lymphocytic leukemia assessed the use of CAM as a treatment option. In this study, the predictors for CAM use were gender, age, education level, newspaper reading level, and Internet availability (32). Bussing *et al.* surveyed parents of public elementary school students and identified CAM use being more likely among children with ADHD when the Internet was used (33). Frequent Internet users prefer more information and decision-making autonomy when using CAM (34). A survey-based study to identify the informational sources influencing cancer treatment options reported that 69% of participants obtained information from sources other than the treatment staff. Participants with a college degree were more likely to use the Internet, and use of support groups was associated with cancer type and CAM use (35).

Multiple logistic regression analysis on survey datasets has been used to investigate the independent associations between CAM use and potential predictors that included Internet research (36). In addition to online information, platforms where patients discuss treatment options may have some affect on the decision to use CAM. Bruce *et al.* investigated the impact of a moderated e-mail discussion group on the use of CAM therapies for recurrent back pain. Their results suggested that participation in interactive discussions over Internet about CAM may not affect use (37).

Theme 3: Understanding the CAM Needs or Interests of the General Population

The Internet has been used for surveillance of health-related online activities of populations. With the increase in online availability of CAM products and information, it is important to identify how consumers are searching and sources that are most likely being used to procure. Three studies investigated the interest in CAM-related products. Keywords were identified using query log data and examined for temporal patterns using Google Trends. Keywords associated with top websites appearing in search results as well as the number of visitors were analyzed using Google Keywords and Compete Site Analytics to determine the traffic of searching for herbal incense (38). Another study investigated public behavior in searching for information about dietary supplement use. The data derived from number of supplement specific hits (webpages containing query terms) and those from the Google PageRank

algorithm and Google Trends can be used to measure interest in particular therapies. Analyzing such metrics within the context of search keyword patterns and search activity, studies have revealed that supplement use information mirrored the rise in H1N1 incidence (39). Fung *et al.* found that Traditional Chinese Medicine posts about infectious diseases increased microblog traffic (40). Evaluation of an Internet-based self-help forum for urinary tract infections revealed CAM as a major theme (41). The amount spent on CAM by cancer patients online using patient simulation exercise reflected a range of $4.33 to $263.00 monthly with median cost of a single agent being $27 per month (42).

Theme 4: Social Media and CAM Use

Social media data are increasingly being used to understand and monitor various health related aspects. Although there has been significant amount of research in health related analysis of social media data, very few studies have been conducted in context of CAM. Online health forums, medical blogs, and social networking sites where patients seek and discuss health information and outcomes may offer a valuable resource to understand the perception and use of CAM therapies. A telephone survey studying the use of online support groups among California patients with chronic conditions showed that the online support group use was associated with CAM use (43). A combination of content analysis (44) and thematic analysis (27) of five online social media platforms for generating glaucoma related information revealed that CAM therapies and treatments were presented more positively than established evidence-based treatments. However, it was also found that un-moderated sites contain more misleading information (10). An investigation of "support group" emails on a mailing-list serving approximately 380 brain tumor patients and their care providers revealed that alternative treatments were the most frequently discussed topics (15%) (45). Another assessment of an online discussion group showed that approximately one-third of the medical information provided was classified as "unconventional" (46).

Identification of biomedical concepts (e.g., drugs or treatments) from patient-authored texts can be challenging as many consumer terms are not in formal ontologies (47). Consumer health vocabularies have been designed for bridging the gap between patient language and formal ontologies (48). Gupta *et al.* demonstrated the use of lexico-syntactic patterns for extracting concepts from patient authored text (49). Several examples of alternative and preventative treatments were identified in this study, including herbal treatments (e.g., *Aloe vera* for acne).

Theme 5: Need for CAM Information

Understanding health related informational needs of the public could be vital in designing content and delivery of materials for educating. This becomes essential especially in the context of CAM, where use in many cases does not involve consultation with health-care professionals. Studies have aimed to replicate patient searches for information related for particular diseases or therapies. An electronic search using WebCrawler to identify information related to alternative therapies for rheumatoid arthritis shows that about half of the websites retrieved were of little relevance for patients (50). A survey-based approach to assess informational needs of 10th graders from suburban New York suggested that 49% of those sampled use the Internet for health information (51). The major topics included

sexually transmitted diseases, diet, fitness, exercise, and sexual behaviors. For alternative medicine, there were significant differences among ethnic groups (F = 2.4, P = .04), with White students rating it the highest for having information available through the Internet. A survey among cancer patients regarding information sources identified that 69% used a source other than treatment staff, with CAM use being a significant predictor of additional source use (35). Another study showed that CAM information-seeking behavior might differ depending on ethnicity. Out of ethnic groups surveyed, Hispanics were more likely to search for CAM information (30).

The pattern of use, knowledge, and attitudes toward CAM among pharmacists was investigated using a survey-based approach. Eighty-one percent of pharmacists felt they had inadequate knowledge to counsel patients on herbal medicine and 90.5% felt the need to include more CAM topics in curricula. Common sources of information on CAM among the group surveyed were books/magazines (64%), friends/family (35.7%), and the Internet (31.4%) (52). A Wikipedia editorial assessment of articles related to CAM concluded that there are opportunities for health professionals to contribute knowledge to improve the accuracy and completeness of CAM articles (53). In spite of the high number of patients using CAM, this topic was not frequently represented on patient advocacy group homepages (54). An analysis of online cancer related news revealed that only 7% of the news sources reported using the results from randomized controlled trials published in peer-reviewed journals (55). Internet-based training interventions have been shown to improve posture among computer users (56). Such alternative ergonomic-based treatments may help prevent emergence, progression, and complications of musculoskeletal disorders. However, a survey-based study showed that dissemination of social media-based CAM information about Multiple Sclerosis needs additional research on audience selection, message formatting, and delivery (57).

Theme 6: Evaluation of Online CAM Information

An important aspect of using dietary supplements (which include herbal products) is having an understanding of benefits, risks, and interactions with other drugs. Several studies have examined quality and reliability issues of online resources pertaining to CAM use. Shon *et al.* have shown that even with the presentation of designations that reflect the quality and standard of websites, there was no significant effect on the credibility and retention of health information on a webpage (58). The possible discrepancies associated with the online CAM information are: discouraging the use of conventional therapies; recommendations for a multitude of treatment without any consensus; discouraging from adhering to clinician's advice; claims that are not supported by facts (25, 59–61). Health information seekers are more likely to encounter websites intended for financial interest. E-commerce websites intended for marketing of herbal products often provide therapeutic claims and therefore need to be evaluated. Several studies have highlighted the risk associated with CAM products marketed online (62–78). False online CAM information may be perceived as true by patients (79). A screening of 216 CAM pages found by the "condition" and "condition + herbs" search identified 78% authored by commercial organizations, whose purpose involved retail sales 69% of the time (24). Another study investigating online information for eight popular herbs identified 76% retail websites (80). It has been pointed out that public

should be advised to identify distinguishing criteria for commercial advertisements from original scientific literature (81). Strategies to screen Internet sites for scientifically correct information have been described (82), including the use of guidelines specific for the evaluation of online information content related to alternative therapies (e.g., (BIOME Resource Evaluation Guidelines) (83).

Commonly used evaluation approaches in Internet research involves use of one or more search engines to query for information and identify websites that are then evaluated for content. Within the context of CAM, some studies have focused on identifying popular forms of CAM for a particular disorder and then evaluating the associated risks (84). The selection of websites for evaluation may depend on the specific goals and could possibly focus on interests of healthcare providers or information-seeking patients or family members. Several benchmarks are available, such as the DISCERN (85), JAMA (86), or HON code (87), which allow raters to evaluate the quality of a given website. For example, an assessment of information quality related to Mediterranean diet using such criteria revealed that there was poor quality of available information in most cases (88). Modification of the DISCERN criteria have also been used to specifically evaluate e-commerce websites (89).

Several studies have reported use of dietary supplements by cancer patients who are already being treated with chemotherapy, many times without discussion with a physician (90). Patients may use online information for making decisions regarding the use of herbal or other supplements. The International Society of Integrated Oncology recommends seven such websites (91). For example, it can be difficult to identify a single website that describes Aromatase Inhibitor-Dietary Supplement interactions (92). The Natural Medicines Comprehensive Database and Memorial Sloan-Kettering Cancer Center websites have been reported as providing the most reliable and unbiased information (92). National Cancer Institute designated cancer center websites have been evaluated for how they present CAM information through their websites, revealing that only 17% of centers received a score of "excellent" (93). By contrast, other studies have suggested that there is significantly low quality information about alternative medicines for non-cancer conditions (e.g., irritable bowel disease or osteoporosis) (94, 95). At the same time, risks of inaccurate and highly variable online cancer-related CAM information quality was assessed using the Sandvik score (96). A study to determine if a domain-independent technical quality criteria can identify potentially harmful online CAM information based on the presence of 22 quality criteria selected from Eysenbach's systematic review shows that 25% of sites that were evaluated contained statements that could lead to direct physical harm and 97% of sites had omitted information, implying that technical quality criteria do not necessarily identify potentially harmful CAM information online (97).

In addition to the content, the ease of understanding and readability are important aspects to be considered. Commonly used methods are calculation of the Flesch Reading Ease Score and the Flesch-Kincaid Grade Level score (24, 60, 88, 94, 95). One study analyzing quality determination of websites for information related to natural products use in management of osteoporosis identified an average reading grade score of 11.9 and mean reading ease score of 41.7 out of 100 (95), where lower grade level and higher reading ease scores reflects

ability to understand content. Inadequacies of commonly used evaluation criteria is pointed out when studying information related to breast cancer and it has been shown that CAM webpages are significantly more likely to contain inaccuracies (98). Use of specific operational definitions helps improve inter-observer reliability (98–101). A list of available and easy to use evaluation instruments has been provided by Breckons *et al.* (99).

CAM claims may not be compliant with the Food and Drug Administration (FDA) Dietary Supplement Health and Education Act (DSHEA). DSHEA compliance has been used as a set of validation criteria. Herbal dietary supplements have been marketed for use as legal alternatives to illicit drugs (72). Of 292 websites searched for eight popular herbal products, 55% claimed to treat, prevent, diagnose, or cure specific diseases. Of the 292 sites with a health claim, 52.4% omitted the required federal disclaimer. Non-retail sites were more likely to include literature references, although only 52 (11.7%) of 443 Web sites examined provided referenced information without a link to a distributor or vendor (80). Commercial sites have been shown to provide testimonials, physician consultation recommendations, and DSHEA warnings 89%, 38.8%, and 36.1% of the time, respectively (102).

In addition to the quality evaluation, risk evaluation is also useful. A scoring method for risk is described by Schmidt *et al.* (103) based on the following criteria, does the site: (1) Discourage the use of conventional medicine? (2) Discourage adherence to clinician's advice? (3) Provide opinions and experiences rather than factual details? (4) Provide commercial details?

Educating information seekers (81) and reforms in regulation and enforcements has been suggested as ways to reduce potential harm from misleading or incomplete information (70). Failure to disclose potential adverse effects, contraindications, disclosure of dosage, presence of misleading information, and FDA approval for sale have been identified as important aspects that consumers should look for (70).

Theme 7: Surveillance of CAM Information and Products

There is an abundance of CAM related information over the Internet and such products can be easily procured online. Several of the studies discussed in previous sections (11, 25, 58, 59, 61–67) indicate the possibility of misleading claims and inaccuracies in information content by e-commerce websites. To avoid adverse events it is important to monitor the spread and marketing of dietary supplements (including herbal products) online using surveillance systems. Although several studies have noted this point, there remains a lack of tools and monitoring systems for addressing such issues. This underscores the importance of the healthcare community being vigilant of potential dietary supplement related adverse events, especially since there are shortcomings in the regulation of the content and commerce of CAM information and products over the Internet. Maggini *et al.* have proposed the inclusion of natural products into existing pharmacovigilance systems (9). The Federal Trade Commission and the FDA have jointly launched a campaign known as Operation Cure in an attempt to lessen the fallout from unsubstantiated claims on the Internet (104). According to one report, "Operation Cure" has identified more than 400 Web sites that make questionable claims about using certain products to treat disease (105). Improved filtering of Google searches for medical terms and products to avoid sponsored links have been

proposed (106). The European commission has funded the Psychonaut Web Mapping Project as an early warning system that collects information for identification, categorization, and use trends (107). In addition to pharmacovigilance systems, encouraging healthcare providers to ask about CAM product use when taking patient history has been suggested (9, 108). According to the National Health Interview Survey (NHIS) 2012, 56.85% patients did not tell their healthcare provider about the use of CAM because they were not asked and 46.28% because they did not think their provider needed to know (109). Clinicians may fail to ask critical questions about CAM based on traditional medical assumptions while patients may be going outside of system to procure medical advice and potentially harmful treatments (108).

Educating the public about identifying reliable sources of information, potential adverse events, and drug interactions associated with CAM has been suggested by several authors (110–115). In addition, need for regulation improvement, registration and quality assurance, and control of herbal medicine online sales was also noted in (70, 80, 116–118).

Methods Used for Identifying CAM Information from Internet Resources

Based on the reviewed literature, there were ten types of Internet resources that have been used as a source for CAM information (Table 2). For these resources, 14 types of methodological approaches were described in the literature reviewed (Table 3).

DISCUSSION

Owing to widespread access and use of the Internet, valuable survey tools have been developed (119–121). Online surveys for studying CAM-related information seeking behavior have been used for specific patient populations. Investigating the predictors for Internet use for CAM information search is essential. Such information may be important for understanding the needs, requirements, and priorities and could help design approaches to reach wider populations with tailored resources for helping make judgments regarding CAM use. Informatics approaches are needed for encouraging community participation, especially those for bridging health disparities and gaps in health care and clinical research (122).

With increased online availability of CAM products and information, it is important to identify how consumers are searching and sources that are most likely being used to procure. Social media data are increasingly being used to understand and monitor various health related aspects such as disease surveillance (123), pharmacovigilance (124), and adverse drug events (125). Use of such data reduces the reaction time of disease surveillance strategies that rely on collection and analysis of data from hospitals and physicians (126). Indeed, it has been suggested that 39% of online health information seekers make use of social media (127). Although there has been research in health-related analysis of social media data, few studies have explicitly focused on CAM. Table 2 provides a listing of the resources that serve as data sources for CAM usage identified from our survey of the literature. Minimally, more studies are needed about modeling the seeking and sharing behavior of CAM information. Patient-authored texts in online health forums, medical blogs, and social networking sites may offer a valuable resource to understand patient's perception

and use of CAM therapies. For example, it has been shown that the most common motivation for using a search engine or social media for seeking and sharing health information is to identify treatment options (128). However, extracting health related information from patient authored text can be a challenging task due to the use of informal language (47). The content within such patient authored text requires extraction of health-related terms. The tools and methods designed for processing expert-authored text have been shown to not perform well on such task (49). Some work has been in this area, including the development of Consumer Health Vocabularies and using the lexico-syntactic patterns of entities. Furthermore, probabilistic topic models such as Latent Dirichlet Allocation (LDA) and Ailment Topic Aspect Model (ATAM) have been shown to be effective in identifying health topics within social media content (129).

Additional studies have suggested a correlation between knowledge seeking and severity of disease (130). There is a need to understand the prevalence of CAM use within social contexts. Such studies have been conducted in the context of general prescription drug use. For example, an investigation of networks of Twitter users who discuss drug abuse indicates that other members who do the same and reflect the potential reinforcement of negative behavior (131). Sentiments from geolocated tweets have been used to correlate emotional, geographic, demographic, and health characteristics (132). Such findings are potentially important for marketing and public-health campaigns (133).

In the context of non-CAM topics, there has been increased interest in the development of approaches for identifying meaningful correlations. Monitoring these types of relationships, especially those that pose a public health threat, may be helpful in the development of approaches for responding to public behavior (134). Graph-based approaches have been used for identification of unusual occurrences or community detection in context of disease outbreaks (123). Peer-interactions in online health forums may provide valuable data for understanding community structures as networks and attain some insight into the flow of information (135). Such systems have been developed for identifying anomalies or non-obvious patterns in the link-structure of web and social media (136). Compared to the CAM-related articles surveyed in this review, there appears to be a gap between the advancement of methods used in social media research versus those used for the systematic collection, management, and interpretation of the prevalence and spread of CAM. Although some studies have been done in this area (Table 3 provides a summary of methods used), there remains significant opportunity for developing social media data mining approaches for providing insight into understanding health behaviors.

The use of dietary supplements or herbal products should be based on having a clear understanding of the benefits, risks, and interactions with other drugs. Articles have been written that provide guidelines for identifying quality information related to alternative medicine on Internet (137). However, the overall misleading nature of Internet-based information available related to CAM was reflected in many of the articles identified in this review.

Several studies surveyed in this review indicated the possibility of providing misleading claims or inaccuracies using information on e-commerce websites. This is further

exacerbated as the Internet becomes a major "drug market" (107). To avoid incidences of adverse events it may therefore be important to monitor the spread and marketing of herbal products online using surveillance systems. An assessment of the relationship between search engine ranking results and the quality of available health information suggests that there is a marked discrepancy of quality and ranking for CAM (138). Although several studies have reflected this point, there continues to be a lack of systematic monitoring systems for tracking CAM therapies. Initiatives like the med-PICS Standard (Platform for Internet Content Selection) for assigning descriptive and evaluative metadata to medical information on Internet may be a possible solution to track uncontrolled promotion of medical information and products (139). Absent the availability of tracking systems, the clinical community must remain vigilant of the potential significant impact on patients (9).

CONCLUSIONS

There is a growing interest in complementary and alternative medicine (CAM) across the patient populations, who may be utilizing the Internet as a source of knowledge. This review provides an early survey of methodologies that have been used to date for identifying CAM information across Internet resources. Our survey of the literature reveals that efforts in designing and disseminating results related to CAM from clinical studies are required. There is also a need for designing approaches for creating awareness about unverified CAM info and creating a flow of reliable content into the community structure of online health forums. Conveying information regarding potential adverse effects and contraindications of CAM treatments will help public make more informed choices regarding CAM use. The survey of the literature presented here underscores a need for the development of informatics methodologies for identifying and categorizing (either by relevance or quality) CAM information, especially from social media.

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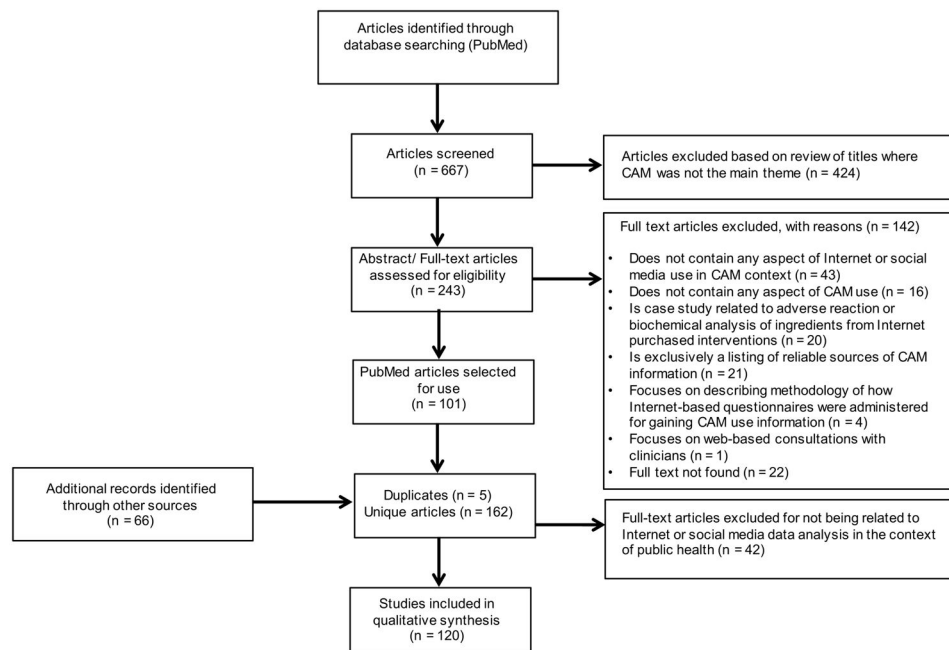
Figure 1. Flow diagram of Systematic Review

The process and flow diagram was adapted from the Preferred Reporting Items for Systematic reviews and Meta-Analysis guidelines. The primary search query was used to identify articles related to Internet based research in context of CAM. Additional articles using manual search were then included as a supplement to primary query where the focus was public health in general. These articles were used for discussion that reflected current research methods and issues with potential applications in CAM context.

Table 1

Inclusion and exclusion criteria used for selection of articles

Inclusion	Exclusion
Retrieved Article: • Relates to Internet or social media used in health care AND mention of some aspect of CAM. • Focuses on evaluation of available online CAM information or CAM related product claims using defined criteria. • Highlights areas related to online spread or surveillance of CAM information. • Characterizes predictors of Internet and social media use and presents results related to CAM. • Highlights policies or guidelines for Internet or social media use in context of health care. • (For survey-based articles) Includes questions related to Internet or social media use for seeking and sharing CAM information.	Retrieved Article: • Does not contain any aspects of Internet or social media. • Does not contain any aspect of CAM use. • Is case study related to adverse reaction or biochemical analysis of ingredients from Internet purchased interventions. • Is exclusively listing of reliable sources of CAM information. • Focuses on describing methodology of how Internet-based questionnaires were administered for gaining information related to CAM use. • Focuses on information derived from biomedical literature databases. • Focuses on web-based consultations with clinicians.

Table 2

Internet Resources That Include CAM Information

The number of articles associated with each resource is shown, with specific citations in parentheses.

Resource	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6	Theme 7
Online Survey/ Training	2[28–29]	1[30]			2[30, 56]		
Standardized Questionnaire/ Survey/ Interview		6[31–35, 37]			3[35, 51, 52]	2[79, 90]	3[9, 108–109]
E-Mail Discussion/ Online Support Group		1[37]					
Web Traffic			3[38–40]		1[57]		
Social Media/ Blog			8[10, 27, 40–41, 43–46]				
Phone Survey			1[43]				
Wikipedia					1[53]		
Online Marketed Product						17[62–78]	5[70, 80,116–118]
Phone Survey			1[43]				
Internet Website				1[50]	1[55]	9[58–61, 91–95]	6[110–115]

Table 3

Methods for Identifying CAM Information from Internet Resources

The number of articles associated with each method is shown, with specific citations in parentheses.

Method	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6	Theme 7
Descriptive Statistics	2[28-29]	7[30-35, 37]			5[30, 35, 51, 5256]	2[79, 90]	3[9, 108-109]
Behavioral Modeling		1[30]			1[30]		
Logistic Regression		1[36]			1[54]		
Correlation Analysis		1[37]					
Infodemiology			3[38-40]		1[57]		
Patient Simulation			1[42]				
Context/Thematic Analysis				2[27, 44]			
Patient Simulation			1[42]				
Vocabulary and Concept Analysis				3[47-49]			
Online Search						2[24, 80]	1[106]
Content Correctness Determination						3[81-83]	
Information Quality Assessment						14[24, 60, 84-89, 94-99]	
Compliance and Claims Data Analysis						3[72, 80, 103]	2[104, 105]
Pharmacovigilance							2[9, 107]